



Muş Alparslan
Üniversitesi



11. ULUSLARARASI TARIM, HAYVANCILIK ve KIRSAL KALKINMA KONGRESİ

11. INTERNATIONAL AGRICULTURE, ANIMAL SCIENCES and
RURAL DEVELOPMENT CONGRESS

03-05 Mart/March 2023
MUŞ



EDITORS

Prof. Dr. Yaşar KARADAĞ
Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU

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**11th INTERNATIONAL CONFERENCE ON AGRICULTURE,
ANIMAL SCIENCE and RURAL DEVELOPMENT**

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Muş, TÜRKİYE

**CONFERENCE
PROCEEDINGS BOOK**

EDITORS

Prof. Dr. Yaşar KARADAĞ
Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU

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MUS ALPASLAN UNIVERSITY, TÜRKİYE
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- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

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Zoom'a girişte sırayla salon numarasını ve soyadınızı yazınız (Salon-1, KARADAĞ)



Opening Speech

Date: 03.03.2023
Ankara Time: 09.20 -09.50

Assoc. Prof. Dr. Demet ÇEKİN
RWTH Aachen University, Germany

Prof. Dr. Erdoğan MEMİLİ
Prairie View A&M University, USA

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SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Prof. Dr. Yaşar KARADAĞ

AUTHOR	AFFILIATION	ABSTRACT TITLE
Ekundare Olugbemi Victor Fagbuaro, Omotayo	<i>Ekiti State University</i>	Karyotypes of the wild and hatchery-bred parentals and the intraspecific hybrids of <i>clarias gariepinus</i>
Şükrü Önalın Ebru Avcı	<i>Van Yuzuncu Yıl University</i>	Production and use of alternative natural substances instead of antibiotics in bacterial disease causes
Edwin John Clemente Ronel S. De Guzman Myla G. Santiago	<i>President Ramon Magsaysay State University</i>	Seed germination and seedling growth of papaya in different concentrations of colchicine
Banu Kadioğlu	<i>East Anatolian Agricultural Research Institute</i>	Unknown value of ecological agriculture vermicompost
Dilfuza Jabborova Mekhrigul Dustova	<i>Uzbekistan Academy of Sciences</i>	Improvement of growth and root morphological traits of okra under drought stress by co-inoculation of arbuscular mycorrhizal fungi and biochar application
Banu Kadioğlu	<i>East Anatolian Agricultural Research Institute</i>	Plant growing in solid/liquid media (Soilless Farming)
Vidya Padmakumar Murugan Shanthakumar	<i>Bangalore University</i>	Fragmentation in herpetofaunal habitats along the coast of Kozhikode, Kerala, India - A review
Ekin Avunduk	<i>Özgün Chemical Material Medical Material Sahlaz Services</i>	The application of genomics in agriculture
Ibrahim Maouhoubi Izeddine Zorkani	<i>Sidi Mohamed Ben Abdellah University</i>	Effects of applied magnetic field and pressure on the diamagnetic susceptibility and binding energy of donor impurity in a circular quantum disk made out of GaAs
Kübra Gül Hikmet Akyol	<i>Gumushane University</i>	Investigation of the impact of the Kahramanmaraş earthquake on the rural development of the region



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SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Prof. Dr. Aydın AKKAYA

AUTHOR	AFFILIATION	ABSTRACT TITLE
Shakhzod Saitjanov Abdulahad Azimov Zafar Ziyayev	<i>Uzbekistan Academy of Sciences</i>	Peroxidase enzyme activity in varieties of mungbean (<i>Vigna radiata</i> L.) under different conditions of water availability
Aydın Akkaya	<i>Muş Alparslan University</i>	Some questions and answers in wheat farming for Muş ecological conditions
Neil John N. Fariñas Diosdado C. Garcia Ronel S. De Guzman	<i>President Ramon Magsaysay State University</i>	Rooting response of air-layered clementine (<i>Citrus × Clementina</i> hort.) on different lahar-based rooting media
Aydın Akkaya	<i>Muş Alparslan University</i>	Importance of rye production
Kave Koorehpaz	<i>Urmia University</i>	Etiology, diagnosis and treatment of uterine cysts in mares
Orhan Karadağ	<i>Muş Alparslan University</i>	Fertility and growth characteristics of kil goats in the Bursa region
Gheorghe Giurgiu Manole Cojocaru SciRes I, Eusplm	<i>Titu Maiorescu University</i>	Microbiota modulation as therapeutic approach in the neuropathic pain in dog with spinal cord injury: impact of polenoplasmin
Cansu Telci Kahramanoğullari	<i>Ankara University</i>	The effect of different sowing densities on seed yield and some yield components of <i>Lathyrus cicera</i> L.
Kave Koorehpaz	<i>Urmia University</i>	Protective effects of varaiity concentrations of trehalose and carboxymethyl cellulose as cryoprotectant during cryopreservation of ram semen
Cansu Telci Kahramanoğullari	<i>Ankara University</i>	The effect of different sowing densities on forage yield and some plant characteristics in <i>Lathyrus sativus</i> L.



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SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: Prof. Dr. Derya YÜCEL

AUTHOR	AFFILIATION	ABSTRACT TITLE
Syed Makhdoom Hussain	<i>Government College University</i>	Role of different supplements in fish feed formulation
Derya Yücel Celal Yücel Irfan Erdemci Medeni Yaşar Murat Koç	<i>Şırnak University</i>	Determination of some technological characteristics of lentil genotypes under ecological conditions of Diyarbakir
Ibrahim Maouhoubi	<i>Sidi Mohammed ben Abdallah University</i>	The action of electromagnetic fields on the interaction electron-impurity: the binding energy as an example
Derya Yücel Celal Yücel Irfan Erdemci Medeni Yaşar Murat Koç	<i>Şırnak University</i>	Determination of phenological and yield components of lentil genotypes under ecological conditions of Diyarbakir
Ibrahim Maouhoubi	<i>Sidi Mohammed ben Abdallah University</i>	Effect of external contributions on the electronics properties of semiconductors
Muhammad Azhar Nadeem Nurettin Baran	<i>Sivas Bilim ve Teknoloji University</i>	Exploring the nutritional potential of common bean
Salma Elamiri Soumia Aboul-Hrouz Achraf Chakir Mohamed Zahouily	<i>Hassan II University - Casablanca</i>	Elaboration and characterization of bionanocomposite films for application in fertilizer coating
Nurettin Baran Muhammad Azhar Nadeem	<i>Sivas Bilim ve Teknoloji University</i>	Exploring the nutritional potential of soybean
Hiba Shahid Syed Ali Raza Naqvi	<i>Government College University Faisalabad</i>	Antioxidant, enzyme inhibition and toxicology studies of methanol extracts of selected medicinal plants
İbrahim Hakan Karabulut	<i>Agriculture and Rural Development Support Institution</i>	Evaluation of the effects of livestock enterprises supported by ipard program on rangeland and forage crops cultivation



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SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR: Assoc. Prof. Dr. Demet ÇEKİN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Mahnour Syed Wafa Majeed Muhammad Saad Tariq	<i>University of Agriculture</i>	Understanding the hypoglycemic activity of different solvent extracts of <i>tabernaemontana divaricata</i> in alloxan induced diabetic rat model
Mustafa Çirka	<i>Iğdır University</i>	Effects of pgpr isolates on plants under drought stress
Batoul Essalimi Siham Esserti Lalla Aicha Rifai Tayeb Koussa Kacem Makroum Malika Belfaiza Mohamed Faize	<i>University Chouaib Doukkali</i>	Enhancement of plant growth, using plant growth promoting rhizobacteria (pgpr) associated with plum trees (<i>Prunus domestica</i>)
Fatih Oğuzay	<i>Çanakkale Onsekiz Mart University</i>	Management of water resources and irrigation systems in early islamic history
Mourad Derra	<i>Ibn Zohr University</i>	Monitoring milk adulteration using ultrasound technique
Süreyya Yiğit	<i>New Vision University</i>	Reform of the common agricultural policy: a perennial challenge for the European Union
Irum Shaheena Khuram Shahzad Ahmada	<i>Fatima Jinnah Women University</i>	Phyto-template assisted facile synthesis of comoo4 nanocomposite as environmentally benign photocatalyst for water remediation
Pamphile Houndji	<i>Université d'Abomey-Calavi</i>	Agriculture périurbaine dans le contexte du developpement durable dans l'arrondissement de lokossa (Benin)
Ogundeji, A.A James, Tolulope. O Onwuka G.I Babyemi, A.W B. Shehu SU Okeleke Ekele S.J	<i>Department of Mathematics Kebbi State University of Science and Technology</i>	Modelling the prediction of nigerian insurances data
Okan Türk	<i>Muş Alparslan University</i>	A rural tourism tour route recommended to Muş province



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SESSION-1, HALL-5/OTURUM-1, SALON-5

MODERATOR: Assist. Prof. Dr. Ahmet YENİKALAYCI

AUTHOR	AFFILIATION	ABSTRACT TITLE
Radouane En-Nadir	<i>University of Sidi Mohamed Ben Abdullah</i>	Low-dimensional systems: promising candidates for energy conversion, lighting, and optoelectronics applications
Mücahit Yüngül Önder Aksu Başar Altinterim	<i>Fırat University</i>	Age and some growth characteristics of colchic khramulya (<i>Capoeta Sieboldii</i> Steindachner, 1864) In Gölova Dam Lake (Sivas-Turkey)
Adamu Ubaida Muhammad Mubarak Ibrahim Zamfara	<i>Far Eastern Federal University</i>	Effects of dietary nutrients on colorectal cancer: an overview
Soner Soylu Merve Kara Yusuf Gümüş	<i>Hatay Mustafa Kemal University</i>	Antibacterial activities of plant essential oils against bacterial disease agents of watermelon
Dnoop K Sim Joseph	<i>Mahatma Gandhi University</i>	Food security system in India: a comparative analysis
Ahmet Kinay Selçuk Kalander	<i>Tokat Gaziosmanpaşa University</i>	Determining the performance of some hybrid and standard confectionery sunflower genotypes in middle black sea transitional zone
Babagana M Shuaeeb, A.I Yahaya, F Ndatsu, A.	<i>Federal University of Technology</i>	Perception of lecturers towards information and technology in improving the quality of teaching and learning in Federal University of Technology Minna, Nigeria
Cevher Ozden	<i>Muğla Sıtkı Koçman University</i>	Digital transformation in agriculture sector of Türkiye
Deghiche-Diab Nacima Bettiche Farida Bengouga Khalila Fadhlaoui Haroun	<i>Scientific and Technical Research Center on Arid Areas</i>	Auxillary diversity under greenhouses in the Ziban Region
Aynur Bilmez Özçinar	<i>Siirt University</i>	Expressing genes of sunflower (<i>Helianthus annuus</i> L.): A review



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SESSION-1, HALL-6/OTURUM-1, SALON-6

MODERATOR: Prof. Dr. Kağan KÖKTEN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Subhashish Dey	<i>Gudlavalleru Engineering College</i>	Biomaterials applications for complete removal of nitrite from water
Ali Küçük Yakup Yildirim	<i>Burdur Mehmet Akif Ersoy University</i>	Investigation Of Bovine Parainfluenzavirus 3 In Cattle With Clinical Signs Of Respiratory System Infection Using Direct Immunofluorescence Test
Pamphile Houndji	<i>Université d'Abomey-Calavi</i>	Agriculture périurbaine dans le contexte du développement durable dans l'arrondissement de lokossa
Ayşegül Usta Yakup Yildirim Mehmet Kale	<i>Burdur Mehmet Akif Ersoy University</i>	Molecular diagnosis of deformed wing virus and acute bee paralysis virus infections in honey bees
Pajtim Bytyçi Ferdije Zhushi-Etemi Edona Kabashi-Kastrati Toni Koren	<i>University of Prishtina</i>	First record of agrotis bigramma (esper, 1790) (lepidoptera: noctuidae), from republic of Kosovo
Özge Sevinç Korkmaz Akar Yakup Yildirim	<i>Burdur Mehmet Akif Ersoy University</i>	Serological investigation of feline coronavirus infection in cats
Balasubramani G.L Rinky Rajput Manish Gupta Pradeep Dahiya Jitendra K Thakur Rakesh Bhatnagar Abhinav Grover	<i>Jawaharlal Nehru University</i>	Structure-based drug repurposing to inhibit the DNA gyrase of Mycobacterium tuberculosis
Özmen İstek	<i>Muş Alparslan University</i>	Examination of three dimensional printing in veterinary surgery
Abraham U.S Abioye O.P	<i>Federal University of Technology Minna</i>	Production and partial purification of protease from bacillus subtilis for dehairing of animal skin
Behlül Sevim	<i>Aksaray University</i>	The use of dried mushroom (<i>Agaricus bisporus</i>) powder in the nutrition of broiler chickens



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SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Assoc. Prof. Dr. Mehmet KARAMAN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Waheed Ullah Usman Haider Wania Nasir Momna Mehmood Wafa Majeed Najeeb Ullah Khan Muhammad Saad Tariq Bilal Aslam Muhammad Naeem Faisal	<i>Institute of Physiology and Pharmacology University of Agriculture Faisalabad</i>	Analyzing the impact of complete newly produced wheat-based feed on gut health of commercial broiler birds (Benin)
Aslı Akyel Ahmet Eşitken	<i>Selçuk University</i>	Selection and determination of steel reproduction characteristics of rosehip genotypes naturally growing in başyayla (Karaman) region
Mehmet Karaman	<i>Muş Alparslan University</i>	The role of wheat yield components on grain yield
Tamer Eryiğit Ela Özer	<i>Van Yüzüncü Yıl University</i>	The effect of different nitrogen doses on yield and yield components of safflower (<i>Carthamus tinctorius</i> L.) cultivars in ağıri doğubayazıt climate conditions
Ali Taimoor Chishti Muhammad Saad Tariq Usman Haider Wania Nasir Najeeb Ullah Khan Muhammad Rehan Sajid Wafa Majeed Muhammad Naeem Faisal	<i>Department of Pharmacy University of Agriculture Faisalabad</i>	Amelioration of chemotherapeutic agent-induced toxicity on vital organs with biodegradable poly lactic-co-glycolic acid-modified nanoparticles
Melisa Önel Okan Erken	<i>Çanakkale Onsekiz Mart University</i>	How the rural population is affected by climate change
Mehmet Karaman	<i>Muş Alparslan University</i>	Comparison of some advanced bread wheat lines (<i>Triticum aestivum</i> L.) with registered varieties in mus conditions
Halil İbrahim Sağbaşı Sezai Ercişli	<i>Atatürk University</i>	Stress conditions and effect of different applications on antioxidant capacity in fruits
Pajtim Bytyçi Ferdije Zhushi-Etemi Edona Kabashi-Kastrati Toni Koren	<i>University of Prishtina</i>	First record of agrotis bigramma (Esper, 1790) (Lepidoptera: Noctuidae), from Republic of Kosovo



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SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Prof. Dr. Rüyeyde TUNÇTÜRK

AUTHOR	AFFILIATION	ABSTRACT TITLE
Deghiche-Diab Nacima Nia Bilel Benouaman Ourida Zguerou Roukiya Roumani Messaoud M'hani Mokhtar Rekis AbdelKarim	Scientific and Technical Research Center on Arid Areas	Hosts of boufaroua oligonychus afrasiaticus (Mcgregor) from weeds plants in the Biskra Oasis-Algeria
Murat Tunçtürk Rüyeyde Tunçtürk	<i>Van Yuzuncu Yıl University</i>	Investigation of the mineral composition of the plant <i>Althea officinalis</i> L.
Rüyeyde Tunçtürk Murat Tunçtürk	<i>Van Yuzuncu Yıl University</i>	Determination of total antioxidant capacity, phenolic and flavonoid substances of <i>Hypericum perforatum</i> L.
Rahma Bejaoui Cevdet Gümüş Kenan Sönmez Emine Kırbay Ş. Şebnem Ellialtıoğlu	<i>Ankara University</i>	The effects of different pgr contents on in vitro organogenesis and shoot proliferation in kalanchoe (<i>Kalanchoe Blossfeldiana</i> Poelln.)
Filiz Baysal	<i>Alata Horticultural Research Institute</i>	Recent advances in carob (<i>Ceratonia siliqua</i> L.) cultivation and breeding
Syed Mohsan Raza Shah Mansoor Hameed Muhammad Sajid Aqeel Ahmad Farooq Ahmad Sana Fatima Muhammad Ashraf Jazab Shafqat Muhammad Irshad Sana Basharat Ansa Asghar Muhammad Kaleem Ummar Iqbal Iftikhar Ahmad	University of Education Lahore	Structural modifications of root in ipomoea carnea jacq. colonizing different saline habitats
Utku Can Torun	<i>Ondokuz Mayıs University</i>	Structure and problems of businesses buying and selling cherry as fruit and vegetable wholesale in Amasya
Emine Topuz	<i>West Mediterranean Agricultural Research Institute</i>	Detection of artichoke pests in antalya and biotechnical control of the widely detected snail
Rukiye Gezer	<i>Siirt University</i>	Vase life in cut flowers



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SESSION-2, HALL-3/OTURUM-2, SALON-3

MODERATOR: Assoc. Prof. Dr. Sancar BULUT

AUTHOR	AFFILIATION	ABSTRACT TITLE
Balasubramani G L Rinky Rajput Manish Gupta Pradeep Dahiya Jitendra K Thakur Rakesh Bhatnagar Abhinav Grover	<i>Jawaharlal Nehru University</i>	Structure-based drug repurposing to inhibit the DNA gyrase of Mycobacterium tuberculosis
Yasmine Chennai Assma Fetteh	<i>Mohamed Khaidhar University</i>	Antibacterial and anti- oxidant activities of extracts from medicinal plants
Sancar Bulut	<i>Kayseri University</i>	Crop rotation in Kayseri
Salah Belaidi Yasmine Chennai	<i>Mohamed Khaidhar University</i>	Qsar modeling using gaussian process applied for a series of flavonoids as potential antioxidants
Sancar Bulut	<i>Kayseri University</i>	Crop rotation in Sivas
Salah Belaidi Yasmine Chennai	<i>Mohamed Khaidhar University</i>	In silico investigation of several series of heterocyclic molecules for drug discovery
Nurşen Aksu Kalmuk	<i>Artvin Çoruh University</i>	Investigation of the antimutagenic effects of propolis against zinc oxide toxicity in <i>Allium cepa</i> L. meristatic cells
Mebarka Ouassaf Yasmine Chennai	<i>Mohamed Khaidhar University</i>	Quantitative structure activity relationship (qsar) investigations and molecular docking analysis of plasmodium protein farnesyltransferase inhibitors as potent antimalarial agents
Muhittin Tutkun	<i>Dicle University</i>	Current approaches to avoid the culling of layer male chicks
Mebarka Ouassaf Yasmine Chennai	<i>Mohamed Khaidhar University</i>	Contribution to drug discovery through computational analysis of several series of heterocyclic molecules



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SESSION-2, HALL-4/OTURUM-2, SALON-4

MODERATOR: Assist. Prof. Dr. Onur ŞAHİN

AUTHOR	AFFILITION	ABSTRACT TITLE
Vinod Kumar Vikas Saini Jyoti Sinha	<i>Sushant University</i>	Future of artificial intelligence (Ai) in the pharmaceutical industry
Onur Şahin Isa Yılmaz Ali Kaygisiz	<i>Muş Alparslan University</i>	A study on type defects in simmental cows raised in Turkey
Ejaz Ahmad Waraich	<i>University of Agriculture</i>	Attenuating drought and nickel stress by application of silicon in maize (<i>Zea mays</i> L.)
Onur Şahin Isa Yılmaz Önder Bayram Çoban	<i>Muş Alparslan University</i>	Evaluation of udder purity in simmental cattle breeds reared in Turkey
Samanda Gjoni Flavia Gjata Florida Hajderaj Emirjana Hasanaj Klodjana Lamaj Aurora Manaj Manjola Sala Megisa Sulenji Nertila Mucollari Spase Shumka	<i>Agricultural University of Tirana</i>	Assessing bio-diverse foods in dietary intake surveys-a case study considering random selected samples
Enise Begüm Göçmez Adem Önen Osman İrfan İlhak	<i>Balıkesir University</i>	The effect of marination with a sauce with protective culture on pathogens and shelf life of chicken wings
Huma Ali Saba Zubair	<i>Jinnah Sindh Medical University</i>	Trends and role of pharmacist in community pharmacy services and facilitation protocol: challenges in real time practices
Yusuf Efteli İsmail Kirbaş Ömer Gürkan Dilek	<i>Burdur Mehmet Akif Ersoy University</i>	Livestock weight estimation based on computer vision
Muhammad Ikram	<i>GC University Lahore</i>	Silver/Cellulose nanocrystal-doped CeO ₂ quantum dots served as industrial dye degrader
Kadir Emre Buğdaycı İsmail Kirbaş	<i>Burdur Mehmet Akif Ersoy University</i>	Classification of crude protein content of sunflower meal using machine learning algorithms



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SESSION-2, HALL-5/OTURUM-2, SALON-5

MODERATOR: Assoc. Prof. Dr. Demet ÇEKİN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Anum Naseer Abdul Basit	<i>University of Azad Jammu and Kashmir</i>	Emerging issues, detection and remediation technologies of heavy metals from contaminated environmental sources
Sibel Bülbül Emine Burcu Turgay Merve Nur Ertay Öz Öztekin Urla Ayten Salantur Selami Yazar Bayram Özdemir Mehmet Emin Alyamaç Gökhan Kiliç Muhsin Ibrahim Avcı Fatma Betül Sade	<i>Field Crops Central Research Institute Directorate</i>	Detection of reaction of some wheat genotypes to yellow rust (<i>Puccinia striiformis</i> f. sp. <i>tritici</i>) with artificial inoculation
Ahtesham. M. Shaikh Ganesh. D. Basarkar Atish. S. Mundada	<i>SNJB's SSDJ College of Pharmacy</i>	Complexities involved in drug approval process by usfd
Emre Kara Mustafa Sürmen	<i>Aydın Adnan Menderes University</i>	Biomass potential and chlorophyll (spad) content of sweet sorghum as effected by sowing density and deficit irrigation
Séraphin Mouzoun Houesou G. Laurent Toussaint O. Lougbegnon	<i>Université d'Abomey-Calavi,</i>	Etudes des services écosystémiques rendus par les différents écosystèmes de la Commune de Tori-Bossito
Mustafa Sürmen Emre Kara	<i>Aydın Adnan Menderes University</i>	Chlorophyll (spad) content of perennial ryegrass / red clover mixtures under different cutting
Nabila Sher Mohammad Gulnaz Begum Hafsa Zafar Kalsoom Tariq Mashal Zafar	<i>Khyber Medical University Peshawar Pakistan</i>	Effects of lipid based Multiple Micronutrients Supplement on the birth outcome of underweight pre-eclamptic women: A randomized clinical trial
Akgül Taş	<i>Bolu Abant İzzet Baysal University</i>	Evaluation of some physio-chemical properties of mulberry genotypes grown In Duzce Region
Edona Kabashi- Kastrati Ferdije Zhushi- Etemi Pajtim Bytyqi	<i>University of Prishtina</i>	Contribution to the knowledge of the butterfly fauna of some localities in the national park "Bjeshket E Nemuna"
Aykut Kaan Eren	<i>Muş Alparslan University</i>	Evaluation of the environmental impacts of airports on rural areas



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SESSION-2, HALL-6/OTURUM-2, SALON-6

MODERATOR: Prof. Dr. Rüştü HATİPOĞLU

AUTHOR	AFFILIATION	ABSTRACT TITLE
Gilbert Kimlun Joye Elvanika Jaharin Marcella Ann Tetus AD Azwanwell Sabudin Anysia Marius Casey Neville Philemon	<i>Keningau Vocational College</i>	Eating green with vegetable-based pasta
Serdar Uğurlu Emre Bakkalbaşı	<i>Van Yuzuncu Yil University</i>	Extraction of phenolic substance from apple peel
Koroka, M.U.S Aliyu, N.M Shua'eb, A.I Ndatsu, A.	<i>Federal University of Technology</i>	Influence of teachers' professional and career development programs on secondary school biology teachers' productivity in Niger South Senatorial Zone Of Niger State, Nigeria
Serdar Uğurlu Emre Bakkalbaşı	<i>Van Yuzuncu Yil University</i>	Evaluation of some quality characteristics of apple chips dried by vacuum assisted infrared drying
Ibrahim Zailani Abdullahi Dahiru	<i>Universiti Tenaga Nasional</i>	Knowledge and practice of personal hygiene among primary school pupils in paki community ikara local Government Area Of Kaduna State
Mehmet Gencer Fikret Akinerdem	<i>Field Crops Central Research Institute</i>	Determination of the effect of different varieties in safflower (<i>Carthamus tinctorious</i> L.) in irrigated and without irrigation treatments on seed yield and crude oil ratio
Saber Abdelkader Saïdi	<i>University of Jeddah</i>	Evaluation of the administration of ephedra alata extract to obese rats on the lipase and α -amylase activities, insulin resistance, glycogen level, and type 2 diabetes induced various organs toxicities
Vildan Akdeniz	<i>Ege University</i>	New trend in food industry: plant-based dairy alternatives
Nicholas Vicky Voon Mohd Farhan Nabil Bin Jasmizam Macarrance Alven Bin Melvin Hideo Dellfo Richard Awel Alfred Roddy	<i>Keningau Vocational College</i>	Power supply for emergency purpose
Kaan Küçükerdem Serdar Sari	<i>Iğdır University</i>	Effects of low tunnel and mulch on plant microclimate in unheated greenhouses



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SESSION-3, HALL-1/OTURUM-3, SALON-1

MODERATOR: Prof. Dr. Sema GÜN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Grace Ann T. Ballesteros Ronel S. De Guzman Myla G. Santiago	<i>President Ramon Magsaysay State University</i>	Mycelial evaluation of milky mushroom on crack corn and sorghum subculture media
Sema Gün	<i>Ankara University</i>	Policies on the protection and management of pasturelands and sustainability
Selma Myslihaka	<i>University "A. Xhuvani"</i>	Geobotanical and comparative data on vegetation in sselected areas of central Albania, Elbasan Region
Sabri Erbaş Murat Mutlucan Ümit Erdoğan Sercan Önder	<i>Isparta Uygulamalı Bilimler University</i>	Effect of gibberellic acid application on yield and quality characters in lavandin (<i>Lavandula x intermedia</i> Emeric ex Loisel. var. Super A)
Srijani Dasgupta Gaurav Ranjan	<i>Jharkhand Rai University</i>	Flavonoids: an important dietary supplement in prevention of cardiovascular diseases
Sabri Erbaş Murat Mutlucan Ümit Erdoğan Merve Özer	<i>Isparta Uygulamalı Bilimler University</i>	Chamazulene source plants and their cultivation
Jan Alam Zaheer Abbas Shazia Kousar Nidaa Harun Muhammad Javed	<i>University of Education Campus DG Khan</i>	Ecology, diversity and conservation of the flora of the hunza valley, central karakorum mountains, northern Pakistan
Sabri Erbaş Murat Mutlucan Ümit Erdoğan Meryem Çakmak	<i>Isparta Uygulamalı Bilimler University</i>	Immortelle (<i>Helichrysum italicum</i>) farming and future in the world and in turkey
Bisma Ashraf Nasir Rasool Shehla Khalid M Fakhar u Zaman Sumaira Zulfiqar	<i>Government College University</i>	Synthesis of biological active amides and esters through various catalytic reactions
Murat Mutlucan Sabri Erbaş Ümit Erdoğan	<i>Isparta Uygulamalı Bilimler University</i>	Fennel (<i>Foeniculum vulgare</i>) agriculture, problems and future in the world and in Turkey



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SESSION-3, HALL-2/OTURUM-3, SALON-2

MODERATOR: Assist. Prof. Dr. Mustafa YAŞAR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Kalsoom Tariq Sadiah Fatima Nabila Sher Sikandar Ali	<i>Khyber Girls Medical College</i>	The short-term impact of high energy nutritional supplements on energy balance in underweight primi-gravidae; a randomized controlled trial
Yusuf Güzel Demiray Mustafa Yaşar Remzi Ekinci	<i>Muş Alparslan University</i>	Investigation of fiber quality traits in advanced generation of some cotton lines (<i>Gossypium hirsutum</i> L.)
Mukhtar Yakubu Gajida Ahmad Sagiru Dauda Aliyu Hafsat Fadila Chamo Nuhu Uba Haruna Abdulbasid Musa Abdullahi Dahiru	<i>Aminu Kano Teaching Hospital</i>	low birth weight among adolescent mothers in Murtala Muhammad Specialist Hospital, Kano, Nigeria
Hilal Yılmaz Sibel Turan Sirke	<i>Kocaeli University</i>	Haploid plant production in edible grain legumes
Peter Ozovehe Anikoh	<i>Kogi State Polytechnic</i>	Development and performance evaluation of A jat planter
Sibel Turan Sirke Hilal Yılmaz	<i>Kocaeli University</i>	Anther culture applications in plant breeding
Arben Terstena Gazmend Deda Ismail Mehmeti Sokol Krasniqi	<i>University of Applied Sciences in Ferizaj</i>	The impact of subsidies on increasing economic productivity in the agricultural industry at the local level – evidence from Kosovo
Gözde Hafize Yildirim Nuri Yılmaz	<i>Ordu University</i>	Evaluation of bioethanol production from corn cobs
Adeniyi Olarewaju Adeleye Abubakar Ibrahim Michael Edet Nkereuwem Mohammed Bello Yerima	<i>Federal University Dutse</i>	Biostimulatory effect of cattle dung on lead decontamination potential of indigenous fungal population in spent engine oil-polluted soil
Gözde Hafize Yildirim Nuri Yılmaz	<i>Ordu University</i>	Nutritional content and utilization areas of bread wheat



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SESSION-3, HALL-3/OTURUM-3, SALON-3

MODERATOR: Assoc. Prof. Dr. Murat Şevik

AUTHOR	AFFILIATION	ABSTRACT TITLE
Ekpo, Enoobong I Ikpe, Emem O. Umanah, Sunday	<i>University of Uyo</i>	Microbial examination of ready to eat fruits sold within the vicinity of akwa ibom state polytechnic, Nigeria
Murat Şevik	<i>Necmettin Erbakan University</i>	Seroprevalence of bovine respirovirus 3 in cattle in afyonkarahisar province of Türkiye
E. Karthikeyan M. Divya D.S. Harshini Yaamika	<i>Saveetha Institute of Medical and Technical Sciences</i>	Treatment of chronic low back pain with gabapentin in a tertiary care centre
Murat Şevik	<i>Necmettin Erbakan University</i>	Bovine respiratory syncytial virus seroprevalence in non-vaccinated dairy cattle herds in Konya Province, Türkiye
Kave Koorehpaz	<i>Urmia University</i>	Protective effects of variety concentrations of trehalose and carboxymethyl cellulose as cryoprotectant during cryopreservation of ram semen
Ramazan Ayaş	<i>Selçuk University</i>	The application of anionic feeding in dairy ruminants
Olusegun Opeyemi Oni Sarah Oluwakemi Ishola Ajiboye, Gbenga Eyitayo	<i>Agricultural and Rural Management Training Institute</i>	Impact of agricultural finance on agricultural growth in Nigeria
Ramazan Ayaş	<i>Selçuk University</i>	Measures to reduce enteric methane release in ruminants
Obaika, Rita Oseimelu Usungurua, Enefiok Okon Udoh, Itoro Esiet	<i>University of Uyo</i>	Material physicochemical properties analysis and fibre characterization of musa species pseudostem wastes for pulp and paper production
Irem Uzunsoy	<i>Zonguldak Bulent Ecevit University</i>	Antimicrobial activity of buffalo cheeses



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SESSION-3, HALL-4/OTURUM-3, SALON-4

MODERATOR: Assist. Prof. Dr. Dilek KABAĞÇI

AUTHOR	AFFILITON	ABSTRACT TITLE
Mohammed El Amine Zennaki Lahcene Tennouga Soraya Balkaid Brahim Bouras Kouider Medjahed	<i>Tlemcen University</i>	Optimisation of the flocculation process for the removal of turbidity in water using polystyrene waste
Reyhan Uçar Ahmet İpek	<i>Bursa Uludag University</i>	Investigation of the presence of a resistance gene against peronospora destructor disease in some onion genotype
Mohd Adi Taufiq Roslan Elle Zulaikha Binti Halim Clementina Cynthia Moduin Hazamie Jevol @ Alex Gernnyvier Wenzelly Desmond	<i>Keningau Vocational College</i>	Tweaking a traditional steamed cake with a fruit flavor
Simgė Çoban Şule Turhan	<i>Bursa Uludag University</i>	E-commerce and the impact of the covid-19 pandemic in the food industry
Amina Mudhafar Al-Nima Myasar Al-Kotaji Shahad Myasar Alfaris	<i>Mosul University</i>	Comparison of the antimicrobial effect of three natural products formulated as a gel dosage form
Ali Yiğit	<i>Aydın Adnan Menderes University</i>	Wheat root architecture and drought
Owoyemi, S.I, Ojo, M.O, Akinwande, D.D Ikusika A.	<i>Adeyemi Federal University of Education Ondo</i>	Preliminary geophysical and geotechnical investigation for proposed building foundation at united grammar school irele community, south western Nigeria
Selim Sirakaya	<i>Aksaray University</i>	The effect of chitosan gelatinized with acetic and lactic acid on alfalfa silage quality
Caleb Evander Bin Danius Muhammad Adib Irsyad Bin Aliudin	<i>Keningau Vocational College</i>	Teaching construction technology with miniature formwork
Hacer Tüfekci	<i>Yozgat Bozok University</i>	The effects of heat stress on some parameters in sheep and goats



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SESSION-3, HALL-5/OTURUM-3, SALON-5

MODERATOR: Assist. Prof. Dr. Orhan KARADAĞ

AUTHOR	AFFILIATION	ABSTRACT TITLE
Okeke, Chioma Blessing., Oladejo, Afees Adebayo., Metu, MaryCynthia Dumebi, Ayo, Egunlorun Ibukunoluwa.	<i>Nnamdi Azikiwe University</i>	The effect of inhalation of fumes from esbiothrin based mosquito coil on some renal function markers and hematological parameters in male wistar albino rats
Nadia Bashir Ahmet Şekeroğlu Brian Tainika	<i>Niğde Ömer Halisdemir University</i>	The effect of pasture type, age and time on range use and distribution of slower growing broiler chickens on the range in free-range production system
Okeke, Chioma Blessing., Oladejo, Afees Adebayo., Metu, MaryCynthia Dumebi, Ayo, Egunlorun Ibukunoluwa.	<i>Nnamdi Azikiwe University</i>	The effect of inhalation of fumes from esbiothrin based mosquito coil on some renal function markers and hematological parameters in male wistar albino rats
Lawal W.S. Olayiwola S.A Salami M.O Gana E.O Alaya A. Alege .R	<i>Kwara State Polytechnic</i>	Organoleptic characteristic of archatina archatina snail fed ixora coccinea
Mehmet Akif Boz Kadir Erensoy Musa Sarica Ahmet Uçar	<i>Yozgat Bozok University</i>	Advantages of goose meat production and current situation in Turkey
AIIA Fatma Bouras Yacine	<i>El Oued University</i>	Evaluation of antioxidants activity of crude extract of limoniastrum guyonianum dur. (boiss.) plant growing in sahara of oued souf region (South Algeria)
Aziz Korkmaz	<i>Mardin Artuklu University</i>	Bioactive properties of some local and foreign olive oils
Mirza Muhammad Faran Ashraf Baig	<i>The Hong Kong University of Science and Technology</i>	Recent advances of magnetic gold hybrids and nanocomposites, and their potential biological applications



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SESSION-3, HALL-6/OTURUM-3, SALON-6

MODERATOR: Assist. Prof. Dr. Özer KURT

AUTHOR	AFFILITION	ABSTRACT TITLE
Javvaji Harikrishna B.S. Anuradha	<i>Chaitanya Deemed To Be University</i>	Isolation of asymptomatic carrier isolates of group a beta haemolytic streptococci from clinical samples in karimnagar
Kopylova Maria Dmitrievna Getmantseva Varvara Vladimirovna	<i>Russian State University</i>	Analysis of detectors and sensors for monitoring the state of animals
J B Jibitha Sabu Joseph	<i>University of Kerala</i>	Detection of urban expansion and land surface temperature change using remote sensing and gis techniques
Özer Kurt Ayşe Nida Kurt	<i>Muş Alparslan University</i>	Determination of Ceratonia siliqua tree leaves of in vitro Gas Production
Manu Minodora Nicoară Roxana Georgiana Chiriac Luiza Silvia Onete Marilena	<i>Romanian Academy</i>	Influence of grassland management types on soil mites communities from Romania
Ayşe Nida Kurt Yasir Tufan Mahir Özkurt Yaşar Karadağ	<i>Muş Alparslan University</i>	A perspective on the production areas and changes in feed plants of the province of Muş
Nur Ahmad Fadli Lutfi Nur Latifah Vinanda Arum Tri Kurniawan Zeda Erdian Aryanti Rizky Adinda Lusiana Tursina Silaban Christine Wulandari	<i>University of Lampung</i>	Marketing analysis of various types and characteristics of “damar mata kucing” resin (<i>Shorea javanica</i>) to support the economic sector of community in pahmungan, pesisir barat district, lampung province, Indonesia
Bora Bayhan	<i>Dicle University</i>	Marker studies on minor fabaceae (Leguminosae) forages
Serghey A. Shapovalov	<i>V.N. Karazin Kharkiv National University</i>	Systems of associated nanoparticles based on dye solutions for spectrophotometric determination of water-soluble salts of alkylbenzenesulfoacids
Muazzez Değerli Arzu Çığ	<i>Siirt University</i>	Current methods developed on flower drying in ornamental plants



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SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Assist Prof. Dr. Mahir ÖZKURT

AUTHOR	AFFILITION	ABSTRACT TITLE
Soumen Dey Santanu Chakraborty Manami Dhibar Tulshi Chakraborty	<i>Maulana Abul Kalam Azad University of Technology</i>	Development and in vitro evaluation of curcumin-loaded nanocrystals
Ümit Erdoğan Sabri Erbaş Murat Mutlucan	<i>Isparta Uygulamalı Bilimler University</i>	Ultrasonic-assisted extraction of bee pollen grains: determination of total phenolic content, total antioxidant capacity, radical scavenging activity and fatty acid composition
A. Haider	<i>Muhammad Nawaz Shareef University of Agriculture</i>	Enhanced bactericidal action and dye degradation of spicy roots' extract-incorporated fine-tuned metal oxide nanoparticles
Sabri Erbaş Ümit Erdoğan Murat Mutlucan	<i>Isparta Uygulamalı Bilimler University</i>	Comparison of scent components of solid phase microextraction (hs-spme/gc-ms), distillation and extraction products of lavandin (<i>lavandula</i> × <i>intermedia</i> var. Super a) and lavender (<i>lavandula angustifolia</i> var. Munstead) leaves
Le Tran Thanh Liem Pham Van Trong Tinh Nguyen Thi Bach Kim Pham Ngoc Nhan Nguyen Thi Kim Phuoc Nguyen Thu Hien	<i>Can Tho University</i>	An evaluation of watermelon production efficiency in a peri-urban area – a case study in cai rang district, can tho city, Vietnam
Seval Kaçar Uğur Bilgili	<i>Bursa Uludag University</i>	Effects of different nitrogen sources and doses on plant growing and turf quality of some warm season turfgrass
Abdulkadir Halliru	<i>Umaru Musa Yaradua University</i>	Green science and technology for green planet: emerging issues and prospects
Handan Uğuz Furkan Çoban Hakan Özer	<i>Atatürk University</i>	Chemical composition of <i>Heracleum pastinacifolium</i> subsp. Incanum essential oils from eastern anatolia region
Bukola I. Kayode Ojochenemi R. Egwumah Rowland M.O. Kayode	<i>University of Ilorin</i>	Quality evaluation of ginger-spiced ogi flours produced from blends of yellow maize and african yam bean
Harun Polat	<i>Muş Alparslan University</i>	Some mathematics questions asked in some rural areas



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SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Assist. Prof. Dr. Hülya HANOĞLU ORAL

AUTHOR	AFFILIATION	ABSTRACT TITLE
Tulshi Chakraborty Sumeet Gupta Soumen Dey Sudip Roy	<i>Maulana Abul Kalam Azad University of Technology</i>	Effect of insulin-loaded nanoemulsion topical gel on wound healing in diabetes skin diseases
Dalya Saidi	<i>Jordan University of Science & Technology</i>	Investigating the efficacy of lyophilized as1411-gold nanosphere conjugated aptamer against breast cancer
Duong Ngoc Thanh	<i>Can Tho University</i>	Impacts of urbanization on livelihoods: case study in long hoa ward, can tho city, viet nam
Abdulwaheed Adeyemi Bello	<i>College of Agriculture</i>	Sensory and meat quality evaluation of yankasa rams fed sorghum stover supplemented with varying levels of dried poultry droppings based diet
Abdulwaheed Adeyemi Bello Shalu Kumar Balakrishna Gunaji Desai Ramesh Ganu Burte Vishnu Sakhoram Dandekar Janarda Shamroa Dhekale Harendra Singh Chauhan Meenal Parhad	<i>College of Agriculture</i>	Evaluation of external and internal egg geometry traits of vanaraja and giriraja in konkan region of maharashtra, india
Caner Yerli Nergiz Dila Şenol	<i>Van Yuzuncu Yil University</i>	Soil temperature and H ₂ O and CO ₂ releases from soil treated with hazelnut husk compost at different rates under deficit irrigation regime
Cengiz Türkay Filiz Baysal	<i>Alata Horticultural Research Institute</i>	A comparative analysis of turkey and spain and italy olive manufacturing and the olive industry
Hülya Sipahi Terik Djabeng Whyte	<i>Eskisehir Osmangazi University</i>	Genome-Wide identification and characterization of the wall associated kinases gene family in sorghum (<i>Sorghum bicolor</i> (L) Moench).
Serap Kızıl Aydemir Ali Devlet	<i>Bilecik Şeyh Edebali University</i>	Determination of the effect of growth regulators on germination properties of silage sorghum



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SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: Assoc. Prof. Dr. İsa YILMAZ

AUTHOR	AFFILIATION	ABSTRACT TITLE
Moses Adeolu AGOI Oluwadamilola Peace AGOI	<i>Lagos State University of Education</i>	Exploring the efficacy of machine learning in agriculture: an explicit approach
Maryam Saddiq Ahmed Salisu Kamaluddeen Kabir	<i>Umaru Musa Yar'adua University</i>	Effect of sterilization on the bioactive compounds and antimicrobial properties of <i>nymphaea lotus</i> L. Leaves
Ukoha, J. C. I. Maduka, O. A.	<i>Michael Okpara University of Agriculture</i>	Assessment of poultry farmers' knowledge level of climate change adaptation strategies in imo state, Nigeria
Sudha Batta	<i>Himachal Pradesh University</i>	Crispr-Cas9 mediated mutagenesis of two isoforms of starch branching enzymes sbe 2.1 and sbe 2.2 genes in potato cultivar k. chipsona-i
Erhan Çevikkol Mehmet Akif Çam Ömer Faruk Yılmaz	<i>Ondokuz Mayıs University</i>	The concept of welfare and stress in farm animal raising
Mualla Ketem Gökkuş Tahsin Beycioğlu Hasan Değirmenci Fatih Killi	<i>Nevşehir Hacı Bektaş Veli University</i>	Evaluation of drought tolerance in peanut varieties according to drought stress indices and comparison of the indexes
Nazlı Aybar Yalinkiliç Şilan Çiçek Ali Bayram Sema Başbağ	<i>Muş Alparslan University</i>	Determination of the effects of seed pretreatment on germination and seedling growth in some cotton (<i>Gossypium hirsutum</i> L.) varieties
Ali Bayram Nazlı Aybar Yalinkiliç Şilan Çiçek	<i>Muş Alparslan University</i>	Sugar beet pests; <i>cassida</i> spp. biological life cycle of (Coleoptera: Chrysomelidae)
Burcu Özen Rana Akyazi	<i>Ordu University</i>	Distribution of <i>tuckerella japonica</i> (acari: tuckerellidae) in tea plantations of the eastern black sea region, Turkey
Selçuk Yılmaz Yılmaz Karabiçak Harun Alici	<i>Erzincan Horticultural Research Institute Directorate</i>	Erzincan region dried bean breeding studies
Uğur BAŞARAN Seyithan SEYDOŞOĞLU	<i>Yozgat Bozok University</i>	Possible Effects of Kahramanmaraş Centered Earthquakes on 6 February 2023 on Turkish Agriculture



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SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR: Assoc. Prof. Dr. Mehmet KARAMAN

AUTHOR	AFFILIATION	ABSTRACT TITLE
Oluwafemi Michael Adedire	<i>Federal College of Agriculture</i>	Biostimulation and biocontrol potentials of bacterial strains and manure in tomato (<i>Solanum lycopersicum</i> L.) cultivated in a nutrient deficient soil
Raymond Oriebe Anyasi Harrison Ifeanyichuku Atagana	<i>University of South Africa</i>	The use of chromolaena odorata to treat polychlorinated biphenyls contaminated soil in phytoremediation
Skender Demaku Blerina Ahmetaj Jeton Halili	<i>University of Pristina "Hasan Prishtina"</i>	Determination of heavy metals in bee honey as a bioindicator, in the regions: istog, drenas and kastriot
Arbnorë Aliu Donika Sylejmani	<i>University of Pristina "Hasan Prishtina"</i>	Practical work in function of achieving the learning results in content of biology subject
Donika Sylejmani Arbnorë Aliu	<i>University of Pristina "Hasan Prishtina"</i>	Application of knowledge from figurative art and physical education in achieving learning outcomes in biology
Ömer Osman Karabağ Mehmet Demir Kaya	<i>Eskişehir Osmangazi University</i>	The effects of nitrogen doses on the development of sugar beet plants with leaf loss due to hail damage
Emine Nakilcioğlu Eda Nurko Selen Seyhan	<i>Ege University</i>	Healing from the plant: berberine
Emine Nakilcioğlu Selen Seyhan Eda Nurko	<i>Ege University</i>	Hesperidin: a promoting agent of health
Pervin Erdoğan Sümevra Üstündağ	<i>Sivas Bilim ve Teknoloji University</i>	Population monitoring of potato tuber moth [<i>Phthorimaea operculella</i> Zeller [Lepidoptera: Gelechiidae]] on potato cultural area in sivas province
Yasir Tufan Ayşe Nida Kurt Mahir Özkurt Yaşar Karadağ	<i>Muş Alparslan University</i>	Problems and solutions related to Muş province rangelands
Yunus Emre Ata Kemal Çelik	<i>Çanakkale 18 Mart University</i>	Use of propolis as a feed additive in animal nutrition



04.03.2023
SATURDAY / 10.00-12.30

Zoom Meeting ID: 870 6689 9702
Zoom Passcode: 112233

SESSION-1, HALL-5/OTURUM-1, SALON-5

MODERATOR: Assist. Prof. Dr. Mustafa YAŞAR

AUTHOR	AFFILIATION	ABSTRACT TITLE
Ivan Pavlovic Milan Stevanovic Nemanja Zdravkovic Aleksandra Tasic	<i>Scientific Institute of Veterinary Medicine of Serbia</i>	Presence of small wax moth (<i>Achroia grisella</i>) in apiaries in Serbia
Ljiljana Stanojević Aleksandra Milenković Jelena Stanojević Bojana Danilović Goran Nikolić	<i>University of Niš, Faculty of Technology</i>	Comparative analysis of chemical composition, antioxidant and antimicrobial activity of wild carrot (<i>Daucus carota</i> L.) seed essential oil from Serbia and Greece
Darwin H. Pangaribuan Yohanes Cahya Ginting Chatya Novtri Anisa Lamria Stefani M. Sihite	<i>University of Lampung</i>	The effect of vermicompost and p fertilizer on growth, yield and soil health of sweet corn
Raymond Oriebe Anyasi	<i>University of South Africa</i>	Studying the growth of chromolaena odorata in two soil samples under greenhouse condition
Ani Nuraini Dwi Yuni Hastati Wien Kuntari Faranita Ratih Listiasari	<i>IPB University</i>	Development of mocaf (modified cassava flour)-based pastry for cassava food diversification
Esra Esin Yücel Cemal Kaya	<i>Tokat Gaziosmanpaşa University</i>	Effect of tannase enzyme application on color and sensory properties of ultrasound-assisted black tea extracts
C. Vijai D.Joyce M.Elayaraja	<i>Institute of Science and Technology</i>	Green hrm: a way for corporate sustainability
Dmytro Hanaba	<i>Khmelnyskyi National University</i>	Assessment of the phytosanitary condition of street trees on the example of the city of Khmelnytsky
Hanaba Svitlana	<i>National Academy of the State Border Service of Ukraine named after Bohdan Khmelnytskyi</i>	History of species in the history of human civilization: socio-cultural aspect
Khadija Benamar Kawtar fikri benbrahim Saad Insouda Koraichi	<i>Sidi Mohamed Ben Abdellah University</i>	<i>Stevia rebaudiana</i> (history, phytochemistry, and extraction methods of steviol glycosides)



04.03.2023
SATURDAY / 13.00-15.30

Zoom Meeting ID: 870 6689 9702
Zoom Passcode: 112233

SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Assist. Prof. Dr. Hülya HANOĞLU ORAL

AUTHOR	AFFILITION	ABSTRACT TITLE
Tooba Sarwar Rana Awais Masud Naila Amjad Aamir Shehzad Najam Ul Hudda Syed Faizan Ali Shah Muhammad Kaleem Ullah	<i>University of Lahore</i>	Antibacterial activity of ziziphus nummularia against coliform bovine mastitis
Maryam Zakari Aminu Musa Ahmed Lawal Mashi	<i>Umaru Musa Yar'adua University</i>	Metronidazole adsorption from aqueous solution using nano crystalline cellulose obtained from luffa aegyptiaca sponge
Olena Budiakova	<i>Kyiv National University of Technologies and Design</i>	Bioeconomy: achieving scientific and technical progress in agribusiness
Harminder Singh Anu Sheetal	<i>Guru Nanak Dev University</i>	Waste to energy plants performance enhancement for benefit of agriculture and rural economy
Lathief Al Umami Maureenayu Rachmadyani Suwastono Rina Arimarsetiowati Endang Semiarti	<i>Universitas Gadjah Mada</i>	The optimization of plant growth regulators for induction and multiplication of somatic embryogenesis in arabica coffee plants
Rojin Özek Fatih Çığ	<i>Siirt University</i>	Use of plant breeders promoting bacteria in triticale preservatives
Sipan Soysal	<i>Siirt University</i>	Effects of Heavy Metal Toxicity in Edible Legumes
Eqbal Radwan Ghada Aldeeb	<i>Islamic University of Gaza</i>	Visualizing the invisible: 3-D printing of cell division phases as a tool in science education
Abdulvahap Erensayin Murad Aydın Şanda	<i>Muş Alparslan University</i>	The Flora Of Karaçavuş (Haçreş) Mountains (Muş)
Arzu Coşkun Gülcan Demiroğlu Topçu	<i>Ege University</i>	Determination of dry matter yield and properties of some faba bean (<i>Vicia faba</i> L.) cultivars grown in bornova conditions



04.03.2023
SATURDAY / 13.00-15.30

Zoom Meeting ID: 870 6689 9702
Zoom Passcode: 112233

SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Assist. Prof. Dr. Mahir ÖZKURT

AUTHOR	AFFILIATION	ABSTRACT TITLE
Aderemi I. Makinde Osagie John, Afodu Oyeyemi O. Oni Matthew O. Oluwafemi	<i>Babcock University</i>	Assessing scarification and priming period effect on physic nut (<i>Jatropha curcas</i> L.) germination
Luca Quaranta Paola Fortini Giancarlo Ranalli	<i>Università degli Studi del Molise</i>	A protocol for the measurements of crops at risk from climate change: a case of study on <i>Lactuca sativa</i> L. subjected to salt stress
Shylaja Jeyapaul	<i>Lecturer, King Khalid University</i>	Ginger tea effect on dyspepsia among senior citizens
C.Vijai Elayaraja	<i>St.Peter's Institute of Higher Education and Research</i>	A study on consumers perception towards organic products with special reference to chennai city
Adamu Hauni Ganya Hauwa Dauda Monica Ango	<i>Usmanu Danfodiyo University</i>	Investigating and modelling the transmission dynamics of covid-19 virus pandemic
S. Ramesh Kumar Srikanth Vemuru Srinath.A	<i>Koneru Lakshmaiah Education Foundation</i>	An expert system for early detection of pest on crops using image processing techniques to protect the crop health and yield
Thi-Hoang-Anh Tran	<i>Lecturer at Can-Tho University</i>	Agri-tourism and sustainable rural development: research for agricultural tourism model in phong dien district, can tho city, Vietnam
Fadekemi Oketunde	<i>Federal College of Agriculture</i>	Measuring household food insecurity and coping strategies in ibadan, Nigeria
Kader KARA Zeki Karipçin	<i>Siirt University</i>	Vegatables in terms of nutritional value
Gulsah Bengisu	<i>Harran University</i>	Some notes on maize-alternative silages, bioactive compounds and lactic acid bacteria additives
Sinan Mithat Muhammet	<i>Gazi University</i>	Synthesis of new piperazine derivative as potential antimicrobial agents

CONFERENCE GALLERY

Zoom Toplantı

Kaydediyor

IKSAD

Seyithan SEYDOĞANLI, Erdogan Memli, Prof. Dr. Yağar KARADAG..., h4 moderatör: Demet..., h6 moderatör: Prof. Dr...

Fethi Ahmet Polat-MUŞ

Sesi aç Videoyu Başlat Güvenlik Katılımcılar Sohbet Ara Odalar - Başlatılmadı

Ara

10°C Güneşli TUR 10:14 3.03.2023

Katılımcılar (97)

Q katılımcı bul

- IKSAD (Ortak oturma sahibi, ben)
- IKSAD Glob... (Ortak Sahibi)
- H1 Hall 1 - Ob... (Ortak oturma sahibi)
- HO Hall-2, Ob... (Ortak oturma sahibi)
- IKSAD Glo... (Ortak oturma sahibi)
- OH Observer ... (Ortak oturma sahibi)
- SS Seyithan S... (Ortak oturma sahibi)
- FA Fethi Ahmet Polat-MUŞ
- PD Prof. Dr. Yağar KARADAG-Muş AL...
- A aacar
- AU Adamu U.M
- AD ADEM DAL
- A Ahmet furkan Küçüktatlı
- A Akyol_Hikmet-Oturm1-Salon1
- a ali küçük
- AÖ Arzu ÖNDER

Davet Edin Tümünü Sessize Al

Zoom Toplantı

Kaydediyor

IKSAD

Seyithan SEYDOĞANLI, h6 moderatör: Prof. Dr. Kağan KÖK..., h2 moderatör: Aydın Akkaya, Onur ŞAHİN

Erdogan Memli, Özer KURT, h4 moderatör: Demet Cekin, Fethi Ahmet Polat-MUŞ, HALL-2 MUSTAFA YAŞAR

h5 moderatör: Ahmet YENİKALAYCI, Prof. Dr. Yağar KARADAG-Muş Alpars..., H6 Ayşegül USTA, Salon-5, KINAY, HOUNDJI Pamphile

Salon-4 Fatih OĞUZAY, Salon-5, YÜNGÜL, H-6, Behlül SEVİM, Hall 2, Gheorghe Giurgiu, SALON-4, ÇIRKA

Aslı AKYEL, Dr.Banu KADIO..., Duong Ngoc Th..., Akyol_Hikmet...

Aslı AKYEL, Dr.Banu KADIOĞLU, Duong Ngoc Thanh CTU-Vietnam, ali küçük, Akyol_Hikmet-Oturm1-Salon1

Ara

10°C Güneşli TUR 09:56 3.03.2023

Katılımcılar (79)

Q katılımcı bul

- IKSAD (Ortak oturma sahibi, ben)
- IKSAD Glob... (Ortak Sahibi)
- H1 Hall 1 - Ob... (Ortak oturma sahibi)
- HO Hall-2, Ob... (Ortak oturma sahibi)
- IKSAD Glo... (Ortak oturma sahibi)
- OH Observer ... (Ortak oturma sahibi)
- SS Seyithan S... (Ortak oturma sahibi)
- HP HOUNDJI Pamphile
- PD Prof. Dr. Yağar KARADAG-Muş AL...
- B 9357415392
- A Ahmet furkan Küçüktatlı
- A Akyol_Hikmet-Oturm1-Salon1
- B ali küçük
- AÖ Arzu ÖNDER
- Cahit Bulu
- CY Celal Yücel

Davet Edin Tümünü Sessize Al

CONFERENCE GALLERY

Zoom Toplantı

Kaydediyor

IKSAD

IKSAD

IKSAD (Ortak oturum sahibi) ben

IKSAD Glob... (Orturum Sahibi)

Seyithan S... (Ortak oturum sahibi)

H1 Hall 1 - Ob... (Ortak oturum sahibi)

HO Hall-2, Ob... (Ortak oturum sahibi)

IKSAD Glo... (Ortak oturum sahibi)

AO Abdullah osmanoglu

A Ahmet furkan Küçüktatlı

AK ali küçük

CY Celal Yücel

D Dilek

DN Dr. Necati ESENER

DK Dr.Banu KADIOĞLU

EA Ekin Avunduk

Erdogan Memili

FA Fatih ALAY

Arta

Construction on Tur... TUR 09:27 3.03.2023

Zoom Toplantı

Kaydediyor

IKSAD

IKSAD

IKSAD (Ortak oturum sahibi) ben

IKSAD Glob... (Orturum Sahibi)

Seyithan S... (Ortak oturum sahibi)

H1 Hall 1 - Ob... (Ortak oturum sahibi)

HO Hall-2, Ob... (Ortak oturum sahibi)

IKSAD Glo... (Ortak oturum sahibi)

PD Prof. Dr. Yaşar KARADAG-Muş AL...

AO Abdullah osmanoglu

A Ahmet furkan Küçüktatlı

AK ali küçük

CY Celal Yücel

D Dilek

DN Dr. Necati ESENER

DK Dr.Banu KADIOĞLU

EA Ekin Avunduk

Erdogan Memili

Arta

Construction on Tur... TUR 09:27 3.03.2023

CONFERENCE GALLERY

Zoom Toplantı

h4 moderatör: Demet Çekin ekranını görüntüyorsunuz Seçenekleri Görüntüle

IKSAD

ali küçük

Kaydediyor

Natural Enemies

- Predators of arthropods
- Parasitoids of insects
- Pathogens and nematodes for arthropod control
- Herbivores and pathogens in weed control
- Control of plant pathogens



RWTH AACHEN UNIVERSITY

Katılımcılar (59)

Q Katılımcı bul

- I IKSAD (Ortak oturum sahibi, ben)
- IKSAD Glob... (Orturum Sahibi)
- h4 moderatör: Demet Çekin
- H1 Hall 1 - Ob... (Ortak oturum sahibi)
- HO Hall-2, Ob... (Ortak oturum sahibi)
- IKSAD Glo... (Ortak oturum sahibi)
- SS Seyithan S... (Ortak oturum sahibi)
- AO Abdullah osmanoğlu
- A Ahmet furkan Küçükatalı
- AK ali küçük
- CY Celal Yücel
- D Dilek
- DJ DocSara Jahan
- DE Dr. Esra AKÇELİK
- DN Dr. Necati ESENER
- DK Dr.Banu KADIOĞLU

Sevi aç Videoyu Başlat Güvenlik Katılımcılar Sohbet Ekran Paylaşımı Kaydet Ara Odalar Reaksiyonlar Uygulamalar

Ara

8°C Güneşli TUR 09:32 3.03.2023

Zoom Toplantı

IKSAD

Prof. Dr. Yaşar KARADAG-Muş Alparslan Üniversitesi

Katılımcılar (78)

Q Katılımcı bul

- I IKSAD (Ortak oturum sahibi, ben)
- IKSAD Glob... (Orturum Sahibi)
- H1 Hall 1 - Ob... (Ortak oturum sahibi)
- HO Hall-2, Ob... (Ortak oturum sahibi)
- IKSAD Glo... (Ortak oturum sahibi)
- OH Observer ... (Ortak oturum sahibi)
- SS Seyithan S... (Ortak oturum sahibi)
- HP HOUNDJI Pamphile
- PD Prof. Dr. Yaşar KARADAG-Muş AL...
- S1 SESSION 1 HALL 5 DINOOP K
- 9 9357415392
- A Ahmet furkan Küçükatalı
- A Akyol_Hikmet-Oturum1-Salon1
- a ali küçük
- AÖ Arzu ÖNDER
- Cahit Bulu

Sevi aç Videoyu Başlat Güvenlik Katılımcılar Sohbet Ekran Paylaşımı Kaydet Ara Odalar Reaksiyonlar Uygulamalar

Ara

10°C Güneşli TUR 09:56 3.03.2023

CONFERENCE GALLERY

Arbnore-Allu-Practical-work-in-function-of-achieving-the-learning-2 - PowerPoint

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- The research realised at primary school "Emin Duraku" and "Lasgush Poradeci" in the municipality of Shtime. The focus of the study were ninth grade students from two different schools.
- The participants of this research were a total of 265 students participated in the research, 190 of them from primary school "Emin Duraku" and another 75 from "Lasgush Poradeci" in Shtime, who were included in the survey, which is preceded by questionnaires composed of multiple questions, choice.
- Meanwhile, for the collection of qualitative data, an interview was conducted with 8 teachers from both of the above-mentioned schools, for whom special interview protocols were drawn up.

Slide 3 of 10 English (United States) Accessibility: Investigate

INTRODUCTION

Early Blight

Bacterial Canker

White Mold

Septoria Leaf Spot

Magnesium Deficiency

Phosphorus Deficiency

Nitrogen Deficiency

Iron Deficiency

Fig. 3: Selected Infectious Diseases and Nutrient Deficiencies in Tomato

Katılmıcalar (11)

- IKSAD Global
- Hali4, ERDOĞAN
- Doç.Dr.mehmet karaman
- Donikaa Sylejman
- Arbnore Allu
- Oluwafemi Adedire
- Yasir Tufan

CONFERENCE GALLERY

Zoom Toplantı - Hall 6

Balasıbramani G L ekranını görüntüleyebilirsiniz

Seçenekleri Görüntüle

Görüntüle

IKSAD

Balasıbramani G L

h6 moderatör Prof. Dr. Kağan KÖK... H-6, Behlül SEVİM OTURUM 1-Salon 6 Öz... Balasıbramani G L H6 -Korkmaz Akar

Kalan: 08:29:56

Domain organization of DNA gyrase

A **GyrB** **GyrA**

ATPase (62 KDa) TopBK (26 KDa) GA57BK (37 KDa) DNA-gate (512-838)

B **TopBK**

Catalytic core

E-ORND-B DxD C-ter

448 565 609 633 654

C **GA57BK**

DNA-gate C-gate

N-ter ORND-A RYV 9 42 170 356 401 445 491 501

11

Sesli aç Videoyu Başlat Katılımcılar Sohbet Ekran Paylaşımı Kaydı Duraklat/Durdur Ara Odalar Reaksiyonlar Uygulamalar Odadan Çık

Ara

13°C Pusu TUR 11:40 3.03.2023

Katılımcılar (8)

Q Katılımcı bul

- IKSAD (Ortak oturum sahibi, ben)
- BG Balasıbramani G L
- ali küçük
- DS Dr. Sıraç Yavuz
- H6 - Korkmaz Akar
- HM h6 moderatör Prof. Dr. Kağan KÖK...
- HB H-6, Behlül SEVİM
- O1 OTURUM 1-Salon 6 Özmen İSTEK

Tümünü Sessize Al

Zoom Toplantı

Kaydediliyor...

Kalan: 09:35:51

IKSAD

h6 moderatör Prof. Dr. Kağan KÖKTEN IKSAD ali küçük

OTURUM 1-Salon 6 Özmen İSTEK H6 - Korkmaz Akar H-6, Behlül SEVİM

H6 Ayşegül USTA HOUND II Pamphile Edona Kabashi

Edona Kabashi

Barış akdağ

Barış akdağ

Ara

TRY/USD -90.94 TUR 10:44 3.03.2023

Katılımcılar (10)

Q Katılımcı bul

- IKSAD (Ortak oturum sahibi, ben)
- HP HOUND II Pamphile
- ali küçük
- BA Barış akdağ
- EK Edona Kabashi
- H6 - Korkmaz Akar
- HA H6 Ayşegül USTA
- HM h6 moderatör Prof. Dr. Kağan KÖK...
- HB H-6, Behlül SEVİM
- O1 OTURUM 1-Salon 6 Özmen İSTEK

Tümünü Sessize Al

CONFERENCE GALLERY

Zoom Toplantı - Hall 6

Salon-6, UĞURLU ekranını görüntüyorsunuz

Seçenekleri Görüntüle

IKSAD

Ahmet YENİKALAYCI

Hall 6- Joye Elvanika

Özer KURT

HALL-6HAINI KOTIN

Kayıtlı Katılımcı

Kalın: 07:07:48

Bulgular / Result

Ultrason destekli ekstraksiyon uygulanarak elma kabuklarından elde edilen toplam fenolik madde antioksidan aktivite (DPPH) değerleri / Yields total phenolic content and DPPH obtained with ultrasound assisted extraction methods.

Toplam Fenolik Madde / Total Phenolic Compounds (mg GAE/kg)

Ultrason Süresi (U)	Toplam Fenolik Madde (mg GAE/kg)
U15	~750
U30	~1500
U45	~2000

DPPH (mmol Trolox eq./g)

Ultrason Süresi (U)	DPPH (mmol Trolox eq./g)
U15	~8.5
U30	~10.5
U45	~11.5

Sesi aç Videoyu Başlat Katılımcılar Sohbet Ekran Paylaşımı Kaydı Duraklat/Durdur Ara Odalar Reaksiyonlar Uygulamalar Odadan Çık

Ara

15°C Pusu TUR 13:12 3.03.2023

Zoom Toplantı - Hall 6

H6 Mehmet GENCER ekranını görüntüyorsunuz

Seçenekleri Görüntüle

IKSAD

Hall-6 Harikrishna

H6 Mehmet GENCER

Dr. Saber Abdelkader SIAID

CASEY YO (Casey)

Kayıtlı Katılımcı

Kalın: 06:36:05

T.C. TARIM VE ORMAN BAKANLIĞI

Dünya Aspir Üretim (ha)
World Safflower Production (ha)

TADEM

Yıllar (Years)

Yıl	Üretim (ha)
1986	1211370
1987	1126285
1988	895012
1989	1066916
1990	1122766
1991	1181833
1992	1097947
1993	1086726
1994	644427
1995	977444
1996	868008
1997	813893
1998	696152
1999	849410
2000	920939
2001	854485
2002	705624
2003	763876
2004	821633
2005	834815
2006	864102
2007	966887
2008	896898
2009	893054
2010	1003750
2011	861523
2012	1169705
2013	854957
2014	648427
2015	786083
2016	850451

Sesi aç Videoyu Başlat Katılımcılar Sohbet Ekran Paylaşımı Kaydı Duraklat/Durdur Ara Odalar Reaksiyonlar Uygulamalar Odadan Çık

Ara

15°C Pusu TUR 13:44 3.03.2023

CONFERENCE GALLERY

Zoom Toplantı - Hall 6

Hall 6 - AD Azwan Well ekranını görüntüleyorsunuz

Seçenekleri Görüntüle

IKSAD

Ahmet YENİKALAYCI

Hall 6-Sirhajwan Idek

Hall 6 - AD Azwan Well

Hall-6 Harikrishna

Salon-6. UĞURLU

Görüntüle

Kaldır

Kalan: 07:02:11

WPS Office

slide.pptx

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3

4

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Click to add notes

Click to add notes

Click to add notes

Homemade Yanach Fettucine

Gilbert Kimlun
Anysia Marius
Casey Neville Philemon
AD Adzwanwell
Marcella Ann Tetus
Joye Elvanika Jaharin

Sesi aç Videoyu Başlat Katılımcılar Sohbet Ekran Paylaşımı Kaydı Duraklat/Durdur Ara Odalar Reaksiyonlar Uygulamalar Odadan Çık

Ara

15°C Pusu TUR 13:18 3.03.2023

Katılımcılar (19)

Q katılımcı bul

- IKSAD (Ortak oturma sahibi, ben)
- Hall 6 - AD Azwan Well
- AHMET YENİKALAYCI
- Dr. Saber Abdelkader Slaïd
- Salon-6. UĞURLU
- CASEY YO (Casey)
- H6 Mehmet GENCER
- Hall 6 - Anysia Marius
- HALL 6 - Ashraf Daniel
- Hall 6 - Hideo Delfo
- Hall 6 - Nicholas Vicky Voon
- Hall 6 - Joye Elvanika
- Hall 6 - Marcella Ann
- Hall 6-Sirhajwan Idek
- Hall-6 Harikrishna
- HALL-6HAINI KOTIN

Tümünü Sessize Al

Zoom Toplantı - Hall 6

SZH6-Kaan Küçükerdem ekranını görüntüleyorsunuz

Seçenekleri Görüntüle

IKSAD

Ahmet YENİKALAYCI

SZH6-Kaan Küçükerdem

Hall 6-Sirhajwan Idek

VİLDAN AKDENİZ

Hall 6 - Hideo D...

Görüntüle

Kaldır

Kalan: 05:23:46

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Outline

1

2

3

4

Click to add notes

Click to add notes

Click to add notes

Click to add notes

Tehdit esasına dayalı ahlak, ahlak olmadığı gibi güvenilir de değildir.

Sesi aç Videoyu Başlat Katılımcılar Sohbet Ekran Paylaşımı Kaydı Duraklat/Durdur Ara Odalar Reaksiyonlar Uygulamalar Odadan Çık

Ara

16°C Pusu TUR 14:56 3.03.2023

Katılımcılar (20)

Q katılımcı bul

- IKSAD (Ortak oturma sahibi, ben)
- SZH6-Kaan Küçükerdem
- AHMET YENİKALAYCI
- ADEM DAL
- CASEY YO (Casey)
- H6 Mehmet GENCER
- Hall 6 - anysiamarius
- HALL 6 - Ashraf Daniel
- Hall 6 - Hideo Delfo
- Hall 6 - Nicholas Vicky Voon
- Hall 6 - Joye Elvanika
- Hall 6 - Marcella Ann
- Hall 6-gilbert kimlun
- Hall 6-Macarrance alven
- Hall 6-Sirhajwan Idek
- HALL-6HAINI KOTIN

Tümünü Sessize Al

CONFERENCE GALLERY

Zoom Toplantı - Hall 6

Maria Kopylova S-3 H-6 ekranını görüntüleyorsunuz

Seçenekleri Görüntüle

Görüntüle

IKSAD

ÖZER KURT

Maria Kopylova S-3 H-6

Saber Abdelkad...

Saber Abdelkader Saidi

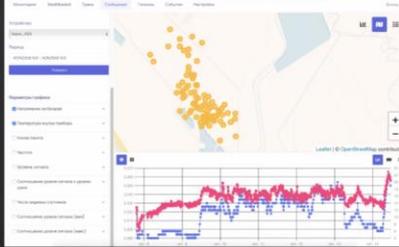
Session 3_Hall 6_Lusia...

Session 3_Hall 6_Arya...

Kalanc 04:14:16

STAV TRACK

GLONASS/GPS cow monitoring system



Sesi aç Videoyu Başlat

Katılımcılar 15

Sohbet Ekran Paylaşımı

Kayı Duraklat/Durdur

Ara Odalar Reaksiyonlar Uygulamalar

Odsadan Çık

16°C Puslu

TUR

1606

3.03.2023

Zoom Toplantı - Hall 6

Maria Kopylova S-3 H-8 ekranını görüntüleyorsunuz

Seçenekleri Görüntüle

Görüntüle

IKSAD

ÖZER KURT

Maria Kopylova S-3 H-6

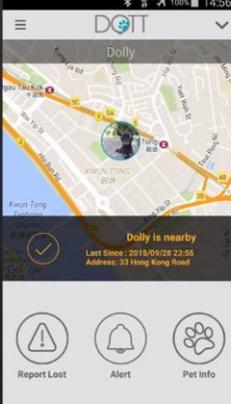
Saber Abdelkad...

Session 2_Hall 6 İbrahim ...

Session 3_Hall 6_Lusia...

Kalanc 04:17:30

Activity trackers for dogs and cats



Sesi aç Videoyu Başlat

Katılımcılar 16

Sohbet Ekran Paylaşımı

Kayı Duraklat/Durdur

Ara Odalar Reaksiyonlar Uygulamalar

Odsadan Çık

16°C Puslu

TUR

1603

3.03.2023

CONFERENCE GALLERY

Zoom Toplantı

IKSAD

Kayıtlıdır...

Kalansız 09:34:07

IPB University
Bogor Indonesia

Materials & methods

Benefits of Mocaf

- High fiber, calcium, fosfor
- 100% Halal
- 100% gluten-free
- Low Glycemic Index
- Organic

Investigate :

1. Cassava strip pastry process,
2. Panels' acceptance,
3. Food Packaging and Label
4. Brand,
5. Product price

Cassava strip pastry

Katılımcılar (9)

Q. Katılımcı bul

- IKSAD (Ortak oturma sahibi, ben)
- S1.Hall-5, Dwi Yuni Hastati
- HALL-5/OTURUM-1, SALON_5 MU...
- ELAYARAJA M
- HE H-5 ESRA ESIN YÜCEL
- H6 hall 6 BENAMAR Khadija
- SD S1.H5 Dr Ivan Pavlović
- SM S1_HL5-Aleksandra Milenković
- SD Subhashish Dey

Tümünü Sessize Al

Zoom Toplantı - Hall 5

S1_HL5-Aleksandra Milenković ekranını görüntüleyorsunuz

Seçenekleri Gözetüle

Görüntüle

IKSAD

Kayıtlıdır...

Kalansız 09:43:08

3. EXPERIMENTAL

WC seeds from Serbia and Greece

Clevenger hydrodistillation 1:10 m/v

WCEOs from Serbia and Greece

GC-MS and GC-FID analysis Agilent Technologies 7890B

Antioxidant agent

DPPH assay

Escherichia coli (ATCC 25922),
Pseudomonas aeruginosa (ATCC 27853),
Proteus vulgaris (ATCC 8427),
Staphylococcus aureus (ATCC 25923),
Bacillus subtilis (ATCC 6633),
Enterococcus faecalis (ATCC 15313),
Alibacillus (ATCC 2091)

1 atanmamış katılımcı

Katılımcılar

Sesli aç

Videosu Başlat

Sohbet

Ekran Paylaşımı

Kayıtlı Duraklat/Durdur

Ara Odalar

Reaksiyonlar

Uygulamalar

Odadan Çık

Tümünü Sessize Al

CONFERENCE GALLERY

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ABSTRACTS



BÜYÜME DÜZENLEYİCİLERİNİN SİLAJLIK SORGUM BİTKİSİNİN ÇİMLENME ÖZELİKLERİNE ETKİSİNİN BELİRLENMESİ

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ÖZET

Dünya çağında su kaynaklarının miktar ve niteliklerinde meydana gelen düşüşler nedeni ile kuraklık stresi bitki yetiştiririliğinde önemli hale gelmekte ve ekonomik öneme sahip bitkilerin fizyolojik işlevlerinde değişikliklere yol açmaktadır. Ekonomik anlamda ürün elde edebilmek için yetiştirilen bitki türünün veya çeşidinin kendisine has optimum çevre isteklerinin karşılanması gerekir. Bu çevre isteklerini artırmak amacı ile bitkinin kendinde doğal olarak bulunan düzenleyici hormonlardan ilham alınarak bitki büyüme düzenleyicilerinin kullanılması son dönemlerde yaygın bir yöntemdir. Çalışmamızda slajlık sorgumda bitki büyüme düzenleyicileri kullanarak çimlenme ve çimlenme unsurlarının artırılması amaçlanmıştır. Araştırmada, bölgede önceden yapılan çeşid verim çalışmasında bölgeye uyumlu olduğu belirlenen Nes sorgum çeşidi ve Zeatin ve Brassinolides büyüme düzenleyicileri materyal olarak kullanılmıştır. Sorgum tohumları filtre kâğıdı bulunan her bir petri kabına yerleştirilmiştir. Tohumların çimlenme deneyleri, 20/25°C (gece/gündüz) sıcaklıkta 10 gün süreyle gerçekleştirilmiştir. Çimlenen tohumlar her gün aynı saatte sayılmıştır. Kökçük 2 mm'ye ulaştığında tohum çimlenmiş olarak kabul edilmiş ve petri kabından uzaklaştırılmıştır. Araştırma sonunda, en yüksek silajlık sorgum tohumlarının çimlenme oranı %98.97 değeri ile %1 Zeatin+ %1 Brassinolides uygulamasından elde edilmiştir. %50 çimlenmeye kadar geçen sürede ortalama değerler 2.15 ile 1.93 arasında değişmiş en yüksek değer 2.15 değeri ile kontrol uygulamasından elde edilmiştir. Çimlenme indeksi ortalama değerleri ise 36.80 ile 28.84 arasında değişmiş olup en yüksek çimlenme indeksi %1 Zeatin + %1 Brassinolides uygulamasından elde edilmiştir. Araştırma sonunda hormon uygulamalarının silajlık sorgum tohumlarının çimlenmesi üzerinde olumlu etkileri olduğu belirlenmiştir.

Anahtar Kelimeler: Sorgum, kuraklık, hormon, çimlenme



DETERMINATION OF THE EFFECT OF GROWTH REGULATORS ON GERMINATION PROPERTIES OF SILAGE SORGHUM

ABSTRACT

Due to the decrease in the quantity and quality of water resources in the world, drought stress becomes important in plant cultivation and causes changes in the physiological functions of economically important plants. In order to obtain products in an economic sense, the optimum environmental requirements of the plant species or variety grown must be met. In order to increase these environmental demands, the use of plant growth regulators, inspired by the regulating hormones naturally found in the plant itself, is a common method recently. In our study, it was aimed to increase germination and germination factors by using plant growth regulators in silage sorghum. In the research, Nes sorghum variety, which was determined to be compatible with the region in the previous cultivar yield study in the region, and Zeatin and Brassinolides growth regulators were used as materials. Sorghum seeds were placed in each petri dish with filter paper. Germination experiments of seeds were carried out at 20/25°C (day/night) for 10 days. Germinated seeds were counted at the same time each day. When the rootlet reached 2 mm, the seed was considered to be germinated and removed from the petri dish. At the end of the research, the highest germination rate of sorghum seeds for silage was obtained from 1% Zeatin + 1% Brassinolides application with a value of 98.97%. Average values between 2.15 and 1.93 in the period until 50% germination were obtained from the control application with the highest value of 2.15. Average germination index values varied between 36.80 and 28.84, and the highest germination index was obtained from 1% Zeatin + 1% Brassinolides application. At the end of the research, it was determined that hormone applications had positive effects on the germination of silage sorghum seeds.

Keywords: Sorghum, drought, hormone, germination



KARYOTYPES OF THE WILD AND HATCHERY-BRED PARENTALS AND THE INTRASPECIFIC HYBRIDS OF CLARIAS GARIEPINUS

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ABSTRACT

This study presents the diploid chromosome number of *Clarias gariepinus* parentals from the wild and hatchery and their intraspecific hybrids. The kidney cells were used for the preparation of metaphase chromosome spreads. The diploid chromosome number for both parentals and hybrids was found to be $2n=56$. The karyotypes for the wild parental revealed were 21metacentric, 1submetacentric, 2subtelocentric and 4telocentric and that of hatchery-bred parental revealed 23metacentric, 1submetacentric, 2 submetacentric and 2telocentric. The hybrids karyotype was 21metacentric, 2 subtelocentric and 5 telocentric for WH while HW had 19metacentric, 1subtelocentric and 8telocentric. The cytogenetic characteristics of both parentals and hybrids varied morphologically. This study provides information for hybridizations and possible manipulations of chromosomes in *C. gariepinus*, evolutionary study, classification and taxonomy and in monitoring aquatic toxicity.

Keywords: Chromosome, *Clarias Gariepinus*, Karyotype, Hybrids, Mitotic Metaphase



BAKTERİYEL HASTALIK ETKENLERİNDE ANTİBİYOTİK YERİNE ALTERNATİF DOĞAL MADDE ÜRETİM VE KULLANIMI

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ÖZET

Bu çalışmada, patent başvurusu yapılmış ağaç kökünden elde edilen doğal ekstraktın balık sağlığı açısından alternatif kullanımı değerlendirilmiştir. Ekstraktın bileşenleri analiz edilmiştir. Çalışmada kullanılan *Lactococcus garvieae* ve *Staphylococcus epidermidis* etkenlerinin fenotipik, biyokimyasal ve moleküler identifikasyonları gerçekleştirilmiştir. Ekstraktın MİK testi ile minimum inhibisyon konsantrasyon değerleri belirlenmiştir. Antibiyogram testinde ise ekstrakt Florfenikol (F) ve Ampisilin (AM) antibiyotikleri ile mukayese edilmiştir. Çalışma sonucunda, kullanılan bakterilerin biyokimyasal olarak katalaz oksidaz ve gram boyama sonuçlarının bakterilere ait sonuçlar olduğu görüldü. Ekstraktın MİK testi sonuçlarında %25, 5 ve 1 oranlarında dilüsyonlarında bakteri gelişmediği saptandı. Bakterilerin sekans sonuçlarından elde edilen dendrograma göre; çalışmada kullanılan *L. garvieae* izolatının blastlama sonucunda en yakın 5 sonuca göre %99.8 oranında benzer olduğu görüldü. *S. epidermidis* izolatının ise blastlama sonucunda en yakın 5 sonuca göre %99.3 oranında benzer olduğu görüldü. Çalışmada kullanılan ekstraktın antibiyotik alternatifi olarak kullanılabilirliğinin testi amacıyla gerçekleştirilen antibiyogram testi sonucunda; Ekstraktın, *L. garvieae* etkeni üzerinde Amfisilin ile aynı etkiye sahip olduğu, Florfenikol antibiyotikğine göre %4 daha etkili olduğu görüldü. Ekstraktın, *S. epidermidis* etkenine göre ise Amfisilin ve Florfenikol antibiyotiklerinden %83 daha etkili olduğu görüldü.

Çalışmada kullanılan ekstrakt su ürünlerinde bakteriyel etkenler üzerinde denenmiş ve başarılı sonuçlar alınmıştır. Maddenin ürün haline getirilmesi ve gerekli izinlerin alınmasının ardından farklı alanlarda da faydalı olacağı düşüncesindeyiz.

Anahtar kelimeler: Antibiyogram, *L. garvieae*, MİK, PCR, *S. epidermidis*, sekans

Bu çalışma Van YYÜ Bilimsel Araştırma Projeleri Başkanlığı tarafından **FLY-2019- 8440** nolu desteklenen projeden üretilmiştir.



PRODUCTION AND USE OF ALTERNATIVE NATURAL SUBSTANCES INSTEAD OF ANTIBIOTICS IN BACTERIAL DISEASE CAUSES

ABSTRACT

In this study, the alternative use of natural extract obtained from the tree root, for which patent application has been filed, was evaluated in terms of fish health. The components of the extract were analysed. Phenotypic, biochemical and molecular identifications of *Lactococcus garvieae* and *Staphylococcus epidermidis* agents used in the study were performed. The minimum inhibition concentration values were determined by the MIC test of the extract. In the antibiogram test, the extract was compared with the antibiotics Florfenicol and Ampicillin.

As a result of the study, it was seen that the results of the biochemical catalase oxidase and gram staining of the bacteria used were the results of the bacteria. In the MIC test results of the extract, it was determined that bacteria did not develop in the 25, 5 and 1 dilutions. According to the dendrogram obtained from the sequence results of the bacteria; It was observed that the *L. garvieae* isolate used in the study was 99.8% similar according to the closest 5 results as a result of blasting. It was observed that *S. epidermidis* isolate was 99.3% similar according to the closest 5 results as a result of blasting. As a result of the antibiogram test performed to test the usability of the extract used in the study as an antibiotic alternative; It was observed that the extract had the same effect as Ampicillin on *L. garvieae* and was 4% more effective than Florfenicol antibiotic. It was observed that the extract was 83% more effective than Ampicillin and Florfenicol antibiotics according to the *S. epidermidis* agent.

The extract used in the study was tested on bacterial agents in seafood and successful results were obtained. We think that the substance will be useful in different fields after it is turned into a product and the necessary permits are obtained.

Keywords: Antibiogram, *L. garvieae*, MIC, PCR, *S. epidermidis*, sequence

This study was produced from the project numbered **FLY-2019-8440** supported by Van YYU Scientific Research Projects Presidency



SEED GERMINATION AND SEEDLING GROWTH OF PAPAYA IN DIFFERENT CONCENTRATIONS OF COLCHICINE

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ABSTRACT

The study aims to evaluate the effects of the different concentrations of colchicine on the seed germination and seedling growth of papaya. It focused on the effects of colchicine on the seed germination and seedling growth of papaya with five treatments and three replications in a Randomized Complete Block Design (RCBD). The treatments were the following: Treatment 1 (0.5 g Colchicine/50 ml Water), Treatment 2 (1 g Colchicine/50 ml Water), Treatment 3 (1.5 g Colchicine/50 ml Water), Treatment 4 (2 g Colchicine/50 ml Water), Treatment 5 (2.5 g Colchicine/50 ml Water), and Treatment 6 (2.5 g Colchicine/50 ml Water) with 5 samples per replication. Based on the results, it was concluded that Treatment 2 performed highly significantly with the other treatments in terms of the average seed germination rate, the average final plant height (cm), the average stem diameter (mm), the average number of leaves, and the average leaf area index (cm²). Therefore, soaking papaya seeds in 0.5 g of colchicine per 50 ml of water is recommended. Meanwhile, there are researchable areas to be addressed, like evaluating different soaking duration, such as 1 hour to 5 hours rather than 8 hours. Moreover, trials with other crops, such as asparagus, carrots, and celery, are suggested.

Keywords: *Colchicine, papaya, seed germination, seedling growth*



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ÖZET

İnsanoğlunun var oluşu ile meydana gelen tarımsal faaliyetler nüfus artışına paralel olarak zamanla toprağın sömürülmesine neden olmuştur. Gelişen toprak bilimi toprağın aşırı sömürüldüğü ve kıt bir kaynak olduğu gerçeğini tüm çıplaklığı ile gözler önüne sermiştir. Artan nüfusun beslenme ihtiyacının giderilmesi ve değerlendirilebilecek birçok atığın geri dönüşümle tekrar üretime kazandırılması amacıyla bilim adamları toprağın yerine geçebilecek değişik unsurları veya topraksız üretim yapılabilecek ortamları araştırmaya başlamışlardır. Bu amaçla çeşitli bitkisel kompostlar, organik veya inorganik substratlar yetiştirme ortamı olarak kullanılabilir. Aynı zamanda organik ve inorganik materyaller sıklıkla toprak düzenleyici olarak kullanılmaktadır. Toprak düzenleyiciler toprak strüktürünü olumlu yönde etkileyerek su tutma kapasitesini artırmakta, agregat stabilitesi, su ve hava geçirgenliği ve bitki büyümesine olumlu katkı sağlamaktadır. Alternatif olarak kullanılabilir olan topraksız tarım çevre korumacı olduğu kadar kullanılamayacak kadar kötü alanların tarıma kazandırılmasını da sağlayabilecek önemli bir araştırma sahasıdır. Asırlardır kullanılan topraksız tarım tekniklerinin yaygınlaşması 1900'lü yılların ortalarında toprak dezenfeksiyonunu kısmen ortadan kaldırdığı için gerçekleşmiştir. Toprak dezenfeksiyonu buharla veya kimyasal yolla yapılmaktadır. Buhar ile toprak dezenfeksiyonun güç ve pahalı olması seralarda topraksız tarıma olan ilgiyi giderek artırmıştır. Kimyasal toprak dezenfeksiyonu ise ozon tabakasına zarar verdiği; toprakta, yeraltı sularında ve yetiştirilen ürünlerde kalıntıya rastlanıldığı için ve insan sağlığını tehdit ettiğinden artık kullanılması istenmemektedir. Bu yüzden alternatif olarak topraksız tarım uygulamaları ilk sırayı almıştır. Toprak, sulama ve gübreleme hatalarını bir dereceye kadar tölere edebilmektedir. Ancak topraksız tarımda veya toprak düzenleyicilerinde yapılan hataların sonuçları çok hızlı ortaya çıkmaktadır. Bundan dolayı topraksız tarım ya da toprak düzenleyicileri kullanılan uygulamalarda, geleneksel şekilde yapılan yetiştiriciliğe kıyasla, bilgi-deneyim ve ayrıntılara dikkat edilmelidir. Topraksız kültürle yetiştiriciliğin geliştirilerek artırılmaya çalışılması, ülke ekonomisini ve ihracat potansiyelini de büyük ölçüde artıracaktır.

Anahtar Kelimeler: Topraksız tarım, toprak düzenleyiciler, substrat, hidroponik, çevre



PLANT GROWING IN SOLID/LIQUID MEDIA (SOILLESS FARMING)

ABSTRACT

Agricultural activities, which occurred with the existence of human beings, have led to the exploitation of the land over time in parallel with the increase in population. Developing soil science has exposed the fact that soil is overexploited and a scarce resource with all its nakedness. In order to meet the nutritional needs of the increasing population and to recycle many wastes that can be used for production, scientists have started to research different elements that can replace soil or environments where soilless production can be made. For this purpose, various vegetable composts, organic or inorganic substrates can be used as growing media. At the same time, organic and inorganic materials are often used as soil conditioners. Soil conditioners increase the water holding capacity by positively affecting the soil structure, contribute positively to aggregate stability, water and air permeability and plant growth. Soilless agriculture, which can be used as an alternative, is an important research field that can provide environmental protection as well as bringing the unusable areas to agriculture. The widespread use of soilless farming techniques, which have been used for centuries, took place in the mid-1900s as soil disinfection was partially eliminated. Soil disinfection is done with steam or chemical means. The fact that soil disinfection with steam is difficult and expensive has increased the interest in soilless agriculture in greenhouses. Chemical soil disinfection damages the ozone layer; Since residues are found in the soil, groundwater and cultivated products and it threatens human health, it is no longer desired to be used. Therefore, as an alternative, soilless farming practices have taken the first place. Soil can tolerate irrigation and fertilization errors to some extent. However, the results of mistakes made in soilless agriculture or soil conditioners emerge very quickly. Therefore, in applications using soilless agriculture or soil conditioners, knowledge-experience and attention to details should be paid compared to traditional cultivation. Trying to improve and increase cultivation with soilless culture will greatly increase the country's economy and export potential.

Keywords: Soilless agriculture, soil conditioners, substrate, hydroponics, environment



EKOLOJİK TARIMIN BİLİNMEYEN DEĞERİ VERMİKOMPOST

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ÖZET

Bitkisel üretimin temel bileşeni olan topraklar farklı özelliklerinden dolayı farklı üretim potansiyeline sahiptirler. Bununla birlikte artan dünya nüfusunun gıda ihtiyacını karşılamak için oldukça yoğun işlenen toprağın yapısı bozulmaktadır. Yapısı bozulan toprağın kalitesini arttırmak için farklı toprak yönetim sistemleri uygulanmaktadır. Toprak organik maddesinin korunması ve iyileştirilmesi toprak yönetim uygulamalarında önemli bir yere sahiptir. Toprakların fiziksel özelliklerinin iyileştirilmesi, ürün verimini olumlu yönde etkilemektedir. Bunun içinde en iyi yöntem toprak organik madde miktarının artırmaktır. Organik madde bitkilere besin maddesi sağlayan, toprak erozyonuna karşı taneleri birbirine bağlayan, topraktaki su hareketini kontrol eden ve su tutma kapasitesini arttıran önemli bir toprak bileşenidir. Bitkisel üretimde önemli bir potansiyele sahip olan solucan humusu biyolojik toprak düzenleyici olarak kullanılmaktadır. Mikroorganizmalarca fermentasyona uğratılan organik atık veya atıklar yer solucanlarının sindirim sisteminden geçerek humifikasyon ve detoksifikasyona uğramaktadır. Toprak solucanları salgıladıkları sölöm sıvısı ile de agregatlaşmayı sağlamaktadırlar. Her geçen gün verimi artırma nedeni ile kimyasal kullanımı artmaktadır. Kimyasal kullanımının artmasına paralel olarak doğal kaynakların güvenilirliği tehdit edilmeye başlanmış buna bağlı olarak biyolojik gübre ve pestisit amacı ile kullanılabilir tarımsal üretim sistemleri araştırılmaya başlanmıştır. Bu bağlamda her halükarda toprak kalitesini artıran aerobik kompost ve vermikompost ürünleri çok büyük önem taşımaktadır. Organik atık veya artıkların kompostlaştırma işleminin solucanlara yaptırılması vermikompost, toprak solucanlarının farklı amaçlar için kullanılmasını sağlayan işlem vermikültür, vermikültür faaliyetlerinde kullanılan teknik veya yöntemler ise vermiteknoloji olarak bilinmektedir. Vermikültür çalışmaları çöp işleme, toprak detoksifikasyon ve rejenerasyonu ve sürdürülebilir tarım uygulamalarında içermektedir. Vermikompostlar maliyeti düşük bitki verim ve hastalıkları üzerine etkili çevreye dost uygulamalardır.

Anahtar Kelimeler: Vermikompost, biyolojik gübre, toprak düzenleyici, organik atık, kompost



UNKNOWN VALUE OF ECOLOGICAL AGRICULTURE VERMICOMPOST

ABSTRACT

Soils, which are the basic components of crop production, have different production potentials due to their different characteristics. However, the structure of the highly cultivated land is deteriorating in order to meet the food needs of the increasing world population. Different soil management systems are applied to increase the quality of the deteriorated soil. Conservation and improvement of soil organic matter has an important place in soil management practices. Improving the physical properties of soils positively affects crop yield. The best method for this is to increase the amount of soil organic matter. Organic matter is an important soil component that provides nutrients to plants, binds grains together against soil erosion, controls water movement in the soil and increases water holding capacity. Vermicompost, which has an important potential in plant production, is used as a biological soil conditioner. Organic residues or wastes fermented by microorganisms pass through the digestive system of earthworms and undergo humification and detoxification. Earthworms also provide aggregation with the coelom fluid they secrete. The use of chemicals is increasing day by day due to increasing efficiency. In parallel with the increase in the use of chemicals, the reliability of natural resources has begun to be threatened, and accordingly, agricultural production systems that can be used for biological fertilizers and pesticides have begun to be investigated. In this context, aerobic compost and vermicompost products, which increase soil quality in any case, are of great importance. The composting process of organic waste or residues is known as vermicompost, the process that allows earthworms to be used for different purposes is known as vermiculture, and the techniques or methods used in vermiculture activities are known as vermiculture technology. Vermiculture work includes garbage treatment, soil detoxification and regeneration, and sustainable farming practices. Vermicomposts are environmentally friendly applications that are effective on plant yield and diseases with low cost.

Keywords: Vermicompost, biological fertilizer, soil conditioner, organic waste, compost



IMPROVEMENT OF GROWTH AND ROOT MORPHOLOGICAL TRAITS OF OKRA UNDER DROUGHT STRESS BY CO-INOCULATION OF ARBUSCULAR MYCORRHIZAL FUNGI AND BIOCHAR APPLICATION

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ABSTRACT

Drought is a major abiotic factor limiting plant growth and crop production. There is limited information on effect of interaction between biochar and Arbuscular mycorrhizal fungi (AMF) on okra growth and root morphological traits under drought stress. We studied the influence of biochar and AMF on the growth of Okra (*Abelmoschus esculentus*) in pot experiments in a net house under drought condition. The roots of okra were washed carefully with water. The whole root system was spread out and analyzed using a scanning system with a blue board as a background. Digital images of the root system were analyzed using Win RHIZO software. The total root length, the root surface area, the root volume, the projected area and the root diameter were evaluated. The results showed that the biochar treatment significantly increased plant growth (the plant height by 14.2%, root dry weight by 30.0%). AMF treatment significantly increased the plant height by 16.6%, shoot dry weight by 21.0% and root dry weight by 40.0% compared to the control. In drought condition, when the combination of biochar and AMF treatment were applied, the plant height improved by 31.9%, shoot dry weight by 34.2% and root dry weight by 60.0% compared to the control respectively. The root morphological traits indicated that root parameters significantly increased the total root length, the root surface area, the projected area, the root diameter and the root volume by biochar alone, AMF alone and combined with biochar with AMF treatment under drought stress. Compared to the control, biochar alone treatment significantly enhanced the projected area by 22.3% and the root diameter by 22.7% under drought stress. The highest values of total root length (68.6%) and root volume (66.6%) were observed in the treatment of biochar and AMF combination as compared to control and individuals under drought stress. This finding reveals the prospective and potential use of okra combined with biochar and AMF for the successful crop cultivation under drought stress.

Keywords: Okra, plant growth, root morphological traits, total root length, drought stress



FRAGMENTATION IN HERPETOFAUNAL HABITATS ALONG THE COAST OF KOZHICODE, KERALA, INDIA - A REVIEW

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ABSTRACT

Globally, the loss of biodiversity is mostly caused by habitat modification and dispersion. There has been an increase in biodiversity concerns over the past few decades. However, it is still unclear how the research effort and approaches will develop in this area. In this study, a review of the state of ecological disruption for two of the most imperiled vertebrate taxa, reptiles and amphibians, as a result of cultivation, timber, dispersion, urbanization, and roadways has been conducted. Along with their related sampling techniques and interaction effects, an assessment of spatial and taxonomical patterns on the various habitat disintegration types in the brackish regions of the Kozhikode shoreline was studied. The review identified several limitations, including earlier research initiatives on mangrove forests and an abundance of studies evaluating relative abundance and diversity. However, the research focus has shifted to utilizing modern technology, such as genetic and geographic data analysis. The incidence of herpetofauna observed in the coastline by many existing literatures suggests that the herpetofauna distribution is highly confined due to the region's near proximity to the sea, which inhibits species from dispersion despite the fact that these organisms are challenging to spot due to their paradox activity. The varieties of habitat loss and fragmentation and sampling techniques have significant correlations. Additional efforts are necessary to discover distinctive and characteristic herpetofauna abundance and diversity of conservation areas or unusual habitats in order to increase and underline their ecological relevance. These important taxa can serve as bioindicators to anticipate the needs and priorities for management in these environments.

Keywords: Herpetofauna; Kozhikode, reptiles, mangroves, habitat, amphibians



**EFFECTS OF APPLIED MAGNETIC FIELD AND PRESSURE ON THE
DIAMAGNETIC SUSCEPTIBILITY AND BINDING ENERGY OF DONOR
IMPURITY IN A CIRCULAR QUANTUM DISK MADE OUT OF GAAS**

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ABSTRACT

In this work, we investigate the influence of the hydrostatic pressure, magnetic field, and conduction band non-parabolicity on both the diamagnetic susceptibility and the binding energy of shallow donor impurity in a quantum disk made out of GaAs. The Hamiltonian of the investigated problem has been solved within the framework of the effective-mass approximation. The energy minimization has been performed using variational approach. Our results reveal that both the diamagnetic susceptibility and binding energy have been reduced with increasing the disk size. Moreover, the diamagnetic susceptibility increases as the impurity moves from the extremity to the center of the disk. However, both the diamagnetic susceptibility and binding energy have been improved under applied magnetic field, hydrostatic pressure, and by considering the conduction band non-parabolicity model as well. We hope that the reported results will be a modest contribution to further theoretical research in the field of nanostructures.

Keywords: Quantum disk, hydrostatic pressure, magnetic field, non-parabolicity, diamagnetic susceptibility, binding energy



PEROXIDASE ENZYME ACTIVITY IN VARIETIES OF MUNGBEAN (*Vigna radiata* L.) UNDER DIFFERENT CONDITIONS OF WATER AVAILABILITY

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ABSTRACT

Mungbean (*Vigna radiata* L.) is an important short-ripening legume crop with wide adaptability and low input requirements. It also plays a vital role in sustainable agriculture as a mixed crop, intercrop and rotation crop that improves soil nitrogen status and can also be used as a nutritious green feed for livestock. Drought is a multidimensional, complex stress that simultaneously disrupts the physiological, morphological, biochemical, and molecular states that control crop growth and quality and, ultimately, crop productivity. This situation is exacerbated worldwide as areas experiencing drought are rapidly expanding due to uneven precipitation, limited water sources, and other rapid and abrupt changes in global environmental conditions. The experiment was carried out in the experimental plot of the Institute of Genetics and Experimental Plant Biology. The varieties of mungbean (*Vigna radiata* L.) Andijon, Durдона, Zilola, Turon as well as new lines L-8, L-59, L-88, L-92 were chosen as objects of study. Under optimal water supply, the highest peroxidase enzyme activity among local varieties ($92.8 \pm 1.83 \mu\text{g/g}$) was observed in cultivar Durдона, among lines the highest peroxidase enzyme activity ($101.72 \pm 0.77 \mu\text{g/g}$) was observed in L-92. Under conditions of water deficit, the highest index of peroxidase enzyme activity among local varieties ($167.09 \pm 1.53 \mu\text{g/g}$) was observed in Zilola variety, among lines the highest index of peroxidase enzyme activity ($133.91 \pm 1.52 \mu\text{g/g}$) was observed in L-92. The frequency and severity of droughts is expected to increase in the coming years due to global climate change. Consequently, there is a need to develop climate-resistant varieties of mungbean that perform better under drought conditions. The above results clearly showed the involvement of enzymes in shaping the drought tolerance of the crop. Therefore, a focus on improving drought tolerance is necessary to improve drought tolerance. Progress made in understanding the mechanisms underlying the physiological and biochemical basis of drought tolerance may also allow the use of more effective antioxidants to improve yield potential and resistance. peroxidase enzyme activity distinguished L-92 ($101.72 \pm 0.77 \text{ mkg / g}$), while the line L-8 peroxidase activity was ($79.5 \pm 1.06 \text{ mkg / g}$).

Keywords: Mungbean, water deficit, peroxidase enzyme activity, drought tolerance



ROOTING RESPONSE OF AIR-LAYERED CLEMENTINE (*Citrus × Clementina* Hort.) ON DIFFERENT LAHAR-BASED ROOTING MEDIA

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ABSTRACT

The study aims to evaluate the effects of the different lahar-based rooting media in the rooting response of air-layered clementine. It focused on the survival rate and root development with four treatments and three replications in a Completely Randomized Design (CRD). The treatments were the following: Treatment 1 (100% Lahar Soil), Treatment 2 (50% Lahar Soil + 50% Carbonized Rice Hull), and Treatment 3 (50% Lahar Soil + 50% Vermicompost). Based on the result of the study, Treatment 2 and Treatment 3 showed a highly significant difference from Treatment 1 in terms of the average survival rate of the air-layered clementine (percentage) and the average number of primary roots while significant in terms of the average length of the longest root. Treatment 2 also showed highly significant differences from other treatments in terms of the average diameter of the longest root and the average rate of air-layered clementine with secondary roots. Lastly, Treatment 2 showed highly significant differences from other treatments in terms of the average diameter of the longest root. Therefore, Treatment 2 (50% Lahar Soil + 50% Carbonized Rice Hull) and Treatment 3 (50% Lahar Soil + 50% Vermicompost) are recommended for rooting an air-layered clementine. Meanwhile, there are researchable areas to be addressed, like the evaluation of natural rooting stimulants combined with lahar-based rooting media.

Keywords: Air-layered, rooting response, miracle fruit tree, carbonized rice hull, manure bokashi



PROTECTIVE EFFECTS OF VARIETY CONCENTRATIONS OF TREHALOSE AND CARBOXYMETHYL CELLULOSE AS CRYOPROTECTANT DURING CRYOPRESERVATION OF RAM SEMEN

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ABSTRACT

Uterine cysts are a common finding in aged brood-mares. They represent underlying uterine pathology that will negatively impact fertility. The physical presence of cysts may also complicate pregnancy diagnosis and successful conceptus mobility and placentation. The significance of these cysts is dependent upon their number and location within the uterus. They may occur throughout the uterus, but tend to occur at the base of the uterine horns near the body of the uterus. Cystic areas of the uterus are not capable of producing histiotroph to provide nutritional support for the embryo during its development prior to placental formation. Accurate record-keeping and mapping the size and location of cysts prior to breeding the mare can help to reduce diagnostic errors. Uterine cysts are categorized according to their size and location within uterine tissue. Glandular cysts are less than 1 cm in diameter and may occur during pregnancy and in the periparturient period as a normal finding. They form as a result of layers of fibrocytes surrounding the glands and causing cystic distension. These cysts are generally not pathological with regard to fertility. It is proposed that the cysts occur as a result of increased estrogen levels similar to the cystic endometrial hyperplasia complex that is seen in canines. Lymphatic cysts are greater than 1 cm and sometimes measure up to 20 cm in diameter. These cysts are of sufficient size to interfere with pregnancy. They arise as dilated areas of lymphatic tissue resulting from uterine fibrosis and a lack of myometrial contractility to move lymph through the duct system. Typically, cysts contain a watery yellow lymphatic fluid. Uterine cysts may be diagnosed by manual palpation, ultrasonography, or endoscopy. Larger uterine cysts may be detected manually by encircling the uterine horn with the thumb placed dorsally starting at the tip of the horn and working toward the body of the uterus. More commonly cysts are detected during ultrasonographic examination of the uterus. The capsule of the cyst appears as a definitive hyperechoic line surrounding a hypoechoic center. Cysts may appear circular or oblong; they are solitary or may appear clumped with hyperechoic septa dividing the cyst into compartments. Hysteroscopy may be used to visualize and treat cysts directly. Required equipment includes an endoscope with at least 1m working length and a light source of 100 to 300 W.

Keywords: Uterine cysts, Brood-mares, Hysteroscopy.



MICROBIOTA MODULATION AS THERAPEUTIC APPROACH IN THE NEUROPATHIC PAIN IN DOG WITH SPINAL CORD INJURY: IMPACT OF POLENOPLASMIN

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ABSTRACT

Background Studies have demonstrated the presence of gut dysbiosis (alterations in gut bacterial homeostasis) secondary to spinal cord injury in dogs. The dysbiosis is thought to impair recovery by decreasing the production of short-chain fatty acids which play a role in suppressing inflammation within the central nervous system. Objective Therefore, targeting gut dysbiosis could have significant therapeutic value in the management of spinal cord injury. The purpose of this study is to determine if gut dysbiosis occurs in dogs with spinal cord injury. Another area of potential intervention interest is in situations of spinal injury where there is an urgent need to generate new neurons. To arrive at these observations, the authors examined how Polenoplasmin and diet solve paralysis in dogs. Materials and methods the most common cause of spinal problems in dogs is trauma. We are currently assessing whether indoles can also stimulate formation of neurons in dogs with paralysis. Results we found that gut microbes that metabolize tryptophan-an essential amino acid-secrete small molecules called indoles, which stimulate the development of new brain cells in dogs, also demonstrated that the indole-mediated signals elicit key regulatory factors known to be important for the formation of new neurons. Conclusion This study is another intriguing piece of the puzzle highlighting the importance of lifestyle factors and diet. The link between the health of the microbiome and the health of the brain shows how microorganisms in the gut solve paralysis, gut microbe secreted molecule linked to formation of new nerve cells in paralyzed dogs.

Keywords: Gut dysbiosis, indole, paralyzed dog, polenoplasmin.



ROLE OF OF DIFFERENT SUPPLEMENTS IN FISH FEED FORMULATION

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ABSTRACT

In the current talk will discuss about the use of conventional and non-conventional plant by-products in aqua-feeds to promote the sustainable production of multiple fish species in aquaculture. The development of sustainable protein sources to substitute fish meal in aqua-feeds is critical to the continued growth and intensification of aquaculture productivity. Fish feed plays an important role in the growth of the aquaculture industry. Fishmeal (FM) has been employed as the principal protein element in aquaculture because of its beneficial essential amino acids, high digestibility, and palatability. Fishmeal prices are expected to rise by 20% between now and 2030 because of rising demand and increased output. This requires the search for better FM alternatives for long term aqua-feed production. In this light, much efforts have been conducted to seek the sustainable supplies of protein sources to substitute FM. Good nutrition in production systems is essential to economically produce a healthy, high product the first consideration for formulation of feed is the quality of the feed ingredients. Use of plant protein source in the feed industry has been in practice for various advantages such as sustainability, availability, cost effectiveness etc. Because of their high protein content, excellent amino acid profile, low cost, and year-round availability, they are commonly utilized as a cost-effective alternative to high-quality fish meal in diets for many aquaculture fish species. *Moringa oleifera* leaf meal, *Moringa oleifera* seed meal, Canola meal, Sunflower meal, and Cottonseed meal have all been studied extensively. Different supplements, such as enzymes, probiotics, organic acids, and Nano-particles, are also given to fish meals in addition to plant by-products. All of these factors help fish species enhance their growth, nutrient digestibility, and body composition.

Keywords: plant by-products, replacement, feed formulation, cost effective, environment friendly



THE ACTION OF ELECTROMAGNETIC FIELDS ON THE INTERACTION ELECTRON-IMPURITY: THE BINDING ENERGY AS AN EXAMPLE

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ABSTRACT

In this study, the electron-impurity distance and the binding energy of a semiconductor quantum disk made out of GaAs are theoretically investigated by solving the Schrödinger equation in presence of an external lateral electric field by considering the position-dependent effective masse and dimension effects. The calculations have been performed by adopting the variational approach within the effective mass theory considering an infinite confining potential. Our findings indicate that the size and electric field strength decrease the binding energy while improving the electron-impurity distance. Furthermore, the incorporation of the position-dependent effective masse enhances the binding energy but reduces the electron-impurity distance. Hence, the direction of the lateral electric field plays a significant role in the behavior change of the quantum disk's binding energy and electron-impurity distance

Keywords: Binding energy, quantum disk, lateral electric field, donor impurity, position dependent effective masse



EFFECT OF EXTERNAL CONTRIBUTIONS ON THE ELECTRONICS PROPERTIES OF SEMICONDUCTORS

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ABSTRACT

In this work, we investigate the influence of the hydrostatic pressure, magnetic field, and conduction band non-parabolicity on both the diamagnetic susceptibility and the binding energy of shallow donor impurity in a quantum disk made out of GaAs. The Hamiltonian of the investigated problem has been solved within the framework of the effective-mass approximation. The energy minimization has been performed using variational approach. Our results reveal that both the diamagnetic susceptibility and binding energy have been reduced with increasing the disk size. Moreover, the diamagnetic susceptibility increases as the impurity moves from the extremity to the center of the disk. However, both the diamagnetic susceptibility and binding energy have been improved under applied magnetic field, hydrostatic pressure, and by considering the conduction band non-parabolicity model as well. We hope that the reported results will be a modest contribution to further theoretical research in the field of nanostructures.

Keywords: Quantum disk; hydrostatic pressure; magnetic field; non-parabolicity; diamagnetic susceptibility; binding energy



EXPLORING THE NUTRITIONAL POTENTIAL OF COMMON BEAN

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ABSTRACT

Legumes are considered one of the most important groups in our agriculture system by providing high-quality and cheaper protein and contributing significantly to sustainable agriculture. Among various legumes, the common bean is considered a “grain of hope” because of its higher nutritional potential. This crop is native to Latin America, however, now it is cultivated in nearly all areas of the world. It is serving as a source of food for millions of people. As the human population is increasing and climate change is affecting drastically, the scientific community made significant efforts to develop climate-resilient common bean cultivars. However, the development of high-yielding and resistance to various biotic and abiotic stresses remained the primary focus of the breeding community. Germplasm characterization is regarded as a requirement for breeding activities since it gives the scientific community the chance to find previously unrecognized differences that may be useful for breeding. While fewer efforts have been made to explore the nutritional potential of the common bean and to identify the genomic regions associated with nutritional traits that will be helpful for the marker-assisted breeding of the common bean. Keeping this in view, the present paper aimed to gather recent information about the nutritional potential of the common bean.

Keywords: *Phaseolus vulgaris*, food legumes, nutritional traits, germplasm characterization



ELABORATION AND CHARACTERIZATION OF BIONANOCOMPOSITE FILMS FOR APPLICATION IN FERTILIZER COATING

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ABSTRACT

In order to reduce the cost of fertilizers as well as their influence on the environment, scientists are paying more and more attention to slow-release or controlled-release fertilizers, which are prepared from abundantly available biodegradable natural materials such as biopolymers. Based on this context, A novel matrix-based fertilizer was prepared by encapsulation of a fertilizer containing nitrogen, phosphorus and potassium (NPK) in presence of biopolymers as the matrix and cross-linked by calcium chloride. The prepared materials were characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), thermogravimetric analysis (TGA), scanning electron microscopy (SEM), water retention capability was also evaluated. The fertilizers release profile in water of the synthesized fertilizers was in good agreement with the European standard EN 13266 indicating its excellent controlled release property with a maximum release rate of 65% (nitrogen); 52% (phosphorus); and 43% (potassium) for 56 days. We also followed the release profile in the soil, and the results show a maximum release rate of 33% (nitrogen), 26% (phosphorus); 22% (potassium) for 35 days. These good characteristics revealed that the prepared S-CRF beads can be practically used in agricultural applications.

Keywords: Slow-Controlled release fertilizer (SCRF), encapsulation, NPK



ANTIOXIDANT, ENZYME INHIBITION AND TOXICOLOGY STUDIES OF METHANOL EXTRACTS OF SELECTED MEDICINAL PLANTS

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ABSTRACT

The purpose of this work was to study the biological activities of methanolic extracts of *Tagetes erecta*, *Calendula officinalis* and *Murraya koenigii* on alpha-amylase at varying concentrations. Antioxidants obtained from selected medicinal plant extracts should be able to produce the desired redox reaction, be physiologically inert, non-toxic, effective in low concentrations, and should provide prolonged stability to the formulation. The comet assay's detection of DNA damage highly depends on the cells in the selected therapeutic plant components. Environmental pollution is a major factor that has an impact on human lives as it damages cell DNA. The % radical scavenging activity was performed by using DPPH and FRAP antioxidant assays. The % inhibition of methanolic extracts were performed by using α -amylase and urease inhibition assays. The toxicology studies were performed by using comet assay to check the selected plants extract's potential to damage DNA. The % inhibition of methanolic extracts of alpha amylase was noted in the range of 11.49 to 50.56 % and IC₅₀ in the range of 04.09±0.05 to 07.39±0.23 µg/ mL respectively at the mentioned concentrations. The % urease inhibition range of leaf extracts at 300 to 400 rpm of *Tagetes erecta* were in range of 52.32 to 2.11 %. Methanolic extracts of *Tagetes erecta* showed the total phenolic contents in the range of 0.03±0.24 to 0.42±0.63 mg GA/ 100g for leaf extracts and 0.006±0.39 to 0.09±0.28 mg GA/100g for stem extracts. 0.02±0.32 to 0.17±0.38 mg GA/ 100g TPC of curry leaves and 0.02±0.32 to 0.17±0.38 mg GA/ 100g, 0.001±0.39 to 0.18±0.39 mg GA/100g for leaf and stem extracts of *Calendula officinalis*. According to researchers, the total phenolic contents in a plant largely contribute to antioxidant activity. The % radical scavenging activity of leaf extracts of *Tagetes erecta* was noted in the range of 2.13 to 76.13 % and 3.73 to 46.31 % by using DPPH and FRAP antioxidant assays. The current experiment showed that NDEA increased DNA damage, as indicated by the lengthening of the comet tail. Ingestion of *T. erecta* leaf extract significantly reduced protein and lipid oxidation and lessened DNA damage, which is interpretable as a decrease in oxidative stress brought on by NDEA. The results of the work therefore, clearly indicate the potential of these extracts to manage hyperglycemia and oxidative stress. The evaluation of enzyme inhibition and antioxidant potentials of plant extracts has been done by using 96-well microplate reader technique. Data obtained has been statistically analyzed using appropriate statistical tools.

Keywords: *Tagetes erecta*, *Calendula officinalis*, *Murraya koenigii*, antioxidant, enzyme inhibition, comet assay, evaluation and statistical analysis



UNDERSTANDING THE HYPOGLYCEMIC ACTIVITY OF DIFFERENT SOLVENT EXTRACTS OF *TABERNAEMONTANA DIVARICATA* IN ALLOXAN INDUCED DIABETIC RAT MODEL

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ABSTRACT

Diabetes mellitus is a divergent disease described by the existence of increased glucose level because of less glucose maintaining hormone (Insulin) discharge and deficient insulin activity. Longterm increase in the glucose level of diabetes is related to generally particular extended micro vascular complexities influencing the kidneys, nerves, eyes and additionally expanded risk for cardiovascular diseases (CVD). *Tabernaemontana divaricata* commonly known as Crape jasmine is a dichotomously branched evergreen ornamental shrub distributed in Bangladesh and South East Asia. The phytochemical constituents of the plant *T. divaricata* such as alkaloids, flavonoids, phenols, terpenes and enzymes have been reported and pharmacological properties include antioxidant, anti-inflammatory, antifertility, analgesic, anti-parasitic and antimicrobial potential against many infectious diseases. The current study was conducted to evaluate the antidiabetic potential of different solvent extracts of plant *T. divaricata* in alloxan induced diabetic rats. Twenty wistar rats were taken in current study. Rats were equally divided into four groups each group containing 5 rats. Alloxan monohydrate was used for the induction of diabetes intraperitoneally at a dose rate of 130mg/kg. Following treatments were given to rats. Group I: Normal control; Group II: Positive Control; (received alloxan only); Group III: Treatment I (received methanolic extract of *T. divaricata* at dose rate of 400 mg/kg); Group IV: Treatment II (received hexane extract of *T. divaricata* at dose rate of 400mg/kg). Antidiabetic activity of methanol and hexane extracts of plant *T. divaricata* was determined by performing biochemical analysis, antioxidant enzyme assay and histopathological analysis. Antidiabetic activity of both extracts was determined in comparison to each other at the same dose rate of 400 mg/kg. Data was analysed statistically by using analysis of variance (ANOVA). Results of biochemical analysis and antioxidant markers indicated that methanolic extract of plant *T. divaricata* have good antioxidant and antidiabetic potential as compared to hexane extract of *T. divaricata*. Different solvent extracts (methanol and hexane) of plant *T. divaricata* have ability to reverse alloxan induced hyperglycemia. Histopathological analysis also revealed the antioxidant and hypoglycemic potential of different solvent extracts of plant *T. divaricata*.

Keywords: Flavonoids, type 2 diabetes, insulin signaling, antioxidant, cardiovascular diseases, anti-inflammatory



ENHANCEMENT OF PLANT GROWTH, USING PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) ASSOCIATED WITH PLUM TREES (*Prunus domestica*)

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ABSTRACT

Plants interact with a great variety of microorganisms that inhabit the rhizosphere playing critical roles in several aspects of plant growth. In this study, we performed a screening of bacteria associated with the rhizosphere of *Prunus domestica* trees to identify bacterial strains with plant growth-promoting activity. Ten strains isolated from the rhizosphere of *P. domestica* showed multiple in vitro plant growth promoting rhizobacteria (PGPR) activity such as the production of indole acetic acid, hydrogen cyanide, ammonia, solubilization of phosphates and antifungal activity against *Verticillium dahliae* and *Fusarium oxysporum* f.sp. *melonis*. In planta, they significantly increased the growth (stem length, number of leaflets, leaf area and root weight) and biochemical (nitrate reductase activity, proline and chlorophyll content) parameters of tomato. Furthermore, PGPR isolates remarkably increased seed germination. 16S rRNA sequencing identified strains Pr7 and Pr8 as *Pseudomonas stutzeri* and *Bacillus toyonensis*, respectively. Since these two PGPR inoculants exhibited multiple traits beneficial to the examined host plants, they may be applied in the development of safe, and effective seed treatments as an alternative to chemical fungicides and fertilization.

Keywords: Plant growth promoting rhizobacteria, seedling growth, *prunus domestica*



MONITORING MILK ADULTERATION USING ULTRASOUND TECHNIQUE

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ABSTRACT

Adulteration in food products means the addition of prohibited substance either partly or wholly for the state of financial gain or lack of hygienic conditions of processing and storing which leads to the consumer being cheated. Ignorance of this fact is not fair since this may endanger consumer health. In the dairy industry, milk quality is measured by criteria such as fat, lactose, protein, and water content. This later is a property of major importance in milk powders and food products in general. It influences storing conditions and shelf life as well as textural and technological qualities. On the other hand, when pure milk is cheated, its physical properties change, such as electrical conductivity, electrical admittance, boiling point, freezing point, viscosity, etc. During the experiments, milk adulteration was performed by blending variable amounts, ranging from 87.36% to 93.98% (by dose of 5mL) in volume of water into 91mL of the original milk sample. Each sample was conducted under different levels of temperatures ranging from 20°C to 40°C, with a step of 5° C. In order to evaluate the water content in powdered milk, an ultrasound technique in backscattering pulse echo mode has been tested and proved to be a simple, fast, inexpensive and non-destructive alternative tool for evaluating the quality of powdered milk. In addition, our technique involves only one transducer and it is non-invasive, which is very important in the food industry for hygiene reasons.

Keywords: Milk adulteration, pulse-echo, CND, ultrasound parameters



REFORM OF THE COMMON AGRICULTURAL POLICY: A PERENNIAL CHALLENGE FOR THE EUROPEAN UNION

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ABSTRACT

Originally developed to ensure the food sovereignty of the European Union, the Common Agricultural Policy (CAP) has evolved over the enlargement of the Union, societal expectations and the economic context to respond to multiple contemporary challenges, especially environmental. The European Economic Community, established by the Treaty of Rome in 1957, had the CAP as its first community policy, which came into force on July 30, 1962. It materialised the ambition of the Six founding States (Germany, France, Italy and the three Benelux countries) to pool their means to feed Europe and ensure its sovereignty and food self-sufficiency after the ravages of war. Initially, the CAP was based on price control and subsidy measures to develop and modernise agriculture while respecting the principles of market unity, financial solidarity and Community preference. The direction given to the CAP by the Treaty of Rome was intended to be productivist and protectionist. It was necessary to increase the agricultural production of the States while making this community self-sufficient within the same border. In addition to solidarity, it was a question of modernising an agricultural sector which was still highly contrasted depending on the member-state. Agriculture, over the decades, became an important issue over which member states had diverging interests. It became a topic whereby fierce debate continued unabated. This research will examine and evaluate the various reforms of this policy from its inception to the present day. It also discusses the evolution of the legal and financial tools it has adopted to regulate agriculture and rural areas within the various Member States of the European Union.

Keywords: Agriculture, european union, common agricultural policy, rural development, france



ORTAK TARIM POLİTİKASI REFORMU: AVRUPA BİRLİĞİ İÇİN ÇOK YILLIK BİR ZORLUK

ÖZET

Başlangıçta Avrupa Birliği'nin gıda egemenliğini sağlamak için geliştirilen Ortak Tarım Politikası (OTP), Birliğin genişlemesi, toplumsal beklentiler ve özellikle çevresel olmak üzere birçok çağdaş zorluğa yanıt vermek için ekonomik bağlam üzerinde gelişti. 1957'de Roma Antlaşması ile kurulan Avrupa Ekonomik Topluluğu, 30 Temmuz 1962'de yürürlüğe giren ilk topluluk politikası olarak OTP'ye sahip oldu. Altı kurucu devletin (Almanya, Fransa, İtalya ve üç Benelüks ülkesi) Avrupa'yı beslemek ve savaşın yıkımından sonra egemenliğini ve gıdada kendi kendine yeterliliğini sağlamak için araçlarını bir araya getirdi. Başlangıçta OTP, piyasa birliği, mali dayanışma ve Topluluğun tercihi ilkelerine saygı duyarak tarımı geliştirmek ve modernize etmek için fiyat kontrolü ve sübvansiyon önlemlerine dayanıyordu. Roma Antlaşması ile OTP'ye verilen yön, üretimi ve korumacı olmayı amaçlıyordu. Bu topluluğu aynı sınırlar içinde kendi kendine yetebilir hale getirirken, Devletlerin tarımsal üretimini artırmak gerekiyordu. Dayanışmaya ek olarak, üye devlete bağlı olarak hala oldukça zıt olan bir tarım sektörünün modernleştirilmesi söz konusuydu. Tarım, on yıllar boyunca, üye devletlerin farklı çıkarlara sahip olduğu önemli ve şiddetli tartışmaların hız kesmeden devam ettiği bir konu haline geldi. Bu araştırma, bu politikanın başlangıcından günümüze kadar geçirdiği çeşitli reformları inceleyecek ve değerlendirecektir. Ayrıca, Avrupa Birliği'nin çeşitli Üye Devletlerinde tarım ve kırsal alanları düzenlemek için benimsediği yasal ve mali araçların gelişimini tartışacaktır.

Anahtar kelimeler: Tarım, Avrupa Birliği, ortak tarım politikası, kırsal kalkınma, Fransa



**PHYTO-TEMPLATE ASSISTED FACILE SYNTHESIS OF COMOO₄
NANOCOMPOSITE AS ENVIRONMENTALLY BENIGN PHOTOCATALYST FOR
WATER REMEDIATION**

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ABSTRACT

Over recent times sustainable advances in metal oxide nanomaterials is critically investigated to develop an effective catalyst, for the treatment of organic pollutants in water bodies at ambient conditions. In this regard here, we reported the synergistic method to create nanostructures CoMoO₄ catalytic material using phyto foliar fuel of *A.pindrow* applying a hydrothermal route. The bio-organic fueled CoMoO₄ catalyst was investigated for the removal of Methyl Orange (MO) from water both in light and dark environments at room temperature and atmospheric pressure (RTP) and it disclosed excellent performance under both conditions. Effectiveness catalytic performance shown by functionalized nanocatalyst was 99 % and 85 % in the solar light and in ambient room conditions (without light) respectively, within 15 minutes. Furthermore, the degradation efficiency of 81 % and 84 % were still retained under dark ambient conditions at 10 and 15 minutes respectively. The prepared catalyst demonstrated the pseudo-first-order kinetic in light ($R^2=0.95$) and in dark experimentation ($R^2=0.74$) indicating good stability. However, the excellent catalytic potential of organic framework-assisted CoMoO₄ was attributed to nanostructure along with incorporated carbon and oxygen stabilizing groups of bioactive compounds. Thus, the overall study demonstrated the excellent CoMoO₄ photocatalyst for dye degradation in water bodies on a practical scale.

Keywords: Organic template; metal oxides; nano-structures; organic contaminants; photo-degradation



AGRICULTURE PÉRIURBAINE DANS LE CONTEXTE DU DEVELOPPEMENT DURABLE DANS L'ARRONDISSEMENT DE LOKOSSA (BENIN)

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RÉSUMÉ

L'agriculture périurbaine constitue un atout à la faveur des interrogations sur l'avenir et la durabilité de l'arrondissement de Lokossa. La question qui se pose maintenant est de savoir comment gérer les espaces agricoles périurbains par rapport à l'extension de l'arrondissement. Cette présente recherche vise à étudier l'agriculture périurbaine dans l'arrondissement de Lokossa. L'approche méthodologique adoptée se résume à la collecte des données, le traitement des données et l'analyse des résultats. Les principales techniques de collecte utilisées sont la recherche documentaire et les enquêtes de terrain menées auprès de paysans. Les résultats ont été analysés à l'aide du modèle FFOM (Forces, Faiblesses, Opportunités, Menaces). Les résultats obtenus montrent que l'agriculture périurbaine présente les caractéristiques d'une agriculture traditionnelle. Elle est produite sur de petites surfaces, dans les bas-fonds qui comprises (355m² et 850m²). Le mode d'accès à la terre par achat occupe 40%, l'héritage occupe 36 %, l'emprunt occupe 17 % et le don 7 %. Les terres n'offrent aucune garantie d'investissement durable pour les paysans parce qu'ils ne détiennent aucun titre de propriété sécurisée. Il est donc important de faire reconnaître l'importance de l'agriculture périurbaine pour la localité, promouvoir sa place dans un développement urbain intégré. Ainsi, de nombreuses actions doivent être entreprises, de commun accord avec le réseau des agriculteurs, dans le but de développer, choisir et maintenir l'agriculture périurbaine à travers de pratiques agricoles durables.

Mots clés: Lokossa, agriculture périurbaine, sécurité alimentaire, développement durable



MODELLING THE PREDICTION OF NIGERIAN INSURANCES DATA

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ABSTRACTS

The occurrences of risk are always very devastating. Recently, with the aftermath of COVID-19 there are global occurrences of so many risks involving monetary or economic, non-monetary, assets and so on. Insurance which is a way of managing risk has become imperative. This study employed the autoregressive integrated moving average (ARIMA) method to modelled the available Nigerian insurance data from 1981 to 2021. The ARIMA (0,2,3) Model was chosen as the best fitted model since it has the least Akaike information criteria (AIC), Hannan-Quinn criteria (HQC) and Schwarz criterion(SC). It was estimated and tested statistically. ARCH test for residual, Jarque-Bera test for non-normality and portmanteau test was found sufficient and best model fitting for forecasting. The model forecast ten(10) years observation from 2022 to 2031.

Keywords: Insurance, ARIMA, forecasting, risk, Akaike, Hannan-Quinn, Schwarz



LOW-DIMENSIONAL SYSTEMS: PROMISING CANDIDATES FOR ENERGY CONVERSION, LIGHTING, AND OPTOELECTRONICS APPLICATIONS

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ABSTRACT

Due to their unique electronic and optical properties, low-dimensional systems, such as quantum wells and quantum dots, have become promising candidates for energy conversion, lighting, and optoelectronics applications. These systems are characterized by their ability to confine electrons and holes in a two-dimensional plane or a zero-dimensional point, respectively, leading to quantized energy levels and enhanced electron-hole interactions. In energy conversion, low-dimensional systems are used to improve the efficiency of photovoltaic cells by enhancing the absorption of light and the separation of photo-generated charge carriers. Quantum dots, on the other hand, can be incorporated into the active layer of solar cells to improve charge carrier transport and reduce recombination losses. In lighting, low-dimensional systems have been employed to develop highly efficient light-emitting diodes (LEDs) and laser diodes. Quantum wells are commonly used as the active region in LED structures, where the recombination of electrons and holes generates light. The size and composition of the quantum wells can be tuned to produce different colors of light, enabling the development of full-color displays. Quantum dots have also been used to improve the color gamut and efficiency of LEDs, as they can emit light at narrow spectral bandwidths. In optoelectronics, low-dimensional systems are used to develop high-speed and high-performance photodetectors, modulators, and switches. Quantum wells can be used as the active region in photodetectors, where incident light is converted into an electrical signal. Quantum dots, on the other hand, can be used as the active region in modulators and switches, where an external electric field can control the absorption and emission of light. Overall, low-dimensional systems have shown great potential in a variety of energy conversion, lighting, and optoelectronics applications. Ongoing research in the field aims to develop new materials and device architectures to further enhance their performance and enable new applications.



GÖLOVA BARAJ GÖLÜ (SİVAS)'NDEKİ SİRAZ BALIĞI (*Capoeta sieboldii* STEINDACHNER, 1864)'NİN YAŞ VE BAZI BÜYÜME ÖZELLİKLERİ

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ÖZET

Bu çalışmada, Temmuz 2020- Haziran 2021 tarihleri arasında Gölova Baraj Gölü'nden avlanan 200 adet (105 dişi, 95 erkek) siraz balığı (*Capoeta sieboldii* Steindachner, 1864)'nın yaş ve eşey kompozisyonu, boy ve ağırlık dağılımları, yaş-boy, yaş-ağırlık, boy-ağırlık ve boy-boy ilişkileri ile kondisyon faktörü incelenmiştir. Örneklerin %52,5'i dişi, %47,5'i erkek bireylerden oluşmaktadır. Dişi ve erkek bireylerin I-VIII yaş grupları arasında dağılım gösterdiği ve erkek/dişi oranının 1:0,91 olduğu belirlenmiştir. Örneklerin total boy ve ağırlık değerlerinin dişilerde 22,04-51,7 cm ve 96,0-1697,3 g; erkeklerde 21,9-49,9 cm ve 94,7-1387,3; tüm bireylerde 21,9-51,7 cm ve 94,7-1697,3 g arasında olduğu tespit edilmiştir. Aynı yaş grubundaki dişi ve erkek bireylerin istatistiksel olarak total boy ortalamaları arasındaki farklılığın VI ve VII. yaşlarda; ağırlık ortalamaları arasındaki farklılığın ise III, VI, VII ve VIII. yaşlarda önemli olduğu saptanmıştır ($p<0,05$). Örneklerin von Bertalanffy eşitliğine göre boyca ve ağırlıkça büyüme denklemleri dişilerde $L_t=75,42[1-e^{-0,10(t+2,93)}]$ ve $W_t=5705,89[1-e^{-0,10(t+2,93)}]^{3,3689}$; erkeklerde $L_t=82,05[1-e^{-0,08(t+3,35)}]$ ve $W_t=8059,06[1-e^{-0,08(t+3,35)}]^{3,4003}$; tüm bireylerde $L_t=81,74[1-e^{-0,08(t+3,24)}]$ ve $W_t=7758,71[1-e^{-0,08(t+3,24)}]^{3,3771}$ olarak hesaplanmıştır. Büyüme performans indeksi (\emptyset) değerleri de dişilerde 2,757, erkeklerde 2,727 ve tüm bireylerde 2,746 olarak belirlendi. Boy-ağırlık ilişkisi dişilerde $W=0,0027TL^{3,3689}$ ($R^2=0,9928$), erkeklerde $W=0,0025TL^{3,4003}$ ($R^2=0,9901$) ve tüm bireylerde $W=0,0027TL^{3,3771}$ ($R^2=0,9916$) olarak tespit edilmiştir. Ortalama kondisyon faktörü değerlerinin tüm bireylerde 0,887-1,201 arasında değişim gösterdiği saptanmıştır. Eşey farkına bağlı olarak farklı boy tipleri arasında da kuvvetli bir ilişkinin olduğu gözlemlenmiştir.

Anahtar kelimeler: *Capoeta sieboldii*, yaş ve eşey kompozisyonu, büyüme, kondisyon faktörü, gölova baraj gölü



AGE AND SOME GROWTH CHARACTERISTICS OF COLCHIC KHRAMULYA (*Capoeta sieboldii* STEINDACHNER, 1864) IN GÖLOVA DAM LAKE (SİVAS- TURKEY)

ABSTRACT

In this study, age and sex composition, length and weight distributions, age-length, age-weight, length-weight and length-length relationships, condition factor of 200 (105 female, 95 male) colchic khramulya (*Capoeta sieboldii* Steindachner, 1864) caught from Gölova Dam Lake between July 2020 and June 2021 were examined. 52.5% of the samples were female and 47.5% were male individuals. It was determined that female and male individuals were distributed between I-VIII age groups and male/female ratio was 1:0.91. The total length and weight values of the samples were 22.04-51.7 cm and 96.0-1697.3 g in females; 21.9-49.9 cm and 94.7-1387.3 g in males; It was determined that it was between 21.9-51.7 cm and 94.7-1697.3 g in all samples. Statistically the difference between total length averages of male and female individuals in the same age group was at the ages VI., and VII.; the difference between weight averages was at the found significant ($p < 0.05$) in ages III., VI., VII., and VIII. According to the relation von Bertalanff the length and weight growth equations of the samples were calculated as $L_t = 75.42[1 - e^{-0.10(t+2.93)}]$ and $W_t = 5705.89[1 - e^{-0.10(t+2.93)}]^{3.3689}$ in females; $L_t = 82.05[1 - e^{-0.08(t+3.35)}]$ and $W_t = 8059.06[1 - e^{-0.08(t+3.35)}]^{3.4003}$ in males; $L_t = 81.74[1 - e^{-0.08(t+3.24)}]$ and $W_t = 7758.71[1 - e^{-0.08(t+3.24)}]^{3.3771}$ in all individuals. The growth performance index (ϕ') values were also determined as 2.757 in females, 2.727 in males and 2.746 in all individuals. The length-weight relationship were detected $W = 0.0027TL^{3.3689}$ ($R^2 = 0.9928$) in females, $W = 0.0025TL^{3.4003}$ ($R^2 = 0.9901$) in males and $W = 0.0027TL^{3.3771}$ ($R^2 = 0.9916$) in all individuals. It was determined that the mean condition factor values ranged from 0.887-1.201 in all individuals. It has been observed that there is also a strong relationship between different lengths types depending on the sex difference.

Keywords: Age and sex composition, *capoeta sieboldii*, condition factor, gölova dam lake, growth



FOOD SECURITY SYSTEM IN INDIA: A COMPARATIVE ANALYSIS

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ABSTRACT

A food system is a composition of varieties of activities which begins from the process of planting a seedling nurturing it, preparing it manufacturing from it, finally an eatable form farm to the plate then again to the garbage can or compost pile. Food can be consider as a projectile which drives the growth of a nation. Particularly agriculture. Farming related business activities in a sustainable manner will help the individual or group of individuals and finally in turn the nation as whole. India's agriculture is directly depended on the climate of the geographical area it possess. Indian agriculture till the date depend directly or indirect on the help of monsoon. Hence the ultimate change will have a great impact on India as far as convinced there is a rise in temperature all over the world. This is reduced the rain fall and another impact of climate change is like cyclones hitting. The unexpected coast lines of India and thus causing Agricultural losses. The rising in temperature will change the perception trended and thus in turn Affect the water availability this is also out cited frequency of enhance weather conditions. But Indians case is unique one got self sufficient in its food production soon at her its independence. There are a lot of reason for it. The green revolution is the Germ that made Indian bright in the case of food production it actually tripled the Indian production of food grains soon after is implementation in 1960's it helped to reduce the food insecurity by a percentage of 50, similarly poverty too.

Keywords: Agriculture, food security, green revolution, India



HİBRİT VE STANDART ÇEREZLİK AYÇİÇEĞİ GENOTİPLERİNİN ORTA KARADENİZ GEÇİT BÖLGESİ PERFORMANSLARININ BELİRLENMESİ

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ÖZET

Araştırma, hibrit ve standart çerezlik ayçiçeği genotiplerinin Tokat-Kazova şartlarındaki performanslarının belirlenebilmesi amacıyla yapılmıştır. Çalışmada, Çiğdem 1, Ahmetbey, Metinbey, Somon Beyazı, Baklan, Karakeçili, İnegöl alası, S 300, S 400, 361 S, 361 G, 363, PST 361, ŞYT 361, AYB 361, AMZ 361 ve AMZ 363 genotipleri kullanılmıştır. Deneme tesadüf blokları deneme desenine göre üç tekerrürlü olarak 2021 yılında yürütülmüştür. Çalışmada yaprak sayısı, bitki boyu, sap çapı, tohum eni, tohum boyu, boş tane oranı, kabuk oranı, tabla çapı, tabladaki tane sayısı, bin tane ağırlığı, hektolitre ağırlığı, tane sınıfı (8 mm elek), tane verimi ve yağ oranı özellikleri incelenmiştir. İncelenen özelliklerden sap çapı hariç çeşitler arasındaki farklılık istatistiki olarak önemli ($p<0.05$ ve $p<0.01$) bulunmuştur. Bitki boyu ortalaması 177.31 cm bulunmuş ve en uzun boy 191.70 cm ile Karakeçili çeşidinde tespit edilmiştir. En büyük tohum eni 11.69 mm ve en büyük tohum boyu 30.00 mm ile İnegöl alası genotipinde belirlenmiştir. Hibrit çeşitlerin tane eni ortalamaları standartlara göre daha geniş iken boyları daha kısa kalmıştır. Boş tane oranı en düşük çeşit ise S 300 olarak tespit edilmiştir. Tabla çapı 18.88-24.25 cm arasında değişmiş ve en büyük tablalar ŞYT 361 çeşidinde belirlenmiştir. Hibritlerin tabladaki tane sayıları (1136.96 adet) standartlara göre (1356.68 adet) daha düşük olmuştur. Hibritlerin bin tane ağırlıkları 189.34 g, hektolitre ağırlıkları 262.45 g, standartların bin tane ağırlığı 160.36 g ve hektolitre ağırlıkları 258.31 g olarak belirlenmiştir. Bin tane ve hektolitre ağırlıkları standartlara göre yüksek olan hibritlerin dekara verim ortalaması 542.17 kg/da olarak belirlenmiş ve standartların verim ortalamasından %8.00 daha yüksek olmuştur. Bölgede en iyi performansı 361 S çeşidi göstermiş ve 669.08 kg/da verim alınmıştır.

Anahtar kelimeler: Adaptasyon, bin tohum ağırlığı, tane verimi, yağ oranı



DETERMINING THE PERFORMANCE OF SOME HYBRID AND STANDARD CONFECTIONERY SUNFLOWER GENOTYPES IN MIDDLE BLACK SEA TRANSITIONAL ZONE

ABSTRACT

The research was carried out to determine the performance of hybrid and standard confectionary sunflower genotypes under Tokat-Kazova conditions. Çiğdem 1, Ahmetbey, Metinbey, Salmon Beyazı, , Baklan, Karakeçili, İnegöl alasi, S 300, S 400, 361 S, 361 G, 363, PST 361, ŞYT 361, AYB 361, AMZ 361 and AMZ 363 genotypes were used in this study. The experiment was carried out according to the randomized blocks design with three replications in 2021. Number of leaves, plant height, stem diameter, grain width, grain length, empty grain rate, shell rate, tray diameter, number of grains per tray, thousand grain weight, hectoliter weight, grain class (8 mm sieve), grain yield and oil rate properties were examined. All of the cultivars were significantly as statistically ($p<0.05$ and $p<0.01$) except for the stem diameter. The average plant height was found to be 177.31 cm and the tallest was 191.70 cm in Karakeçili cultivar. The largest seed width was 11.69 mm and the largest seed length was 30.00 mm in Inegol alasi genotype. While the average grain width of hybrid cultivars was wider than the standards, their lengths remained shorter. The variety with the lowest empty grain rate was determined as S 300. The diameter of the trays varied between 18.88-24.25 cm and the largest trays were determined in ŞYT 361 cultivar. The number of grains per tray of the hybrids (1136.96 piece) were lower than the standards (1356.68 piece). The thousand-grain weight of the hybrids was determined as 189.34 g, the hectoliter weight was 262.45 g, the thousand-grain weight of the standards was 160.36 g and the hectoliter weight was 258.31 g. The average yield per decare of hybrids with a thousand grain and hectoliter weights compared to the standards was determined as 542.17 kg/da and was 8.00% higher than the average yield of the standards. The 361 S variety showed the best performance in the region and 669.08 kg/da yield was obtained.

Keywords: Adaptation, thousand grain weight, grain yield, oil rate



AUXILLARY DIVERSITY UNDER GREENHOUSES IN THE ZIBAN REGION

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ABSTRACT

During a study carried out on tomato cultivation under greenhouse in the region of Sidi Okba (Algeria) in 2020-2021, that have for objective to highlight the key pest auxiliaries of tomato cultivation under greenhouse in the region. The results of trapping using the yellow traps show a total wealth of 90 species belonging to 12 families and 7 orders, the most represented order was that of Hymenoptera (17) species followed by Diptera order with 11 species, in terms of their ecological niches, pest species represent the highest rate with 42% followed by predators 23% as well as pollinators (23%) and parasitoids species represented 12%. This latest that represented an important Biological programm applied nature under green houses in the region.

Keywords: tomato, pest control, biological auxiliry, biskra, inventory.



BIOMATERIALS APPLICATIONS FOR COMPLETE REMOVAL OF NITRITE FROM WATER

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ABSTRACT

In rural India the contamination of water by nitrite is profound. Cost-effective and safe water treatment methods are required to remove nitrite from water. A nitrite is regulated in drinking water quality primarily because excess amount can cause methemoglobinemia (also known as blue baby syndrome) disease. The fresh water contains 3% in the worldwide. Human and industrial activities produce and discharge wastes containing nitrite metal into the water resources making them polluted and threatening human health and ecosystem. Conventional methods for the removal of nitrite metal ions such as chemical precipitation and membrane filtration are more expensive when treating large amounts of water, inefficient at low concentrations of metal and generate large quantities of sludge and other toxic products that require careful disposal. Bio-sorption is eco-friendly and alternative methods for treatment of wastewater. These methods have advantages over conventional methods because it has a lower cost, easily available and reused. The present work studies the feasibility use of neem leaf, custard apple leaf, guava leaf, mango tree leaf, orange peel and banana peel as a biosorbent in removal of nitrite from contaminated water. The removal efficiency is 100% obtained from this work. The effects of different parameters like contact time, agitation speed, adsorbent dosage, pH and temperature are also studied. Also, the biomass can be modified by physical and chemical treatment before use. The process can be made economical by regenerating and reusing the bio-sorbent after removing the heavy metal.

Keywords: Nitrite, water, biosorbents, regenerating, removal efficiency and heavy metals



SOLUNUM SİSTEMİ ENFEKSİYONU KLİNİK BULGULARI GÖSTEREN SIĞIRLARDA BOVİNE PARAINFLUENZAVİRUS 3'ÜN DİREKT IMMUNFLORESAN TESTİ KULLANILARAK ARAŞTIRILMASI

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ÖZET

Sığırların solunum sistemi enfeksiyonları dünyada yaygın olarak görülen ve özellikle büyük çaplı sürülerde üreticilerin ekonomik kayıplar yaşamasına yol açan nedenlerdendir. Bu kapsamda Bovine Parainfluenzavirus-3 (BPIV3) sığırlarda solunum sistemi hastalıkları kompleksinin ortaya çıkmasına neden olan önemli viral etkenler birisidir. Stres, immunsupresyon, çevresel faktörler ve bilinçsiz sürü yönetimi gibi etmenlerin bir arada bulunması hayvanların enfeksiyona karşı predizpoze hale gelmesine yol açar. BPIV3 sığırlarda çoğunlukla subklinik bir enfeksiyona neden olsa da affinite gösterdiği bölgedeki lokal immunizasyonu baskılaması sonucu diğer bakteriyel ve viral etkenlerin solunum sistemi dokularına daha kolay yerleşmesine ve akut enfeksiyonların meydana gelmesine sebep olur. Bu çalışmada solunum sistemi klinik semptomları gösteren sığırlarda direkt immunfloresan tekniği (DIF) kullanılarak BPIV3'ün antijenik tespiti hedeflendi. Bu amaçla altı farklı işletmeden sürünün %10'unu olacak şekilde etkene karşı aşılammış farklı yaş, ırk ve cinsiyetteki kırk sığırdan nazal swap örneği toplandı. Toplanan örneklerden preparatlar hazırlandı ve floresein bir madde ile işaretlenmiş konjugat ile kaplanarak floresan mikroskopta değerlendirildi. Yapılan incelemede yedi (7/40) preparatta BPIV3 antijenine özgü tutunmalar ve sarı-yeşil renkli parlamalar tespit edildi. Bununla birlikte örneklemelerin yapıldığı sürülerin bakım ve besleme koşulları ile ilgili istatistiksel değerlendirmelerde bulunuldu. Bu değerlendirmelere göre sürü sağlığını korumak amacıyla sürüye yeni katılan hayvanlara karantina uygulamaları ve işletmelerin hayvan refahına uygunluğu (asgari zootekni şartlarını sağlaması, yeterli bakım ve besleme, barınak büyüklüğüne uygun hayvan sayısı, immunsupresyona neden olan faktörlerin iyileştirilmesi vb.) ile BPIV3 tespiti arasındaki ilişkinin istatistiksel olarak önemli olduğu sonucuna ulaşıldı. Diğer yandan hayvanların besleme amaçları ve besi şekilleri ile etken tespiti arasında istatistiksel açıdan önem arz eden bir ilişkinin olmadığı tespit edildi. Sonuç olarak örneklemenin yapıldığı bölgedeki sığırların solunum sistemi enfeksiyonlarının etiyolojisinde BPIV3'ün yer aldığı ortaya koyuldu. Bununla birlikte etkenin DIF yöntemiyle antijenik tespitinde enfeksiyonun akut döneminde toplanan nazal swap örneklerinden hazırlanan preparatların uygun olduğu kanısına varıldı. Özellikle büyük çaplı sürülerin koruma ve kontrol mekanizmalarının önemli bir basamağı olan etken tespitinde virus izolasyonu ve moleküler teknikler gibi maliyetli ve zaman alan teşhis metotları yerine daha kısa sürede sonuç veren DIF metodunun uygulanabileceği değerlendirildi. Ayrıca hayvan sirkülasyonunun sürekli olduğu işletmelerde sürüye katılacak yeni hayvanlara karantina uygulamalarının yapılmasının ve hayvan refahına uygun ve zooteknik şartları sağlamış hayvan barınaklarının kurulmasının yararlı olacağı kanaatine varıldı.

Anahtar Kelimeler: Sığır, bovine parainfluenzavirus-3, direkt immunfloresan testi



INVESTIGATION OF BOVINE PARAINFLUENZAVIRUS 3 IN CATTLE WITH CLINICAL SIGNS OF RESPIRATORY SYSTEM INFECTION USING DIRECT IMMUNOFLUORESCENCE TEST

ABSTRACT

Respiratory system infections of cattle are common in the world and cause economic losses for producers especially in large herds. The combination of factors such as stress, immunosuppression, environmental factors and unconscious herd management causes animals to become predisposed to infection. Although BPIV3 mostly causes a subclinical infection in cattle, it suppresses the local immunization in the area where it has affinity, causing other bacterial and viral agents to more easily settle in the respiratory system tissues and cause acute infections. In this study, the antigenic detection of BPIV3 was aimed using the direct immunofluorescence technique (DIF) in cattle with respiratory system clinical symptoms. For this purpose, nasal swap samples were collected from forty cattle of different ages, races and genders, which were not vaccinated against the agent, 10% of the herd from six different farms. Slides were prepared from the collected samples and evaluated under a fluorescent microscope, coated with a conjugate labeled with a fluorescein substance. In the examination, BPIV3 antigen-specific attachments and yellow-green flashes were detected in seven (7/40) preparations. In addition, statistical evaluations were made about the care and feeding conditions of the herds from which the samples were taken. According to these evaluations, it was concluded that the relationships between the relationship between quarantine practices for newly joined animals in the herd and compliance with animal welfare (minimum zootechnical conditions, adequate care and feeding, number of animals suitable for the size of the barn, improvement of factors causing immunosuppression, etc.) and BPIV3 detection were statistically significant. On the other hand, it was determined that there was no statistically significant relationship between the feeding purposes of the animals and the fattening methods and the detection of the agents. As a result, it was revealed that BPIV3 is involved in the etiology of respiratory system infections in cattle in the sampling region. In additionally, it was concluded that the slides prepared from nasal swab samples collected in the acute phase of the infection were suitable for the antigenic detection of the agent by DIF method. It was evaluated that instead of costly and time-consuming diagnostic methods such as virus isolation and molecular techniques, the DIF method, which gives results in a shorter time, can be applied. protection and control mechanisms of large-scale herds. In addition, it was concluded that it would be beneficial to implement quarantine practices for new animals that will join the herd in enterprises where animal circulation is continuous and to establish animal shelters that are suitable for animal welfare and that provide zootechnical conditions.

Keywords: Cattle, bovine parainfluenzavirus-3, direct immunofluorescence test



**FIRST RECORD OF *Agrotis bigramma* (ESPER, 1790) (LEPIDOPTERA:
NOCTUIDAE), FROM REPUBLIC OF KOSOVO**

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ABSTRACT

This paper provides the first information on the record of *Agrotis bigramma* (Esper, 1790), as a new species for the moth register of Republic of Kosovo. Nine specimens of this species, known also as Great Dart, were captured with light traps in open sunny grasslands and in an arable land in September 2021 and 2022, during the moth survey in the mountain Koritniku. *Agrotis bigramma* is univoltine and has a flight period from September to November. With this new record, the Noctuidae country list has reached 323 species.

Key words: Noctuidae, distribution, mountain, faunistic, checklist



STRUCTURE-BASED DRUG REPURPOSING TO INHIBIT THE DNA GYRASE OF *Mycobacterium tuberculosis*

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ABSTRACT

Short Introduction: Drug repurposing is an alternative avenue for identifying new drugs to treat tuberculosis (TB). Although TB can be cured with anti-tubercular drugs, the emergence of multidrug-resistant and extensively drug-resistant strains of *Mycobacterium tuberculosis* H37Rv (Mtb), as well as the significant death toll globally, necessitate the development of effective drugs to treat TB.

Experiments and Key result findings: In this study, drug repurposing approach was employed to address this drug resistance problem by screening drugbank database to identify novel inhibitors of the Mtb target enzyme, DNA gyrase. The compounds were screened against the ATPase domain of gyrase B subunit (MtbGyrB47), and the docking results showed Echinacoside, Doxorubicin, Epirubicin, and Idarubicin possess high binding affinities against MtbGyrB47. Comprehensive assessment using fluorescence spectroscopy, SPR, and CD titration studies revealed that Echinacoside as a potent binder against MtbGyrB47. Further, ATPase, and DNA supercoiling assays exhibited IC₅₀ values of 2.1-4.7 µM for Echinacoside, Doxorubicin, Epirubicin, and Idarubicin. Among these compounds, the least MIC₉₀ of 6.3 µM and 12 µM were observed for Epirubicin and Echinacoside, respectively. Hence, our findings indicate that Echinacoside and Epirubicin target mycobacterial DNA gyrase, inhibit its catalytic cycle, and retard mycobacterium growth. Further these compounds exhibits potential scaffolds for optimizing novel anti-mycobacterial agents that can act on drug-resistant strains.



PRODUCTION AND PARTIAL PURIFICATION OF PROTEASE FROM *BACILLUS SUBTILIS* FOR DEHAIRING OF ANIMAL SKIN

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ABSTRACT

This study was conducted to evaluate the efficacy of dehairing of animal skin by protease from *Bacillus subtilis*. The screening and isolation of bacteria was carried out on soil samples collected from chicken littered soil within Kure Market Minna. The isolates were positive on skim milk agar after screening and were selected as protease producing strain. Various biochemical tests and a confirmatory molecular test were carried out on the organisms and identified as *Bacillus subtilis*. Crude protease was produced from the identified *Bacillus subtilis* KM5B through submerged fermentation in a basal medium and incubated at 25° to 45°C for 72 hours at pH ranging from 6.0 to 10.0. The crude protease was optimized for temperature, pH, incubation time, carbon and nitrogenous sources with optimum production at 35°C, pH 8 for 72 hours in glucose and peptone respectively with an enzyme activity of 123.2U/ml. The harvested protease was partially purified by Ammonium sulphate precipitation method followed by centrifugation and later applied on some selected animal skin for ease of depilation. This study showed that *Bacillus subtilis* is a good producer of protease which is effective for dehairing and a potential technology for application by local tanneries in Nigeria to improve leather quality without environmental pollution.

Keywords: Protease, *Bacillus subtilis*, purification, dehairing, pollution



KURUTULMUŞ MANTAR (*Agaricus bisporus*) TOZUNUN ETLİK PİLİÇLERİN BESLENMESİNDE KULLANILMASI

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ÖZET

Etlik piliç yetiştiriciliğinde kullanılan sentetik yem katkı maddelerine ve bu maddeler kullanılarak üretilen ürüne karşı tüketicilerin takındığı tavır sektörde alternatif katkı maddesi arayışlarına neden olmuştur. Son yıllarda gerek dünya da gerek ülkemizde üretimi artan kültür mantarı yetiştiriciliği etlik piliç sektörü açısından alternatif yem katkı maddesi olarak kullanılabilir bir potansiyel barındırmaktadır. Kültür mantarı hasadından sonra ticari olarak pazarlanabilir olmayan mantarlar atık olarak değerlendirilmektedir. Kültür mantarlarının protein, karbonhidrat, doymamış yağ asitleri, lif, mineral maddeler ve vitaminler bakımından zengin olması etlik piliçler için değerli bir yem materyali olarak kullanılabilirliği değerlendirilmektedir. Kültür mantarlarının besin özellikleri yanı sıra önemli farmakolojik etkileri sebebiyle de inovatif bir yem katkı maddesi potansiyeli taşıdığı söylenebilir. Bu derlemede, kurutulmuş mantar tozunun etlik piliçlerin beslenmesinde kullanımı, performans ve karkas özellikleri üzerindeki etkileri değerlendirilmiştir.

Anahtar kelimeler: Etlik piliç, mantar, performans



THE USE OF DRIED MUSHROOM (*Agaricus bisporus*) POWDER IN THE NUTRITION OF BROILER CHICKENS

ABSTRACT

The attitude of consumers towards the synthetic feed additives used in broiler breeding and the product produced using these substances has caused the search for alternative additives in the sector. Cultivated mushroom cultivation, the production of which has increased both in the world and in our country in recent years, has a potential to be used as an alternative feed additive in terms of the broiler sector. After the culture mushroom harvest, mushrooms that are not commercially marketable are evaluated as waste. Mushroom protein, carbohydrates, unsaturated fatty acids, fiber, minerals and vitamins that can be used as a feed for broiler chicks being rich in valuable material is considered. It can be said that cultured mushrooms have the potential of an innovative feed additive due to their nutritional properties as well as their important pharmacological effects.

Keywords: Broilers, mushroom, performance



ANALYZING THE IMPACT OF COMPLETE NEWLY PRODUCED WHEAT- BASED FEED ON GUT HEALTH OF COMMERCIAL BROILER BIRDS

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ABSTRACT

Digestibility of nutrients depends entirely on the nature of nutrients and response of the gastrointestinal tract. While the digestibility of the starch, crude protein, and non-soluble polysaccharide (NSP) contents in maize-based diet is lower as compared to wheat-based dietary supplementation for commercial broiler. Therefore, an experimental study was designed to elucidate the effect of 100% dietary newly produced wheat feed replaced with corn and soybean meal for commercial broiler birds at the Poultry Research Centre, University of Agriculture



Faisalabad. The broiler breed “Ross 308” was used for experimental trial. G1 was control group that was fed on corn and soybean meal-based commercially available broiler feed while G2 was experimental group which was fed on experimental feed containing 100% newly produced wheat-based feed. Experimental birds were slaughtered on 21st (starter) and 35th (finisher) days. Blood serum samples were collected for biochemical analysis while tissue samples of liver, pancreas, thymus, kidney, and ileum were collected for histology in 10% neutral buffered formalin solution. Microbiota was isolated from the caecum for microbiota quantification. The present study revealed that new wheat significantly increased ($p<0.001$) the average body weight gain and feed conversion ratio remains non-significant in broiler birds. There was non-significant affect in the level of alkaline phosphatase, alkaline transaminase while it significantly decreases ($p<0.001$) the level of aspartate transaminase, and significantly decrease ($p<0.001$) in total oxidative stress and non-significant on the total antioxidative capacity. There was also increase the expression of *Bifido* ($p<0.001$), *lactobacillus* ($p<0.001$), V_2 ($p<0.001$) and significantly increase ($p<0.001$) in the expression of pathogenic bacteria *E.Coli* in cecum. Overall study concluded that completely new wheat improves the gut physiological parameter

Keywords: Microbiota, gene expression, ileum



BAŞYAYLA (KARAMAN) YÖRESİNDE DOĞAL OLARAK YETİŞEN KUŞBURNU GENOTİPLERİNİN SELEKSİYONU VE ÇELİKLE ÇOĞALTMA ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Bu araştırma, Karaman ilinin Başyayla yöresinde doğal olarak yetişen kuşburnu populasyonundan üstün özelliklere sahip genotiplerin belirlenmesi amacıyla 2018 ve 2021 yıllarında yürütülmüştür. Araştırma öncesinde Başyayla (Karaman) yöresinde kuşburnu populasyonunun yoğun olduğu bölgeler hakkında inceleme yapılmış ve bu incelemeler doğrultusunda çalışmaya yön verilmiştir. Genotipleri arazide belirleme çalışması sırasında, bitkilerin hastalık ve zararlılardan arı, bölgede bol ürün veren, iri, meyve et oranının yüksek olması esas alınmıştır. Seçilen bitkilerin buldukları yerlerin koordinat ve rakımları el GPS aleti ile tespit edilerek çalışmaların düzenli ve sağlıklı yürütülmesi sağlanmıştır. Yapılan bu çalışmada seleksiyon yoluyla elde edilen 15 farklı kuşburnu genotipinden meyve örnekleri ve yarı odun çelikler alınmıştır. Farklı yıllarda ve aylarda alınmış olan kuşburnu çelikleri, 2000 ppm 'Indol-3-butyric acid' (IBA) ile muamele edilerek, sisleme sistemindeki perlit köklendirme ortamında köklenme durumları incelenmiştir. Araştırma sonucu köklenme oranı genotiplere göre değişiklik göstermiştir. Ayrıca kuşburnu meyvelerinin meyve boyu, meyve çapı, meyve yaş ağırlığı, meyve kuru ağırlığı, tohum ağırlığı, tohum sayısı gibi pomolojik özellikleride incelemeye alınmıştır. Seçilen genotiplerde 2018 yılında SA-5 genotipi meyve boyu (23,75 mm), meyve yaş ağırlığı (2,42 g), meyve kuru ağırlığı (1,63 g) ve tohum ağırlığı (0,68 g) bakımından en iyi sonuçlara sahip olurken; 2021 yılında SA-16 genotipi en büyük meyve çapı (11,40 mm), meyve kuru ağırlığı (0,92 g) ve tohum ağırlığı (0,39 g); SA-5 genotipi en büyük meyve boyu (19,59 mm), meyve yaş ağırlığı (1,35 g) ve titre edilebilir asit oranı (% 7,0) bakımından en iyi sonuçlara sahip olmuşlardır. Ayrıca, çelik köklenmesi genotiplere ve yıllara göre %0-88 arasında belirlenmiştir. SA-5 genotipi diğer selekte edilmiş genotiplere kıyasla ümitvar ve çeşit adayı olabilecek potansiyele sahip olduğu değerlendirilmiştir.

Anahtar kelimeler: Kuşburnu, *rosa spp.*, seleksiyon, pomoloji, köklendirme



SELECTION AND DETERMINATION OF STEEL REPRODUCTION CHARACTERISTICS OF ROSEHIP GENOTYPES NATURALLY GROWING IN BAŞYAYLA (KARAMAN) REGION

ABSTRACT

This research was carried out in 2018 and 2021 to determine the genotypes with superior characteristics from the rosehip population naturally grown in Başyayla region of Karaman province. Before the research, an examination was made about the regions where the rosehip population is concentrated in the Başyayla (Karaman) region and in line with these investigations, the study was directed. During field determination of genotypes, it is based on the fact that the plants are free from diseases and pests, yield abundant products in the region, large, fruit-meat ratio is high. The coordinates and altitudes of the selected plants were determined with a handheld GPS device, and it was ensured that the works were carried out regularly and in a healthy way. In this study, fruit samples and semi-wood cuttings were taken from 15 different rosehip genotypes obtained by selection. Rosehip cuttings taken in different years and months, treated with 2000 ppm 'Indol-3-butyric acid' (IBA), rooting conditions were investigated in perlite rooting medium in the fogging system. As a result of the research, the rooting rate varied according to the genotypes. In addition, pomological characteristics of rosehip fruits such as fruit size, fruit diameter, fruit fresh weight, fruit dry weight, seed weight, seed number were also examined. Among the selected genotypes, SA-5 genotype had the best results in terms of fruit size (23.75 mm), fruit fresh weight (2.42 g), fruit dry weight (1.63 g) and seed weight (0.68 g) in 2018. while; in 2021, SA-16 genotype had the largest fruit diameter (11.40 mm), fruit dry weight (0.92 g) and seed weight (0.39 g); SA-5 genotype had the best results in terms of the largest fruit size (19.59 mm), fruit fresh weight (1.35 g) and titratable acidity (7.0%). In addition, rooting of cuttings is between %0-88 according to genotypes and years determined. The SA-5 genotype was evaluated as promising and has the potential to be a cultivar candidate compared to other selected genotypes.

Keywords: Rosehip, rosa spp., selection, pomology, rooting



**AMELIORATION OF CHEMOTHERAPEUTIC AGENT-INDUCED TOXICITY ON
VITAL ORGANS WITH BIODEGRADABLE POLY LACTIC-CO-GLYCOLIC
ACID-MODIFIED NANOPARTICLES**

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ABSTRACT

Cancer is the second most common disease all over the world. Mitoxantrone is one of the most important anticancer drugs, which is used nowadays. Most anticancer drugs have toxic effects on different organs in the body. Myelosuppression is one of the side effects of cancer treatment. For this purpose, poly lactide-co-glycolide (PLGA) nanoparticles were prepared and characterized by zeta size, and zeta potential. The PLGA nanoparticles were further modified by chitosan and stearic acid. The zeta size of plane PLGA nanoparticles was 91nm, chitosan-coated PLGA nanoparticles were 295.3nm and stearic acid-coated PLGA nanoparticles were 105.70nm. The zeta potential of plane PLGA nanoparticles was -4.4mv, chitosan-coated PLGA nanoparticles were 49.77mv, and stearic acid-coated PLGA nanoparticles were 9.85mv. A total of 30 rats were used in this study and randomly divided into 5 groups. The first group was kept



as normal control. The second group was given mitoxantrone. The third group was given mitoxantrone + PLGA nanoparticles. The fourth group was given mitoxantrone + PLGA nanoparticles modified with chitosan. The fifth group was given mitoxantrone + PLGA nanoparticles modified with oil. The drug was given through the intraperitoneal route (i.p) once a time on starting day of the trial. Samples of blood were collected at the 4th day and 8th day after killing all animals. A toxicity study was done through blood sampling. The body weight and weight of the thymus and spleen organs were determined and showed $P < 0.05$ in treatment groups. The mutagenicity of nano formulations showed that all nanoparticles were non-mutagenic. The toxicity was checked by doing hematology, liver function, kidney function test, and acetylcholine esterase. Oxidative stress parameters and inflammatory mediators were checked. The final Data was analyzed by one and two-way analysis of variance (ANOVA). So, from this study, we conclude that our nano formulations showed better results.



KIRSAL NÜFUSUN İKLİM DEĞİŞİKLİĞİNDEN ETKİLENME DURUMU

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ÖZET

Dünya tarihine baktığımız zaman farklı coğrafyalarda çeşitli iklimsel değişimler ile bu iklimsel değişimlere bağlı olarak doğal afetler ve ekosistem üzerinde bozulmalar meydana gelmiştir. Üç tarafı denizlerle çevrili bir yarımada olan Türkiye, birbirinden oldukça farklı ve çok çeşitli bir iklim yelpazesine sahiptir. Ülkemizin mevcut konumu ele alındığında, çeşitli iklim tiplerine sahip olması sebebiyle küresel ısınmaya bağlı olarak görülebilecek iklim değişikliğinden en çok etkilenebilecek ülkelerden arasındadır. İklim değişikliğinin en tehlikesi etkilerinden birisi de kuraklıktır. Bunun nedeninin, kuraklığın birdenbire ortaya çıkmayan ve yavaş gelişim göstererek etkilerini uzun yıllar devam ettiren bir doğal afet olmasıdır. Kuraklık etkisini ise en fazla tarım sektöründe göstermektedir. Bu amaçla, Çanakkale’de geçimini tarımdan sağlayan kırsal nüfusun iklim değişikliğinden etkilenme durumu ve düzeyleri araştırılmıştır. Tarım ve Orman İl Müdürlüğü çiftçi kayıt sisteminden bilgiler alınmış ve “Basit Tesadüfi Örnekleme Yöntemi” kullanılarak anket yapılacak çiftçi sayısı belirlenmiştir. Anket sonuçlarına göre çiftçilerin %98,7’si son 10 yılda meydana gelen iklim değişikliğinin farkında olduğu ve buna karşı bazı önlemler almaya çalıştığını belirtmiştir. Bu önlemler arasında anket yapılan 76 çiftçi arasından % 55,3’ü ürün deseninde değişikliğe yaptıklarını ve bunun sebebi olarak %64,3’ü eski yetiştirdikleri ürünlerin artık eskisi kadar karlı olmadığını belirtmişlerdir. Ankete katılanların %23,7’si sulu tarım alanını azaltmış ve %73,8’i değişiklik yapma sebeplerinin su sorunu yaşandığından kaynaklandığını belirtmişlerdir. Bu çalışma Çanakkale’de kırsal nüfusun iklim değişikliğinden nasıl etkilendiğini belirlemek amacıyla yürütülmüştür.

Anahtar kelimeler: İklim değişikliği, kuraklık, kırsal nüfus



HOW THE RURAL POPULATION IS AFFECTED BY CLIMATE CHANGE

ABSTRACT

In the past, various climatic changes in different geographies have occurred and natural disasters and ecosystem deterioration took place due to these climatic changes. Turkey, which is a peninsula surrounded by seas on three sides, has a very different and diverse climate range. Considering its current geographic position and the various climate types it contains, it is among the countries that may be most affected by climate change caused by global warming. One of the most dangerous effects of climate change is drought. This is because drought is a natural disaster that does not appear suddenly and continues its effects for many years by showing slow development. The effects of drought is most evident in the agricultural sector. For this purpose, it has been investigated how and to what level the rural population in Çanakkale, who make their living from agriculture, is affected from climate change. Information was obtained from the farmer registration system of the Provincial Directorate of Agriculture and Forestry and the number of farmers to be surveyed was determined by using the "Simple Random Sampling Method". According to the survey results, 98.7% of the farmers have stated that they were aware of climate change that has occurred in the last decade and were trying to take some measures against it. Among these measures, 55.3% of the 76 farmers surveyed stated that they made a change in the product pattern, and 64.3% of them stated that the products they used to grow are no longer as profitable as it was previously. 23.7% of the respondents reduced the irrigated agricultural land and 73.8% of them stated that the reason for the change was due to problems in water resources. This study was carried out to understand how the rural population in Çanakkale is effected from climate change.

Keywords: Climate change, drought, rural population



**FIRST RECORD OF *AGROTIS BIGRAMMA* (ESPER, 1790) (LEPIDOPTERA:
NOCTUIDAE), FROM REPUBLIC OF KOSOVO**

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ABSTRACT

This paper provides the first information on the record of *Agrotis bigramma* (Esper, 1790), as a new species for the moth register of Republic of Kosovo. Nine specimens of this species, known also as Great Dart, were captured with light traps in open sunny grasslands and in an arable land in September 2021 and 2022, during the moth survey in the mountain Koritniku. *Agrotis bigramma* is univoltine and has a flight period from September to November. With this new record, the Noctuidae country list has reached 323 species.

Keywords: Noctuidae, distribution, mountain, faunistic, checklist



KEÇİBOYNUZU (*Ceratonia siliqua* L.) YETİŞTİRİCİLİĞİ VE ISLAHINDA SON GELİŞMELER

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ÖZET

Keçiboynuzu (*Ceratonia siliqua* L.), Portekiz, Fas, İtalya İspanya ve Türkiye gibi Akdeniz sahil şeridinde sahip ülkelerin makilik denilen alanlarında yetişen ve her daim yeşil kalabilen bir baklagil bitkisidir. Türkiye’de keçiboynuzu ağacı varlığına Adana, Antalya, Mersin, Burdur, Muğla ve Osmaniye illerinde rastlanmaktadır. 2022 yılı itibari ile en büyük üretici iller ise Antalya (13 095 ton) ve Mersin (8 776 ton)’dir. Keçiboynuzu meyvesi, içeriğinde bulunan ve insan vücudunda antioksidan etki gösteren polifenoller açısından oldukça zengindir. Yüksek mineral ve diyet lif açısından da oldukça zengin olan bu tür Türkiye’de herhangi bir kimyasal ilaç uygulaması yapılmadan yetişmektedir. Gıda, Tarım ve Ormancılık Bakanlığı her sene atıl arazileri ekonomiye kazandırmayı amaçlayan projeler üreterek bazı türlerin üretim artışını sağlamaktadır. Bu sayede özellikle bazı illerde keçiboynuzu projeleri için harekete geçilmiş ve son yıllarda üretimde istenilen artış sağlanmıştır. Keçiboynuzu çeşitlerine dair agronomik özellikler ile ilgili yeterli çalışmaların olmaması bu konudaki en büyük eksiklik olarak görülmektedir. Şimdiye kadar Dünya’da dokuz adet keçiboynuzu koleksiyon bahçesi kurulmuş ve Türkiye’de ise 1974 yılında sadece 3 tip belirlenmiştir. 2003-2004 yılları arasında Batı Akdeniz ve Ege Bölgesinde değişik lokasyonlardan değerlendirmeye alınan toplam 54 tip arasından, incelenen kriterler yönünden üstün özellik gösteren 10 yabani ve 4 kültür tipi ümit var bulunmuştur. 2005 yılında Adana ve Mersin’de değişik keçiboynuzu lokasyonlarında yürütülen seleksiyon çalışmaları sonucunda, 8 yabani ve 5 adet kültür tipi ümitvar bulunmuştur. Son yıllarda sağlıklı beslenmenin önem kazanması ile değeri artan keçiboynuzu bitkisi Türkiye’de halen çöğür fidan olarak satılmakta ve piyasaya hitap edecek bir çeşit bulunmamaktadır. Bu çalışmada Türkiye ve Dünya’daki keçiboynuzu üretimi ve ıslahı hakkında bir değerlendirme yapılmış olup güncel durumu ve ileride yapılması gereken çalışmalar hakkında bilgi verilmiştir.

Anahtar kelimeler: Çöğür, ıslah, keçiboynuzu, seleksiyon, üretim



RECENT ADVANCES IN CAROB (*Ceratonia siliqua* L.) CULTIVATION AND BREEDING

ABSTRACT

Carob (*Ceratonia siliqua* L.) is an evergreen legume plant that grows in the so-called maquis areas of countries with Mediterranean coastline such as Portugal, Morocco, Italy, Spain and Turkey. Carob trees are found in Adana, Antalya, Mersin, Burdur, Muğla and Osmaniye provinces in Turkey. As of 2022, the largest producing provinces are Antalya (13 095 tons) and Mersin (8 776 tons). Carob fruit is rich in polyphenols, which have antioxidant effects in the human body. This species, which is very rich in terms of high minerals and dietary fiber, is grown in Turkey without any chemical pesticide application. The Ministry of Food, Agriculture and Forestry produces projects aiming to bring the idle lands to the economy every year, increasing the production of some species. In this way, action has been taken for carob projects, especially in some provinces, and the desired increase in production has been achieved in recent years. The lack of sufficient studies on agronomic characteristics of carob cultivars is seen as the biggest deficiency in this regard. Nine carob collection gardens have been established in the world so far, and only 3 types have been identified in Turkey in 1974. Among the 54 species evaluated from different locations in the Western Mediterranean and Aegean Regions between 2003 and 2004, there were hopes for 10 wild and 4 cultured types that showed superior characteristics in terms of the criteria examined. As a result of the selection studies carried out in different locust locations in Adana and Mersin in 2005, 8 wild and 5 cultivated types were found to be promising. Carob plant, whose value has increased with the importance of healthy nutrition in recent years, is still sold as seedlings in Turkey and there is no variety that will appeal to the market. In this study, an evaluation was made about the production and breeding of carob in Turkey and in the world, and information was given about its current status and future studies.

Keywords: Seedling, breeding, carob, selection, production



ANTALYA'DA ENGİNAR ZARARLILARININ TESPİTİ VE YAYGIN OLARAK TESPİT EDİLEN SALYANGOZUN BİYOTEKNİK KONTROLÜ

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ÖZET

Enginar, Akdeniz Ülkelerinin en önemli sebze türlerinden biri olarak kabul edilir. Ülkemizde İzmir, Bursa, Aydın, Antalya ve Adana illerinde yoğun olarak üretilen enginarın son yıllarda, Antalya ilindeki ekimi artmıştır. Antalya iklim koşulları ile enginar yetiştirmek için elverişli olup aynı zamanda bu iklim koşulları zararlılar için çok uygundur. Bu bağlamda, 2016-2017 yılı enginar üretim döneminde, Antalya ilinde altı farklı lokasyonda (Muratpaşa, Kepez, Aksu, Serik, Kumluca ve Gazipaşa) bitki vegetasyonu boyunca 2 ila 4 hafta arayla sürveyler yapılmıştır. Bu sürveyler sonucunda bulunan türler, Diptera (*Liriomyza huidobrensis*), Styломmatophora (*Helix* sp.), Hemiptera (*Aphis craccivora* Koch, *Aulacorthum solani* (Kaltenbach), *Macrosiphum euphorbiae*, *Aphis gossypii*, *Dolycoris baccarum*, *Nezara viridula*, *Empoasca* spp., *Lygus* spp.), Acarina (*Tetranychus urticae*, *Aceria cynarae*), Lepidoptera (*Tebenna micalis*, *Emmelina monodactyla*, *Vanessa cardui*), Thysanoptera (*Frankliniella occidentalis*), Coleoptera (*Lixus* sp.), parazitoit (*Aphidius colemani*) ve avcı tür (*Coccinella septempunctata*) Serik, Muratpaşa, Kumluca ve Gazipaşa yörelerinde yetiştirilen enginar bitkilerinde tespit edilmiştir. Bu zararlı ve faydalı böcekler Antalya ilinde enginar da yeni kayıt niteliğindedir. Çalışmada Antalya ilindeki enginar üretim alanlarında en yaygın zararlı türün salyangoz (*H. aspersa*) olduğu ve bu zararlının incelenen bitkilerin yeşil aksamını istila ettiği görülmüştür. 2018 yılında bu zararlıya karşı besin cezbedici tuzaklar (bira içeren cezbedici tuzaklar, ayran içeren cezbedici tuzaklar) ve alüminyum folyo şerit ile fiziksel bariyer uygulaması gibi bazı biyoteknik mücadele yöntemleri denenmiştir. Denemelerde ayran içerikli tuzaklar salyangoz mücadelesinde daha etkili bulunmuştur. Ayrıca alüminyum şeritli fiziksel bariyer uygulamasının da salyangozların bitkilere tırmanmasını büyük ölçüde engellediği tespit edilmiştir. Denenen her iki mücadele yönteminin de enginar yetiştiriciliğinde salyangoz mücadelesinde kullanılabileceği ortaya koyulmuştur.

Anahtar kelimeler: *Cynara scolymus*, Antalya, zararlılar, biyoteknik mücadele, salyangoz



DETECTION OF ARTICHOKE PESTS IN ANTALYA AND BIOTECHNICAL CONTROL OF THE WIDELY DETECTED SNAIL

ABSTRACT

Globe artichoke (*Cynara scolymus*) is one of the important vegetable crops in Mediterranean countries. It has been extensively produced in Turkey in the provinces of Izmir, Bursa, Aydın, Antalya and Adana. Its cultivation in Antalya has increased in recent years. Due to its climatic conditions. However, the climatic conditions are also very favorable for pests. In this context, six different locations (Muratpaşa, Kepez, Aksu, Serik, Kumluca and Gazipaşa) in Antalya Province were surveyed at 2 to 4 weeks intervals throughout the vegetation of artichoke during the 2016 to 2017 production season. In these surveys, Diptera (*Liriomyza huidobrensis*), Styломmatophora (*Helix* sp.), Hemiptera (*Aphis craccivora*, *Aulacorthum solani*, *Macrosiphum euphorbiae*, *Aphis gossypii* Glover, *Dolycoris baccarum*, *Nezara viridula*, *Empoasca* spp., *Lygus* spp.), Acarina (*Tetranychus urticae*, *Aceria cynarae*); Lepidoptera (*Tebenna micalis*, *Emmelina monodactyla*, *Vanessa cardui*), Thrips (*Frankliniella occidentalis*), Coleoptera (*Lixus* sp.), parasioit (*Aphidius colemani*) and predator (*Coccinella septempunctata*) were detected in artichoke crops cultivated in Serik, Muratpaşa, Kumluca and Gazipaşa locations. These pests and natural enemies are new records for artichokes in Antalya province. In the study, it was observed that the most common pest species in the artichoke production areas in Antalya was snail (*H. aspersa*) and this pest invaded the green parts of the plants. Some biotechnical control methods such as food attractant traps (beer-containing attractant traps, ayran-containing attractant traps) and physical barrier application with aluminium foil ribbon, were tested against this pest in 2018. Among these methods, a trap containing ayran was found to be effective in snail control. In addition, it was also determined that the physical barrier with aluminium ribbon efficiently prevented the snails from climbing the plants. It has been revealed that both biotechnical and mechanical control methods can be successfully used for snail control in artichoke cultivation.

Keywords: Antalya, *Cynara scolymus*, pests, biotechnical control, snail



STRUCTURE-BASED DRUG REPURPOSING TO INHIBIT THE DNA GYRASE OF *MYCOBACTERIUM TUBERCULOSIS*

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ABSTRACT

Drug repurposing is an alternative avenue for identifying new drugs to treat tuberculosis (TB). Although TB can be cured with anti-tubercular drugs, the emergence of multidrug-resistant and extensively drug-resistant strains of *Mycobacterium tuberculosis* H37Rv (Mtb), as well as the significant death toll globally, necessitate the development of effective drugs to treat TB. In this study, drug repurposing approach was employed to address this drug resistance problem by screening drugbank database to identify novel inhibitors of the Mtb target enzyme, DNA gyrase. The compounds were screened against the ATPase domain of gyrase B subunit (MtbGyrB47), and the docking results showed Echinacoside, Doxorubicin, Epirubicin, and Idarubicin possess high binding affinities against MtbGyrB47. Comprehensive assessment using fluorescence spectroscopy, SPR, and CD titration studies revealed that Echinacoside as a potent binder against MtbGyrB47. Further, ATPase, and DNA supercoiling assays exhibited IC₅₀ values of 2.1-4.7 µM for Echinacoside, Doxorubicin, Epirubicin, and Idarubicin. Among these compounds, the least MIC₉₀ of 6.3 µM and 12 µM were observed for Epirubicin and Echinacoside, respectively. Hence, our findings indicate that Echinacoside and Epirubicin target mycobacterial DNA gyrase, inhibit its catalytic cycle, and retard mycobacterium growth. Further these compounds exhibits potential scaffolds for optimizing novel anti-mycobacterial agents that can act on drug-resistant strains.

Keywords: ATP hydrolysis, ATPase, DNA gyrase, DNA supercoiling, drug repurposing, *Mycobacterium tuberculosis*



ANTIBACTERIAL AND ANTI- OXIDANT ACTIVITIES OF EXTRACTS FROM MEDICINAL PLANTS

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ABSTRACT

The algerian flora provides a diverse range of aromatic plants with a high therapeutic interest due to their secondary biologically active metabolites, which have sparked scientific interest. In this study, we are interested in the plants *Ocimum basilicum* L. of the Lamiaceae family and *Artemisia campestris* A. of the Asteriaceae family, which are well known locally and have a variety of curative properties in traditional medicine. The first part of this study is devoted to the quality control of the plant powder and the investigation of the metabolites. The phytochemical screening revealed the presence of flavonoids, tannins, coumarine, essential oil, and other metabolic compounds. The HE were obtained using hydrodistillation with a yield of 2.4% for *O.basilicum* L. and 1.8% for *A.campestris* A. The phenolic compounds were obtained by a series of extractions with four solvents of increasing polarity. The concentration of these extracts in total polyphénols, flavonoids, and tanins was determined by using the reactif Folin Ciocalteu, aluminum trichlorure, and vanilline with the addition of chlorhydric acid. In the second section, we investigated the antioxidative capacity of extracts (HE and phenolic compounds) in vitro using the DPPH method. The results show that our extraits have interesting antioxidant properties, with ethyl acetate being the most effective. Furthermore, the essential oil has a very low antioxidative activity when compared to the benchmark for the two plants. Finally, we assessed the antibacterial activity of our extracts against ten pathogenic bacteria using the MH diffusion method. The results show that phenolic extracts of *O. basilicum* L. have higher activity for HE. Unlike *A.campestris* A., the acétate of éthyle extract is the most active on the majority of Gram+ souches.

Keywords: *O.basilicum* L., *Artemisia campestris* A, Antibacterial, oxidant activities



CONTRIBUTION TO DRUG DISCOVERY THROUGH COMPUTATIONAL ANALYSIS OF SEVERAL SERIES OF HETEROCYCLIC MOLECULES

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ABSTRACT

Breast cancer is the most common type of female cancer. One class of hormonal therapy for breast cancer drugs -non steroidal aromatase inhibitors- are triazole analogues. In this work a fundamental and original research was made on the molecule of triazole heterocyclic, whose the aim is to predict the reactivity and biological activity studied of the compound. It is based on different computational and approaches used in computer aided -drug-design. (SPR, QSAR, molecular. docking, ADMET). A study of structure – property relationships (SPR) for 1,2,3 triazole derivatives has been carried. A linear quantitative structure activity relationship model is obtained using Multiple Linear Regression (MLR) analysis as applied to a series of triazole derivatives with inhibitory activity of the aromatase. The accuracy of the proposed MLR model is illustrated using the following evaluation techniques: cross validation, and external test. Docking process, the interaction and binding of ligands – protein were done and visualized using software Molegro Virtual Docking. Molinspiration and ADMETSAR web servers used to calculate ADMET and physicochemical properties of the target compounds respectively. The results are reported and discussed in the present investigation. A close agreement with experimental results was found which improves the affinity of the present work.

Keywords: 1,2,3-triazole, aromatase inhibitory, density functional theory, QSAR, MLR, ADMET, docking molecular



**STRUCTURAL MODIFICATIONS OF ROOT IN *IPOMOEA CARNEA* JACQ.
COLONIZING DIFFERENT SALINE HABITATS**

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ABSTRACT

Ipomoea carnea Jacq. is an invasive plant species that invades almost all types of ecosystems e.g. deserts, plains, water bodies, mountains and saline soil. The current study was conducted to investigate its structural modification in roots along salinity gradient. This study can help to understand its invasion from non-saline to highly saline habitats. Root samples were collected from thirty diverse saline habitats from Punjab and Azad Jammu and Kashmir. Root anatomical traits showed variable response along salinity gradient to survive under saline environment. Root and shoot Na⁺ were significantly high in highly saline population. Root cross-sectional area, cortical region thickness, metaxylem number and stellar region thickness significantly reduced at higher salinities. Reduction in cortical region in root was an important modification conditions survive high saline. Sclerenchyma thickness was increased in highly saline habitats. Epidermal thickness was significantly increased in highly saline populations of *I. carnea*. These structural modifications conferred invasive success to *I. carnea* under high saline conditions

Keywords: Structural modification; salinity gradient; invasive species, cortical region



QSAR MODELING USING GAUSSIAN PROCESS APPLIED FOR A SERIES OF FLAVONOIDS AS POTENTIAL ANTIOXIDANTS

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ABSTRACT

For decades, flavonoids have been the core of diverse research, especially for their significant antioxidant activity. They have several biological activities, and they are used as anticancer, antileishmanial, anti-inflammatory, and antiaging compounds. However, current researchers are very much interested in the antioxidant activity of flavonoids since oxidative stress is strongly related to several diseases. In this study, we have chosen to elaborate on a quantitative structure-antioxidant activity relationship (QSAR) using a statistical method called Gaussian process (GP). The main advantage of this method compared to other techniques currently used in QSAR studies is that it does not increase the complexity of learning tests. Typical QSAR studies use common techniques such as the artificial neural method, multiple linear regression, and partial least squares regression. The aim of this work was to use a statistical technique little known in pharmaceutical chemistry, the Gaussian process regression which is rarely used to build a QSAR model. Finally, we have also demonstrated that GP is reliable and capable of predicting the antioxidant activity with a respectable record (R^2_{pred}) which is equal to 0.86, so it is much higher than the reference value of 0.6. Therefore, we estimate that this reliable model can be used to predict the antioxidant activity of a series of new molecules. Also, based on the HC results, our set was divided into four separate clusters according to the presence of glycosides and the molar weight of the flavonoids.

Keywords: Flavonoids, Antioxidant, QSAR, Gaussian process, PCA, HCA



***Allium cepa* L. KÖK MERİSTEMATİK HÜCRELERİNDE PROPOLİSİN ÇİNKO OKSİT TOKSİSİTESİNE KARŞI ANTİMUTAJENİK ETKİLERİNİN ARAŞTIRILMASI**

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ÖZET

Propolis, doğanın en dikkat çekici maddelerinden biridir. Balmumu ile birleştirilmiş ağaç ve bitki reçinelerinden bal arıları tarafından üretilir. Arılar oldukça yapışkan özellikteki bu maddeyi, kovanlarındaki delikleri kapatmak için kullanırlar. Propolis, koloniyi enfeksiyon ve hastalıktan koruyan bir tür harici bağışıklık sistemi görevi görür. Propolisin kimyasal içeriğinin iklime, propolisin oluşturulduğu yere, kullanılan bitkilere ve zamana bağlı olarak değişiklik gösterdiği bilinmektedir. Buna ek olarak, sahip olduğu yüksek antibakteriyel ve antifungal etkilerden dolayı sağlık açısından da oldukça faydalıdır. Bu çalışmada, Artvin-Hatila Bölgesi'nden temin edilen propolisin sulu ekstraktının, bakır oksit çözeltisine karşı antimutajenik etkisi *Allium* testi ile araştırıldı. Bunun için, 12 saat boyunca 680 ng/L'lik çinko oksit çözeltisinde büyütülen *Allium cepa* kökleri daha sonra, 25, 50, 100, 200 ve 400 mg/L'lik propolis ekstraktına alındı 12 saat büyümeye bırakıldı. Saf su ve çinko oksit çözeltisi sıra ile negatif ve pozitif kontrol olarak kullanıldı. Muamale sonundaki sitogenetik incelemeler ile her bir uygulama grubu için mitotik indeks ve kromozom anormallikleri belirlendi. Çinko oksit uygulaması ile mitotik indekste belirgin bir azalmanın olduğu görüldü. Mitotik anormallikler düzensiz profaz, c-metafaz, yapışık kromozom, kromozomal köprü, çok kutuplu anafaz, kalgın ve ileri kromozomlar, telofazda diyagonallik olarak tespit edildi. Buna ek olarak, mikronukleus indeksi de tespit edildi. Propolis uygulama grupları içerisinde 100 mg/L'lik olan grupta mitotik indeks değerinin arttığı ve toplam anormallik miktarının azaldığı görüldü. Böylece propolis sulu ekstraktının, çinko oksit mutajenine karşı genotoksik potansiyeli *Allium cepa* hücreleri kullanılarak ilk kez ortaya koyuldu ve toksik olmadığı belirlenen dozun kullanımını önerildi.

Anahtar kelimeler: Propolis, *allium cepa*, mitotik indeks, antimutajenik



INVESTIGATION OF THE ANTIMUTAGENIC EFFECTS OF PROPOLIS AGAINST ZINC OXIDE TOXICITY IN *ALLIUM CEPA* L. MERISTATIC CELLS

ABSTRACT

Propolis is one of nature's most remarkable substances. It is produced by honey bees from tree and plant resins combined with beeswax. Bees use this highly sticky substance to seal holes in their hives. Propolis acts as a kind of external immune system that protects the colony from infection and disease. It is known that the chemical content of propolis varies depending on the climate, the place where the propolis is created, the plants used and time. In addition, it is very beneficial for health due to its high antibacterial and antifungal effects. In this study, the antimutagenic effect of aqueous extract of propolis obtained from Artvin-Hatila Region against copper oxide solution was investigated by *Allium* test. For this, *Allium cepa* roots grown in 680 ng/L zinc oxide solution for 12 hours were then taken into 25, 50, 100, 200 and 400 mg/L propolis extract and allowed to grow for 12 hours. Pure water and zinc oxide solution were used as negative and positive controls, respectively. Mitotic index and chromosomal abnormalities were determined for each treatment group by cytogenetic studies at the end of the treatment. It was observed that there was a significant decrease in mitotic index with zinc oxide application. Mitotic abnormalities were detected as irregular prophase, c-metaphase, adherent chromosome, chromosomal bridge, multipolar anaphase, laggard and vagrant chromosomes, and diagonal telophase. In addition, the micronucleus index was also determined. Among the propolis application groups, it was observed that the mitotic index value increased and the total abnormality amount decreased in the 100 mg/L group. Thus, the genotoxic potential of propolis aqueous extract against zinc oxide mutagen was demonstrated for the first time using *Allium cepa* cells, and the use of a non-toxic dose was suggested.

Keywords: Propolis, *allium cepa*, mitotic index, antimutagenic



IN SILICO INVESTIGATION OF SEVERAL SERIES OF HETEROCYCLIC MOLECULES FOR DRUG DISCOVERY

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ABSTRACT

Drug discovery and design are inextricably linked to various branches of chemistry, particularly organic chemistry. Many aspects of chemistry must be involved in order to translate knowledge of the molecular, genetic, and cellular bases of cancer into effective therapies. Thus, the goal of this research is to identify promising active compounds for coumarin as CK2 protein kinase inhibitors using a QSAR model and drug similarity analysis. CK2 is a ubiquitous Ser/Thr-specific protein kinase that is required for cell cycle viability and progression. CK2 levels are particularly high in proliferating, normal, or transformed tissues, and transgenic mice expressing its catalytic subunit are responsible for lymphomas. The work began with the optimization of the equilibrium structures of the basic coumarin in order to select the most reliable forecasting approach compared to experimentation and at the lowest computational cost. Following our research, we conduct a multiple linear regression (MLR) analysis to generate QSAR models. An external validation research was done because the results show that the QSAR model of CK2 inhibitory activity is robust and has extremely strong prediction capacity, as indicated by R² values of 0.951 and 0.927, respectively, following linear regression analysis. The investigation using QSAR models is successful in screening 34 candidate chemicals. Following that, the compounds under consideration were evaluated for drug-likeness and reactivity (ADME, golden triangle, lipophylicity indices). The results reveal that when supplied orally, the majority of the substances have no bioavailability issues. The data also aid in determining which chemicals do not have clearance issues, as well as which are the most stable and reactive among those examined. The anticipated findings of this study may aid in the development of novel coumarins with significant CK2 inhibitor activity.

Keywords: Coumarine, CK2, QSAR, MLR



**QUANTITATIVE STRUCTURE ACTIVITY RELATIONSHIP (QSAR)
INVESTIGATIONS AND MOLECULAR DOCKING ANALYSIS OF PLASMODIUM
PROTEIN FARNESYLTRANSFERASE INHIBITORS AS POTENT
ANTIMALARIAL AGENTS**

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ABSTRACT

The development of *farnesyltransferase* inhibitors based on the benzophenone scaffold directed against *Plasmodium falciparum* is considered a strategy in malaria treatment. In this work, quantitative structure–activity relationship (**QSAR**) was performed to predict the protein *farnesyltransferase* (**PFT**) inhibitory activities for a series of 36 benzophenone derivatives. The data set was divided into two subsets of training and test sets, and the best model using **multiple linear regression (MLR)**, with the values of internal and external validity ($R^2 = 0.884$, $R^2_{adj} = 0.865$, $R^2_{pred} = 0.821$, $Q^2_{cv} = 0.822$ and $R^2_p = 0.811$) was found in agreement with the Tropsha and Golbraikh criteria. The applicability domain (AD) was determined using the Williams plot to describe the chemical space for the model used in this study. The model shows that antimalarial activities of benzophenone depend on logP, bpol, MAXDn, and FMF descriptors. These indications prompted us to design new benzophenones PFT inhibitors and predict the value of their anti-malarial activities based on the MLR equation. Docking results reveal that the newly designed benzophenones bind to the hydrophobic pocket and polar contact with high affinity. The predicted results from this study can help to design novel benzophenone as inhibitors of human **PFT** with high antimalarial activities.

Keywords : QSAR, docking, benzophenone, PFT inhibitory, antimalarial



TÜRKİYE'DE YETİŞTİRİLEN SİMENTAL İNEKLERDE TIP KUSURLARI ÜZERİNE BİR ÇALIŞMA

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ÖZET

Simental ve Fleckvieh ırkı sığırlarda tip sınıflandırması olan Fleckscore yönteminin amacı ve hedefi, öncelikle sığırdan verimli ömür uzunluğunu etkileyen tip özelliklerinin mümkün olan en erken dönemde tanımlanması ve tespiti, ikinci olarak tip özelliğine ait damızlık değerin tahmin edilmesidir. Çalışmanın materyalini, Simental sığır yetiştiren 1103 çiftlik ve bu çiftliklerde yetiştirilen 3921 baş Simental ırkı inek oluşturmuştur. Değerlendirmeler 98 sınıflandırıcı kişi tarafından yapılmıştır. Çalışmada, ineklere ait beden kusurları, meme kusurları ile ayak ve bacak kusurları değerlendirilmiştir. Sınıflandırılan her bir ineğin beden yapısı, ayak-bacak yapısı ve meme yapısında tespit edilen kusurlar; 0 puan (kusur yok), 1 puan (hafif kusurlu) ve 2 puan (ağır kusurlu) şeklinde puanlanmıştır. Toplam inek sayısı içerisindeki vaka sayısına göre beden kusurları sırasıyla, çatı tipi kalça (1 puan: 348 inek, 2 puan: 14 inek), dar göğüslülük (1 puan: 176 inek, 2 puan: 11 inek), dar sağrı (1 puan: 167 inek, 2 puan: 16 inek), basık sırt (1 puan: 150 inek, 2 puan: 7 inek) ve basık bel (1 puan: 133 inek, 2 puan: 12 inek). Meme kusurları sırasıyla; basamaklı meme (1 puan: 232 inek, 2 puan: 17), birbirine yakın meme başı (1 puan: 200 inek, 2 puan: 11 inek), dışa bakan ön meme başı (1 puan: 146 inek, 2 puan: 9 inek), ileri bakan ön meme başı (1 puan: 113 inek, 2 puan: 12 inek), ödemli meme (1 puan: 113 inek, 2 puan: 7 inek) ve meme başı şekil bozukluğu (1 puan: 92 inek, 2 puan: 8 inek). Ayak ve bacak kusurları ise sırasıyla; dönmüş tırnak (1 puan: 300 inek, 2 puan: 3 inek), ayırık tırnak (1 puan: 282 inek, 2 puan: 5 inek), X bacaklılık (1 puan: 168 inek, 2 puan: 7 inek), gevşek omuzluluk (1 puan: 142 inek, 2 puan: 10 inek) ve ön bacak duruş bozukluğu (1 puan: 96 inek, 2 puan: 7 inek) olarak tespit edilmiştir. Sonuç olarak, Türkiye'ye getirilmek üzere Avrupa ülkelerinden gebe düve ve boğa sperması seçimi ve ithalatında kusurlar mutlaka değerlendirilmelidir. Simental ırkı sürülerde uygulanan seleksiyonda tip özelliklerinin yanı sıra tip kusurları da değerlendirilmelidir. Ağır kusurlu inek ve boğalar sürülerden ayıklanmalıdır. Sperma üretimi amacıyla boğa adayları seçimlerinde, adayın kendisi, boğa anası, ve boğa babasında tür kusurlarının tespit edilmesi halinde seçim dışı bırakılması tavsiye edilir.

Anahtar kelimeler: Fleckscore, tip sınıflandırması, tip kusuru, simental



A STUDY ON TYPE DEFECTS IN SIMMENTAL COWS RAISED IN TURKEY

ABSTRACT

The purpose and objective of the Fleckscore method, which is a type classification method in Simmental and Fleckvieh cows, is to identify and determine the type characteristics that affect the productive lifespan in cattle, as early as possible, and secondly, to estimate the breeding value of the type trait. The material of the study consisted of 1103 dairy farms raising Simmental cattle and 3921 Simmental cows raised in these farms. Type classification study was performed by 98 classifiers. In the study, body defects, udder defects, and foot and leg defects of cows. Defects in body structure, foot-leg structure, and udder structure of each classified cow; It is scored as 0 point (no defects), 1 point (slightly defective), and 2 point (severely defective). According to the number of cases in the total number of cows, the body defects are rump roof shaped (1 point: 348 cows, 2 point: 14 cows), narrow chest (1 point: 176 cows, 2 point: 11 cows), narrow rump (1 point: 167 cows, 2 point: 16 cows), backline impressed (1 point: 150 cows, 2 point: 7 cows) and low waist (1 point: 133 cows, 2 point: 12 faults), respectively. The udder defects are staged udder (1 point: 232 cows, 2 point: 17), teats close to each other (1 point: 200 cows, 2 point: 11 cows), front teats spread out (1 point: 146 cows, 2 point: 9 cows), front teats spread forward (1 point: 113 cows, 2 point: 12 cows), udder edema (1 point: 113 cows, 2 point: 7 cows) and teats crumbly (1 point: 92 cows, 2 point: 8 cows), respectively. Foot and leg defects were, respectively, rolled hoof (1 point: 300 cows, 2 points: 3 cows), splayed hoof (1 point: 282 cows, 2 points: 5 cows), hindfoot outwards (1 point: 168 cows, 2 points: 7 cows), loosely shoulder (1 point: 142 cows, 2 points: 10 cows), and front legs distroted (1 point: 96 cows, 2 points: 7 cows). As a result, defects in the selection and import of pregnant heifer and bull semen from European countries must be evaluated. In the selection applied in Simmental herds, type defects should be evaluated as well as type characteristics. Heavily defective cows and bulls should be removed from the herds. In the selection of bull candidates for sperm production, it is recommended to exclude such defects in the candidate himself, the bull mother, and the bull father.

Keywords: Fleckscore, type classification, type defect, simmental



TÜRKİYE'DE YETİŞTİRİLEN SİMMENTAL IRKI SIĞIRLARDA MEME ARILIK DEĞERLENDİRİLMESİ

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ÖZET

Süt üretim amaçlı yetiştirilen çiftlik hayvanlarında meme dokusu ve meme başı dokularındaki değişiklikler bulaşıcı veya çevresel patojenlerin meme kanalına nüfuzunu kolaylaştırarak mastitis hastalığının ortaya çıkmasına yol açmaktadır. Bu çalışmanın materyalini, Simental ırkı sığır yetiştiren 1103 çiftlik ve bu çiftliklerde yetiştirilen 3921 baş inek oluşturmuştur. Değerlendirmeler konusunda eğitim almış 98 sınıflandırıcı kişi tarafından yapılmıştır. Çalışmada, meme arılığı; meme başları, ön meme lobları, ön ve arka meme lobları arası ile arka meme lobları olmak üzere dört aşamada incelenmiştir. Meme arılığı 1-9 puan skalasına üzerinden puanlanmıştır. Esas alınan 1-9 skalası üzerinden meme dokusu üzerinde fistül, hiperkeratoz, siğil ve çoklu meme kanalı gibi sorunlar 1 puanla, herhangi bir anomaliye sahip olmayan meme yapısı ise 9 puan ile derecelendirilmiştir. Yapılan değerlendirmede, ineklerin %53.94'ünün meme dokusunun ari, %46.06'sının ise kusurlu olduğu tespit edilmiştir. Bu kusurlardan arka meme başı üzerinde küçük fazla meme başı (%11.71), arka meme başı üzerinde meme tomurcuğu (%11.32) ve arka ve ön meme lobları arasında meme tomurcuğu (%10.25) olarak belirlenmiştir. Sağım makinesi basıncının yüksek veya sağım süresinin uzun tutulmasından kaynaklanan meme başı şekil bozukluklarının (fistül, hiperkeratoz, siğil) oranı da %3.09 olarak belirlenmiştir. Arka ve ön meme lobları arasında fazla meme başı, arka meme başı üzerinde büyük meme başı, meme başına bitişik kanallaşmış fazla meme başı ve ön meme başı üzerinde fazla meme başı vakalarının oranları da sırasıyla %2.88, %2.83, %2.07 ve %1.91 olarak tespit edilmiştir. Sonuç olarak, meme kusuruna fazla rastlanan Avrupa ülkelerinden Türkiye'ye yapılacak ithalatlarda seçim heyetlerinin meme kusuru olan sürü ve familyalardan gebe düve seçmemelerini sağlayacak mevzuat düzenlemesine ihtiyaç duyulmaktadır. Türkiye'de de mevcut sürülerdeki damızlık seçimlerinde ise meme yapısı ari olan dişi akrabaya sahip erkek sığırlar ile meme yapısı ari olan dişi sığırlar lehine seleksiyon uygulanmalıdır. Meme yapısı ağır kusurlu olan erkek ve dişi sığırlar sürülerden ayıklanmalıdır. Türkiye'ye yapılacak boğa sperması ithalatında meme kusurlu döl veren boğaların spermalarının ithalatına izin verilmemelidir. Ayrıca, makineli sağımda yüksek basınç uygulanmaması ve gereğinden uzun süre sağım yapılmaması konularında yetiştiriciler bilinçlendirilmelidir.

Anahtar kelimeler: Fazla meme başı, hiperkeratoz, mastitis, meme arılığı, simental



EVALUATION OF UDDER PURITY IN SIMMENTAL CATTLE BREEDS REARED IN TURKEY

ABSTRACT

Changes to the udder tissue and teat tissues can play an initiating role in the development of mastitis, as they can facilitate penetration of the teat canal by contagious or environmental pathogens. The material of the study consisted of 1103 dairy farms raising Simmental cattle and 3921 Simmental cows raised in these farms. Type classification study was performed by 98 classifiers. In the study, body defects, udder defects, and foot and leg defects. In the study, mammary purity was evaluated in four stages as teats, anterior udder lobes, between anterior and posterior udder lobes and posterior udder lobes, according to a scale of 1-9. Problems such as fistula, hyperkeratosis, wart and additional teat with multi-channel on the udder tissue are evaluated with 1 point, whereas udder tissue without any anomaly is scored with 9 points. According to the evaluation, it was determined that 53.94% of the cows had free udder tissue, and 46.06% had a defect in the udder tissue. According to the evaluation, it was determined that 53.94% of the cows had free udder tissue and 46.06% had a defect in the udder tissue. According to the order of mammary defects, the small additional teat (11.71%) on the posterior teat, the mammary bud (11.32%) on the posterior teat, and the mammary bud (10.25%) between the posterior and anterior mammary lobes are in the top three ranks. The rate of teat deformities (fistula, hyperkeratosis, wart) caused by high pressure of the milking machine or prolonged milking time was determined as 3.09%. The rates of additional teat between the posterior and anterior udder lobes, big teat on the posterior teat, additional canalized teat adjacent to the teat, and additional teat over the anterior nipple were determined as 2.88%, 2.83%, 2.07% and 1.91%, respectively. As a result, there is a need for a legislative arrangement to ensure that selection committees do not select pregnant heifers from herds with udder defects in imports from European countries where udder defects are common. Selection should be made in favor of male cattle whose female relatives are female cattle without udder defects. Also, male and female cattle with severely defective for udder structure should be removed from the herds. In the importation of semen for bulls with udder defects should not be allowed. In addition, breeders should be made aware of not applying high pressure in machine milking and not milking longer than necessary.

Keywords: Additional teat, hyperkeratosis, mastitis, udder purity, simmental



ATTENUATING DROUGHT AND AND NICKEL STRESS BY APPLICATION OF SILICON IN MAIZE (*Zea mays* L.)

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ABSTRACT

Abiotic stresses are the leading environmental factors which adversely affect plant growth and development particularly drought and nickel stress. The present study was conducted to evaluate the role of silicon to improve drought and nickel stress in maize. Treatments of the study were, i) Control (100% F.C) ii) drought stress (60% F.C) iii) nickel stress (100 mg/kg) and silicon applications, i) control (No silicon) and ii) 50mg kg⁻¹silicon. The experiment was lay out in a completely randomized design replicated thrice. The result showed that plant height reduced up to 24% under drought stress, and 13% under nickel stress and leaf water potential decreased 25% under drought stress and 11% under nickel stress and 53% under combined stress as compared with control. Silicon applications increased the plant height and leaf water potential under stress and non-stress conditions. Photosynthetic rate, stomatal conductance, transpiration rate were also significantly increased by silicon application. Drought and nickel stress reduced the chlorophyll content but applications of silicon increased the contents of chlorophyll a and b up to 21% and 32% as compared with control. H₂O₂ values increased under the drought and nickel stress conditions and decreased in control-no stress. Water deficit and heavy metal stress increased the levels of SOD, POD and CAT but application of silicon @ 50mg/kg improved the values of SOD, POD and CAT. In crux, the present investigation suggested that silicon application mitigated the harmful effects of drought and nickel alone and in combination by improving antioxidant defense in maize.

Keywords: Abiotic stresses, maize, silicon application



**ASSESSING BIO-DIVERSE FOODS IN DIETARY INTAKE SURVEYS-A CASE
STUDY CONSIDERING RANDOM SELECTED SAMPLES**

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ABSTRACT

This survey is based on expressing diet diversity indicators such as the diet diversity score (DDS) or food variety score as a reflection for dietary quality and measure the diversity of unique food groups and food items consumed, respectively. During our approach the questionnaires conducted in the period of 2022 and 2023 the DDS for women was a count of the total number of food groups consumed from a list of 10: (i) grains, white roots and tubers, and plantains; (ii) pulses; (iii) nuts and seeds; (iv) dairy; (v) meat, poultry, and fish; (vi) eggs;



(vii) dark-green leafy vegetables; (viii) other vitamin A-rich vegetables and fruits; (ix) other vegetables; and (x) other fruits. For children, a seven food-group classification was used, including the following: (i) grains, white roots and tubers, and plantains; (ii) legumes, nuts, and seeds; (iii) dairy; (iv) meat, poultry, and fish; (v) eggs; (vi) vitamin A-rich fruits and vegetables; and (vii) other fruits and vegetables. Following references a 15-g minimum quantity consumed was considered as a cutoff for species inclusion in the DDS for women but not for children. The questionnaire considered 271 adult woman and 233 children. The Minimum Dietary Diversity (MDD) was used as a cutoff for higher nutrient adequacy and refers to a minimum of five and four food groups for women and children, respectively. The results shows that >50% of adult woman's have value of dietary species richness lower than 0.5, while in case of children's the average value was slightly higher (0.52).

Keywords: food diets, food diversity, consumption, children, woman, poverty



TRENDS AND ROLE OF PHARMACIST IN COMMUNITY PHARMACY SERVICES AND FACILITATION PROTOCOL: CHALLENGES IN REAL TIME PRACTICES

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ABSTRACT

Background: Community Pharmacy is most debatable part of practice in Pakistan with respect to its application and existence. There are many reasons behind the implications of long-term growth plans of this valuable Practice. In Pakistan major challenges associated may be enlisted as lack of significant information, least priority from higher stack holders, less incentive in terms of job and retention, limited opportunities, no mass level communication for pharmacy setups offering community services, ranges of services offered and trained staff availability, absence of counselling and education activities, limited media coverage and social responsibility, prioritizes and resources allocation and maintenance. **Study Design and Methodology:** A cross sectional descriptive study design was used to evaluate the information and perception of public towards community pharmacy setup in Pakistan and role of Pharmacist in drugs management system. Moreover multiple groups of Pharmacy related professionals including community pharmacist's, technician and other healthcare professionals were also included to determine the related practices and scope of work. **Data Collection** was carried out using a well constructed questionnaire and validation was performed prior to this study. **Results:** Values of Cronbach's alpha and spearman correlation were found satisfactory. It was revealed during the study that pharmacist's recognition at mass level is comparatively very low in this region. Moreover costly community related services are one other discouraging factor from public perspective. Basic health indicators are relatively low and people's levels of knowledge was much less towards any available pharmacy services. **Conclusion:** Incentive should be attractive to maintain long-term relationships and growth of community pharmacy service. Service providers and public relations must be encouraged to build with proper media support towards better quality of medication provisions in presence of trained and qualified pharmacist. Campaigns for education and awareness should be placed on regular basis in various territories across the country. All stakeholders should develop a reflective practice model with clear provision of policies and feedback to improve and expand community services in order to improve better system.

Keywords: Community pharmacy pharmacist role, real time challenges and practice, policy, service



ÇİFTLİK HAYVANLARININ BİLGİSAYARLA GÖRMEYE DAYALI AĞIRLIK TAHMİNİ

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ÖZET

Hayvanların ağırlıklarının ölçülmesi, beslenme, gelişim ve sağlık durumlarının izlenmesi açısından önemlidir. Bununla birlikte, geleneksel tartılarla hayvan büyümesinin gerçek zamanlı olarak izlenmesi hayvanlar için stresli, üreticiler için de maliyetli ve emek yoğun bir süreçtir. Bu çalışmada çiftlik hayvanları için bu sürecin otomatikleştirilmesinde kullanılan çeşitli bilgisayarlı görüntüleme ve makine öğrenmesi yöntemlerinin incelenmesi amaçlanmıştır. Çeşitli veri tabanları ve anahtar kelimelerle bu konuda yapılmış çalışmalar derlenmiştir. İki ve üç boyutlu görüntüleme teknikleri kullanılarak, elde edilen verilerden bilgisayarla görmeye dayalı tahmin modellerinin geliştirildiği görülmüştür. Görüntü eldesinde iki boyutlu kameralar, üç boyutlu kameralar (derinlik kamerası), kızılötesi ve ultrasonik sensörler veya bunların kombinasyonlarından oluşan sistemler kullanılabilir. Tahminleme için genellikle hayvanların üstten görünen vücut alanı, cidago yüksekliği, omuz yüksekliği, gövde uzunluğu, kalça genişliği, vücut hacmi, göğüs çevresi gibi ölçüler kullanılmaktadır. Görüntülerin işlenmesi ile elde edilen bu metrikler kullanılarak çeşitli makine öğrenmesi veya derin öğrenme algoritmaları ile hayvan vücut ağırlığı tahmin eden çalışmalar yapılmıştır. Ağırlık kestirimi modellerinde sınıflandırma için çeşitli değerlendirme ölçütleri kullanılmış ve %73,21 ile %98,93 aralığında doğruluk değerleri elde edilebildiği görülmüştür. Görüntü tabanlı ağırlık tahmini uygulamalarının başarısı, görüntü kalitesi, kamera pozisyonu, ortam aydınlatması, kamera kalibrasyonu, hayvanın vücut duruşu, görüntüleme zamanlaması, hayvanın kürk rengi ve çevreye bağlı görüntüleme hataları gibi birçok faktörden etkilenmektedir. Makine öğrenmesi perspektifinden bakıldığında, öğrenme aktarımı yaklaşımı görüntü kalitesini değiştiren faktörlerin etkisini azaltabilir. Ayrıca, daha fazla veri ve işlem gücüne ihtiyaç duysa da derin öğrenme modelleri, diğer geleneksel makine öğrenmesi yöntemlerine göre daha yüksek başarı sağlayabilirler. Sonuç olarak, bilgisayarla görmeye dayalı yöntemler görüntü eldesindeki teknik zorluklar nedeniyle henüz tam etkili ve olgunlaşmış bir çözüm sunmasa da hayvan ağırlık kestirimi konusunda gelecek vadettirmektedir.

Anahtar kelimeler: Makine öğrenmesi, bilgisayarla görme, ağırlık tahmini, çiftlik hayvanları



LIVESTOCK WEIGHT ESTIMATION BASED ON COMPUTER VISION

ABSTRACT

Measuring the weight of animals is essential for determining their diet, growth, and health state. Nevertheless, tracking animal growth in real time with conventional scales is stressful for the animals and expensive and labor-intensive for producers. The purpose of this research is to investigate the various computerized imaging and machine learning techniques utilized to automate this process for farm animals. Numerous databases and keywords were utilized to construct the research on this topic. It has been observed that prediction models based on computer vision have been constructed employing two- and three-dimensional image data. Image acquisition can be conducted using systems comprised of two-dimensional cameras, three-dimensional cameras (depth camera), infrared and ultrasonic sensors, or combinations thereof. For weight estimation, metrics such as body area as viewed from above, wither height, shoulder height, body length, hip width, body volume, and chest circumference are employed. Various machine learning and deep learning methods have been used to estimate the body mass of animals based on the image processing-obtained parameters. Diverse evaluative criteria were utilized for classification in weight estimation models, and it was shown that accuracy values between 73.21 and 98.93 percent were attainable. Numerous aspects influence the performance of image-based weight estimate applications, including picture quality, camera position, ambient illumination, camera calibration, animal body posture, imaging timing, animal fur colour, and environmental imaging errors. From the standpoint of machine learning, the learning transfer method can mitigate the influence of picture quality-altering elements. In addition, although they demand more data and computing capacity, deep learning models can achieve more success than other classic machine learning approaches. In conclusion, despite the fact that computer vision-based approaches do not yet provide a fully effective and mature solution due to technological problems in picture collecting, they are promising for estimating animal weight.

Keywords: Machine learning, computer vision, weight estimation, livestock



SILVER/CELLULOSE NANOCRYSTAL-DOPED CeO₂ QUANTUM DOTS SERVED AS INDUSTRIAL DYE DEGRADER

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ABSTRACT

In the present study, the novel Ag/cellulose nanocrystal (CNC)-doped CeO₂ quantum dots (QDs) with highly efficient catalytic performance were synthesized using one pot co-precipitation technique, which were then applied in the degradation of methylene blue and ciprofloxacin (MBCF) in wastewater. Catalytic activity against MBCF dye was significantly reduced (99.3%) for (4%) Ag dopant concentration in acidic medium. For Ag/CNC-doped CeO₂ vast inhibition domain of G-ve was significantly confirmed as (5.25–11.70 mm) and (7.15–13.60 mm), while medium- to high-concentration of CNC levels were calculated for G + ve (0.95 mm, 1.65 mm), respectively. Overall, (4%) Ag/CNC-doped CeO₂ revealed significant antimicrobial activity against G-ve relative to G + ve at both concentrations, respectively. (Published in Carbohydrates Polymer, 2021)

Keywords: Silver; CNC; catalytic activity



EMERGING ISSUES, DETECTION AND REMEDIATION TECHNOLOGIES OF HEAVY METALS FROM CONTAMINATED ENVIRONMENTAL SOURCES

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ABSTRACT

Aim: Heavy metals have toxic effects on living organisms and the occurrence of heavy metals in nature has been raised significant concerns throughout the world. So, the aim of current research is the production and utilization of earthworm species along with the green hyper-accumulators for the remediation of heavy metals. Sufficient knowledge is lacking on the indigenous fauna of worms concerning vermiremediation in Azad Jammu and Kashmir, Pakistan. **Methods:** *Eisenia fetida*, *Pheretima lignicola* (earthworm species), and *Spinacia oleracea* (plant species) were used for the remediation of cadmium, lead, and chromium from artificial prepared soil. Different concentrations such as 0 mg, 5 mg, 10 mg, 20 mg, 40 mg, 80 mg, 160 mg, 320 mg, and 640 mg of each heavy metal i.e. lead nitrate, chromium nitrate, and cadmium nitrate per kg of soil were used for artificial soil preparation. Throughout the research work, Vermiremediation experiment was carried out for 60 days and phytoremediation was carried out for 45 days. After experimentations, the effect of heavy metals on the growth and reproduction of *E. fetida* were examined. The effect of heavy metals on *E. fetida* through FTIR (functional groups analysis), histology (internal architecture), and comet assay (DNA damaging effect) were also recorded. Similarly, the effect of heavy metals on seedling and growth parameters of *S. oleracea* were recorded. DNA damaging and functional groups involved in the phytoremediation were also examined through FTIR and comet assay. Heavy metals were analyzed using Atomic Absorption Spectrophotometer and bioaccumulation factor was calculated. *E. fetida* associated bacteria were also screened for the bacto-remediation capabilities. **Results:** The current study revealed that various concentrations of heavy metals (5 mg to 640 mg) did not affect the cocoon production and hatching of *E. fetida*. Atomic absorption spectrometry (AAS) results reveal that *E. fetida* significantly ($P < 0.001$) and efficiently remediate the heavy metals from the artificially contaminated soil. Bioaccumulation factor results revealed that *E. fetida* showed maximum accumulation of cadmium>chromium>lead.



The BAF for all the heavy metals showed a positive correlation with each other i.e. Cd ($R^2 = 0.1814$, $P < 0.001$), Cr ($R^2 = 0.8686$, $P < 0.001$), and Pb ($R^2 = 0.0026$, $P < 0.001$) and clearly showed that heavy metals are accumulated in the tissues of *E. fetida*. In the case of phytoremediation of heavy metals, results revealed that *Spinacia oleracea* showed significant remediation of heavy metals from the artificially prepared soil at $P < 0.001$. Among all three metals (Pb, Cd, and Cr) Cd had more effect on the growth of *S. oleracea*, and Cd concentrations (80-640 mg) not only reduced the number of plants but also reduced leaf and root areas. The BAF showed correlation as: Cd ($R^2 = 0.0012$, $P < 0.001$), Cr ($R^2 = 0.0018$, $P < 0.001$), and Pb ($R^2 = 0.1383$, $P < 0.001$).

Conclusions: The current study reveals that vermiremediation, bactoremediation, and phytoremediation integrated approaches. These approaches are linked to each other, all associations i.e. soil, microbes, organisms, and plants play an important role in the remediation of heavy metals.



**ÖN VERİM KADEMESİNDEKİ BAZI EKMEKLİK BUĞDAY GENOTİPLERİNİN
SARI PAS'A (*Puccinia striiformis* f. sp. *triticici*) KARŞI DAYANIKLILIKLARININ SUNİ
İNOKULASYON İLE BELİRLENMESİ**

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ÖZET

Sarı Pas (*Puccinia striiformis* f. sp. *tritici*), sarı pas oluşumunu sınırlayan önemli biyotik stres faktörlerinden biridir. Ülkemizde buğday verimi ve kalitesi. Dirençli/toleranslı çeşitlerin geliştirilmesi ve kullanımı en etkili hastalık kontrol yöntemlerinden biridir. Bu amaçla; Tarla Bitkileri Merkez Araştırma Enstitüsü (TARM) Islah ve Genetik Bölümü, Buğday Islahı Birimince geliştirilmiş Ekmeklik Ön Verim Denemesine (EÖVD) ait 321 genotipte fide ve ergin dönem reaksiyonları 2020-2021 üretim sezonunda *Warrior* (PstS7; 1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,Amb dayanıklılık genleri üzerine etkin) sarı pas ırkı kullanılarak suni inokulasyon ile belirlenmiştir. Fide dönemi testleri TARM Yenimahalle yerleşkesinde bulunan seralarda gerçekleştirilmiştir. Mineral yağ (Soltrol 170®) içerisinde süspanse edilen üredinosporlar, 15-20°C sera koşullarında 7-9 gün süre ile yetiştirilen bitkilere inokule edilmiştir. İnkübasyon için bitkiler 9°C de 24 saat süreyle %100 nem içeren ortamda bırakılmış ve sonra 15-20°C sera koşullarına aktarılmıştır. Fide dönemi reaksiyonları inokulasyondan 15-17 gün sonra 0-9 McNeal skalası kullanılarak değerlendirilmiştir. 0-6 arası reaksiyon gösteren genotipler dayanıklı olarak, 7-9 arası reaksiyon gösteren genotipler hassas olarak değerlendirilmiştir. Fide dönem testleri sonucunda 321 materyalin 51'i hassas 254'ü dayanıklı olarak belirlenmiştir. Ergin dönem testleri ise TARM, Ankara İkizce Araştırma ve Uygulama Çiftliği'nde yürütülmüştür. Genotipler 1'er metrelik sıralara elle ekilmiştir. Her 10 sırada bir hassas kontrol olarak Little club çeşidi ekilmiştir. Hassas kontrol çeşidinde reaksiyon 90S'e ulaştığında Modifiye Cobb skalası kullanılarak genotipler değerlendirilmiştir. Ergin dönem testleri sonucunda %16 genotip dayanıklı, %79'u hassas olarak tespit edilmiştir.

Anahtar kelimeler: Sarı Pas (*Puccinia striiformis* f. sp. *tritici*), kışlık buğday, dayanıklılık kaynağı



DETECTION OF REACTION OF SOME WHEAT GENOTYPES TO YELLOW RUST (*Puccinia striiformis* f. sp. *tritici*) WITH ARTIFICIAL INOCULATION

ABSTRACT

Yellow Rust (*Puccinia striiformis* f. sp. *tritici*) is one of the important biotic stress factors limiting wheat yield and quality in our country. The development and use of resistant/tolerant varieties are one of the most effective methods of disease control. The aim of this study; Field Crops Central Research Institute (TARM) Department of Breeding and Genetics, Wheat Breeding Unit, seedling and adult reactions of 321 genotypes of Bread Pre-yield Trial (EÖVD) in the 2020-2021 production season *Warrior* (PstS7; 1,2,3,4,-,6,7,-,9,-,-,17,-,25,-,32,Sp,AvS,Amb resistance genes) were determined by artificial inoculation using yellow rust strain. Seedling period tests were carried out in greenhouses located in TARM Yenimahalle campus. Urediniospores suspended in mineral oil (Soltrol 170®) were inoculated into plants grown under greenhouse conditions of 15-20°C for 7-9 days. For incubation, the plants were left at 9 °C for 24 hours in an environment containing 100% humidity and then transferred to greenhouse conditions at 15-20 °C. Seedling stage reactions were evaluated 15-17 days after inoculation using the 0-9 McNeal scale. Genotypes showing 0-6 reactions were evaluated as resistant, and genotypes showing 7-9 reactions were evaluated as sensitive. As a result of the seedling period tests, 51 of 321 materials were determined as sensitive and 254 as resistant. Adult tests were carried out at TARM, Ankara İkiççe Research and Application Farm. Genotypes were sown in 1-meter rows by hand. Little club variety was planted every 10 rows as a precision control. When the reaction reached 90S in the sensitive control variety, the genotypes were evaluated using the Modified Cobb scale. As a result of the adult tests, 16% of the genotypes were found to be resistant and 79% to be sensitive.

Keywords: Yellow Rust (*Puccinia striiformis* f. sp. *tritici*), winter wheat, source of resistance



COMPLEXITIES INVOLVED IN DRUG APPROVAL PROCESS BY USFDA

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ABSTRACT

US pharmaceutical market is highly regulated market and US pharmaceutical industry earns \$550 billion in 2021. The US pharmaceutical market accounted for 48% of global pharmaceutical market as of 2020. In the development of new drug a lot of research efforts are put in at every step by the medicinal chemists, pharmacologists and pharmaceutical technologists. Data of various steps involved like discovery, preclinical tests, clinical tests are required to be submitted for the drug approval process and this is really complex and voluminous data is being generated during these steps. The regulatory body of USA is USFDA that analyze the safety and efficacy of the drug candidate before being approved for marketing. Drug reviewer in regulatory agencies around the world bear the responsibility of evaluating whether the research data is sufficient to support the safety, efficacy, and quality of new drug product which serves the public health.

Keywords: USFDA, IND, NDA.



ETUDES DES SERVICES ÉCOSYSTÉMIQUES RENDUS PAR LES DIFFÉRENTS ÉCOSYSTÈMES DE LA COMMUNE DE TORI-BOSSITO

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RESUME

Les écosystèmes de la commune de Tori-Bossito et la biodiversité sont soumis à de fortes pressions anthropiques. En effet, les habitats naturels terrestres, aquatiques et anthropiques participent à cette biodiversité et leur situation les rend accessibles aux hommes. Ces habitats fournissent des services écosystémiques (des services et des biens à l'origine de bien-être pour les humains). L'objectif de ce travail est d'identifier et caractériser les services fournis par les écosystèmes de la commune. Le travail a permis de réaliser un état des connaissances des populations locales et autres acteurs sur la fourniture des services écosystémiques par les écosystèmes. La méthodologie appliquée, à la collecte et l'analyse de la littérature scientifique afin de fixer un cadre opérationnel d'analyse pour la spécification et l'évaluation des services écosystémiques rendus par les écosystèmes naturels et semi-naturels, d'identifier la liste des services écosystémiques à instruire, et de proposer des méthodes d'évaluation de ces services écosystémiques ; collecte et analyse des données de terrain. L'approche ascendante par habitat et par services écosystémiques a été appliquée. Quatre (4) discussions de groupe et 7 entretiens individuels ont été réalisés avec divers acteurs : eaux, forêts et chasse ; services communaux ; cellule communale de l'agence territoriale pour le développement agricole ; associations de jeunes et de femmes, des agriculteurs, des éleveurs, des chasseurs, chefs traditionnels et religieux. Les résultats révèlent 25 services rendus réparties suivant dans 3 catégories de services écosystémiques retenues dans le cadre de cette étude. Il s'agit des services de l'approvisionnement, culturels et régulation. Cette étude ouvre des perspectives intéressantes en matière d'évaluation de la restauration de sites dégradés.

Mots-clés: habitats, services écosystémiques, caractérisation, Tori-Bossito, Bénin



EFFECTS OF LIPID BASED MULTIPLE MICRONUTRIENTS SUPPLEMENT ON THE BIRTH OUTCOME OF UNDERWEIGHT PRE-ECLAMPTIC WOMEN: A RANDOMIZED CLINICAL TRIAL

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ABSTRACT

Background and Objective: Maternal under nutrition and low birth weight babies are among the common tragedies of developing countries like Pakistan. Preeclampsia and its significant association with fetal growth restriction due to spiral arteries remodeling and trophoblastic invasion decreases nutritional supply to growing fetus added by maternal under nutrition. This study was designed to see the effects of lipid based nutritional supplements for pregnant and lactating women LNS-PLW on maternal and fetal outcome of pre-eclampsia. Methods: Sixty underweight pre-eclamptic women were randomly assigned into two study Groups from April 2018 to December 2019 at the antenatal units of the tertiary Health care facilities of Lady Reading Hospital, Hayatabad Medical Complex Peshawar and Civil Hospital Matta Swat, KPK Pakistan in a randomized clinical trial. Participants were on routine drugs for pre-eclampsia and Iron and Folic Acid (60mg, 400 µg) daily, while participant of Group-2 (n=30) received one sachet of Lipid based nutritional supplement for pregnant and lactating women LNS-PLW in addition daily till delivery. The birth weight, gestational age, head-circumference, and birth length of babies were measured. Results: The significant improvement found in the birth weight (p-value 0.003), gestational age (p-value 0.006), head circumference (P-value of 0.0006) and birth length (P-value of 0.0017) of babies of Group-2 women. We observed that addition of Lipid based nutritional supplement for pregnant and lactating women LNS-LPW improved the birth outcome in underweight women of pre-eclampsia. Conclusion: The Prenatal supplementation of Lipid based nutritional supplement for pregnant and lactating women LNS-PLW can improve birth weight, gestational age, length and head circumference of babies of underweight preeclamptic women.

Keywords: Pre-eclampsia, lipid based nutritional supplements, neonatal outcome, khyber pakhtun khwa province Pakistan



CONTRIBUTION TO THE KNOWLEDGE OF THE BUTTERFLY FAUNA OF SOME LOCALITIES IN THE NATIONAL PARK "BJESHKET E NEMUNA"

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ABSTRACT

The National Park "Bjeshket e Nemuna" is very rich in butterfly fauna for what it has been declared a prime butterfly area. It is located in the northwestern part of Kosovo, north of Albania, west of Kosovo, and southeast of Montenegro. The purpose of this study was to learn more about the butterfly fauna's composition. We conducted our surveys at seven locations, including "Peklen," "Gryka e Rugoves," "Boge," "Shkrel," "Kuqishte," "Junik," and "Lloqan," in the National Park "Bjeshket e Nemuna," at elevations ranging from 610 m to 1595 m. The survey was conducted in the period from June to October 2019, mostly on sunny days. The butterflies were collected with entomological nets, then the species were mainly identified in the field and released back into nature. A total of 68 butterfly species were discovered during this survey, one of which is a new species for Kosovo (*Heteropterus morpheus*, Pallas 1771). Of the 68 species discovered, 32 are members of the Nymphalidae family, 22 of the Lycaenidae, 10 of the Pieridae, 3 of the Hesperidae, and 1 of the Papilionidae. One species is listed in the European Red List of Butterflies as Near Threatened: *Parnassius apollo* (Linnaeus, 1758). Further research is required to obtain more data on the presence and distribution of other species in this region of the National Park "Bjeshket e Nemuna".

Keywords: National park, butterfly diversity, red list



EATING GREEN WITH VEGETABLE-BASED PASTA

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ABSTRACT

This project introduced a new variant of pasta which was made from the conventional ingredients with the addition of sweet potato and spinach. The goal is to produce a type of pasta that is more nutritious and more aesthetically appealing to the local population in Keningau. The locals appeared to have shown less interest in eating healthy and their choice of food is heavily influenced by aesthetic appearance of the food. Thus, this project was intended to offer this food product as an alternative that can provide nutrients to the target customers with greater aesthetic appeal. The target subjects were villagers from a local area in Keningau, Sabah, Malaysia. There were 30 respondents who sampled the pasta and gave their feedback through Likert-scale questionnaire. The results revealed that the respondents generally expressed approval on the taste, aesthetic appeal, texture and aroma of the paste but remained less confident in its commercial potential for the local market. It was recommended that more experiments on the taste and texture need to be done and the target group should be expanded to gather data from different groups in the community.

Keywords: pasta, sweet potato, spinach, aesthetic appeal, nutrients



ELMA KABUĞUNDAN FENOLİK MADDE EKSTRAKSİYONU

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ÖZET

Elmalar diyetin önemli bir parçasıdır. Özellikle fenolik bileşikler başta olmak üzere çok sayıda bitkisel besin açısından zengin bir kaynaktır. Meyve suyu ve kurutma endüstrisinde yan ürün olarak ortaya çıkan elma kabuğu etkin bir şekilde değerlendirilemeyen bir atıktır. Elma kabuğu, önemli miktarda fenolik bileşik ve antioksidan madde içermektedir. Bu nedenle elma kabukları biyoaktif bileşiklerin alternatif bir kaynağıdır ve elma kabuklarının gıda, kozmetik ve ilaç sanayinde kullanım potansiyeli bulunmaktadır. Meyve ve sebzelerin yapısında doğal olarak bulunan fenolik bileşikler farklı ekstraksiyon yöntemleri ile elde edilmektedir. Fenolik bileşiklerin ekstraksiyonunda yaygın olarak kullanılan konvansiyonel yöntemin uzun zaman alması ve fazla miktarda çözücü kullanımı nedeniyle ultrason destekli ekstraksiyon konvansiyonel yöntem alternatif olarak görülen bir ekstraksiyon tekniğidir. Bu çalışmada ultrason destekli ekstraksiyon ile konvansiyonel ekstraksiyon yöntemlerinin elma kabuklarından fenolik madde ve antioksidan madde (DPPH) ekstraksiyonu üzerine etkilerinin araştırılması amaçlanmıştır. Çalışmada, ultrason destekli ekstraksiyon ile konvansiyonel ekstraksiyon denenmiş ve farklı zaman aralıklarında elde edilen ekstraktların toplam fenolik madde miktarı ve antioksidan aktivite değeri belirlenmiştir. Ultrason destekli ekstraksiyon ve konvansiyonel yöntemlerinde süre arttıkça elma kabuğundan suya geçen toplam fenolik madde miktarı ve antioksidan aktivite değeri artmıştır. Toplam fenolik madde miktarı açısından, 30 dakikalık ultrason destekli ekstraksiyon, konvansiyonel yöntemin 60 dakikalık ekstraksiyonuna denk gelirken, 45 dakikalık ultrasonikasyon konvansiyonel ekstraksiyonun 90. dakikasından daha yüksek bulunmuştur. Antioksidan aktivite değerleri açısından ise, 30 dakikalık ultrason destekli ekstraksiyon, konvansiyonel ekstraksiyonun 90. dakikasından daha yüksek bulunmuştur. Sonuç olarak bir işleme atığı olarak görülen elma kabuğunun fenolik maddelerinin ekstrakte edilip değerlendirilebileceği, ultrason destekli ekstraksiyon yönteminin ise konvansiyonel yöntem göre daha hızlı ve daha etkili olduğu saptanmıştır.

Anahtar kelimeler: Antioksidan, elma kabuğu, ekstraksiyon, fenolik madde, ultrason



EXTRACTION OF PHENOLIC SUBSTANCE FROM APPLE PEEL

ABSTRACT

Apple is an important part of the diet and a rich source of numerous phytonutrients, particularly phenolic compounds. Apple peel is a by-product of the apple juice and dry apple production and cannot be effectively evaluated. Apple peel contains significant amounts of phenolic compounds and antioxidants. Therefore, apple peel is an alternative source of the bioactive compounds and apple peel has potential for use in the food, cosmetics and pharmaceutical industry. Phenolic compounds from fruits and vegetables are extracted by different extraction methods. Ultrasound assisted extraction is an alternative extraction technique to the conventional method. Conventional methods is widely used in the extraction of phenolic compounds. However, it takes a long time and uses a large amount of solvent. The purpose of this study was to investigate the impacts of ultrasonic-assisted and conventional extraction methods on phenolic content extraction from apple peels. The total phenolic content and antioxidant activity of extracts at different time intervals during the extraction was determined. For both extraction methods, total phenolic contents and antioxidant activities of extracts raised with increasing extraction time. The phenolic content extraction process, which takes 60 min with conventional extraction, was completed to 30 min with ultrasound assisted extraction. Ultrasonic application for 45 min had a higher total phenolic content than the conventional extraction for 90 min. The ultrasound assisted extraction for 30 min yielded a higher antioxidant activity than the conventional extraction for 90 min. It was concluded that the phenolic substances of apple peel can be successfully extracted and evaluated. Especially the ultrasound assisted extraction method is faster and more effective than the conventional method.

Keywords: Antioxidant, apple peel, extraction, phenolic content, ultrasound



VAKUM DESTEKLİ İNFRARED KURUTMA İLE KURUTULAN ELMA ÇİPSLERİNİN BAZI KALİTE ÖZELLİKLERİNİN DEĞERLENDİRİLMESİ

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ÖZET

Elmalar iyi bir tada, renge ve dokuya sahip, oldukça besleyici ürünlerdir. Yıl içinde hasat döneminde kısa bir süre için oldukça fazla miktarda ürün elde edilmektedir. Taze elmaların belli bir bölümü soğukta muhafaza edilerek uzunca bir süre korunup piyasaya arz edilebilirler. Ancak hasat edilen ürünün önemli bir kısmının sonraki dönemlerde gıda olarak kullanılabilmesi için farklı işlemlerden geçirilerek farklı ürünlere dönüştürülmektedir. Kurutma, genellikle nemli bir üründen termal olarak su uzaklaştırma işlemi olarak tanımlanır ve farklı endüstrilerde sıklıkla kullanılan en önemli işlemlerden biridir. Kurutma en eski gıda işleme yöntemidir. Nem içeriği azaltıldığı için kuru gıdalar daha besleyicidir. Ayrıca kurutma ile gıdaların paketlenme, depolama ve nakliye maliyetleri en aza indirilir. Son yıllarda sağlık üzerine olumlu etkileri olduğu için popüler olan meyve cipsleri de genellikle kurutma teknolojisi ile üretilirler. Bu çalışmada, farklı infrared güç seviyeleri (180, 275 ve 325 W) ve vakum basıncının (100 ve 400 mmHg) elma cipslerinin bazı kalite parametreleri üzerindeki etkisi araştırılmıştır. Kurutulmuş elma cipslerinin renk (L^* , a^* ve b^*), rehidrasyon, 5-Hidroksimetilfurfural (HMF), esmerleşme indeksi, şeker bileşenleri (glukoz, fruktoz ve sakaroz) ve toplam şeker gibi bazı fiziksel ve kimyasal özellikleri incelenmiştir. İnfrared güç seviyelerinin elma cipslerini kuruma süresini, fiziksel ve kimyasal özelliklerini etkilediği gözlemlendi. İnfrared gücün artmasıyla örneklerin kuruma süresi azalmıştır. Her iki vakum basıncında da kurutulmuş elma cipslerinin L^* değerleri, rehidrasyon oranı ve toplam şeker içerikleri artan infrared güçle azalırken, a^* ve b^* değerleri, esmerleşme indeksi ve HMF miktarı artmıştır. Aynı kurutma sıcaklığında genellikle 100 mmHg ile kurutulan örnekler 400 mmHg ile kurutulan örneklere kıyasla daha yüksek rehidrasyon oranı, daha parlak renk ve şeker içeriği, daha düşük esmerleşme indeksi ve HMF içeriğine sahip olmuştur. Elma cipsi üretiminde yüksek infrared gücün ve yüksek vakum basıncının kurutma süresinin azalmasına katkıda bulunduğu ve vakum destekli infrared kurutma ile elma cipsinin başarılı bir şekilde üretilebileceği sonucuna varılmıştır.

Anahtar kelimeler: Elma cipsi, renk, 5-hidroksimetilfurfural, infrared kurutma, şeker

Teşekkür: Bu çalışma Van Yüzüncü Yıl Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından desteklenmiştir (Proje No: **FDK-2021-9659**).



EVALUATION OF SOME QUALITY CHARACTERISTICS OF APPLE CHIPS DRIED BY VACUUM ASSISTED INFRARED DRYING

ABSTRACT

Apples have good taste, color and texture and are highly nutritious. A large amount of apple is obtained for a short harvest period. A certain part of the fresh apples can be stored in the cold for a long time and offered to the market. However, the majority of fresh apples processed using different processes. Drying is usually described as a thermal process that water removes from a wet product by thermal processing. Drying is one of the most important operations commonly using in various industries. Drying is one of the oldest preservation processes in food technology. Dried foods are more nutritious as their moisture content is reduced. In addition, packaging, storage and transportation costs of foods are minimized by drying. Fruit chips are generally produced with drying technology. They have become popular in recent years because of their positive effects on health. In this study, effect of different infrared power levels (180, 275 and 325 W) and vacuum pressure (100 and 400 mmHg) on some quality parameters of apple chips was investigated. Some physical and chemical properties (color (L*, a* and b*), rehydration rate, 5-Hydroxymethylfurfural (HMF), browning index and sugar content) of apple chips were investigated. It was observed that the infrared power levels affected the drying time, physical and chemical properties of apple chips. The drying time of the samples decreased with increasing the infrared power. For both vacuum pressures, while L* values, rehydration rate and total sugar content decreased with an increasing infrared power the a* and b* values, browning index and HMF content increased. Generally, at the same drying temperature, sample dried at 100 mmHg had higher rehydration ratio, brighter color, and sugar content and lower browning index, and HMF when compared to samples dried at 400 mmHg. In the production of apple chips, high infrared power and high vacuum pressure contributed to the reduction of drying time. It was concluded that apple chips can be produced successfully with vacuum assisted infrared drying.

Keywords: Apple chips, color, 5-hydroxymethylfurfural, infrared drying, sugar



KNOWLEDGE AND PRACTICE OF PERSONAL HYGIENE AMONG PRIMARY SCHOOL PUPILS IN PAKI COMMUNITY IKARA LOCAL GOVERNMENT AREA OF KADUNA STATE

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ABSTRACT

Background: Good knowledge and practice of personal hygiene plays a major role in reduction of the burden of communicable diseases, when school pupils are educated on the knowledge and practice of personal hygiene that will promote and protect their health. Aims: Assess knowledge and practice of personal hygiene among primary school pupils in Paki community.

Methods: This study adopted Simple random sampling technique and stratified random sampling technique was conducted among 300 primary school pupils of class four to six from four (4) selected primary schools in paki community, age group 7 to 14 years. Closed ended questionnaire was used for data collection.

Results: Hypothesis tested significant gender influence on knowledge of personal hygiene with $p = 0.024$, Females pupils with 170(56.7) adequate knowledge while males primary pupils has 130(43.3%). **Conclusion:** Gender has an influence on knowledge of personal hygiene among primary school pupils in Paki community.

Recommendation: Government should intensify efforts in health education with emphasis on the importance of personal hygiene in all the primary schools in the state and Schools in Paki community should encourage inter school competition on personal hygiene to increase awareness of personal hygiene among others.

Keywords: Knowledge, practices, personal hygiene, primary school pupils, class, gender



EVALUATION OF THE ADMINISTRATION OF EPHEDRA ALATA EXTRACT TO OBESE RATS ON THE LIPASE AND A-AMYLASE ACTIVITIES, INSULIN RESISTANCE, GLYCOGEN LEVEL, AND TYPE 2 DIABETES INDUCED VARIOUS ORGANS TOXICITIES

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ABSTRACT

Obesity is a metabolic disease marked by an augmented blood glucose and disorders in the metabolisms of lipids, sugars, and proteins. This disease participates in various perturbations such as type 2 diabetes, hypertension, heart diseases, cancers and various other diseases. The purpose of the study was to identify the possible anti-diabetic, anti-obesity, and anti-toxic properties of *Ephedra alata* by analyzing its phytochemical composition, effects on the α -amylase and lipase enzymes, and toxicities caused by diabetes on the liver, kidneys, and blood tests. Obesity was caused by a high-fat, high-fructose diet (HFFD). Different elements were recognized and evaluated in EA aqueous extract (EAWE). We found that EAWE induced inhibition of lipase activity when compared to EA methanol (EAME) and ethyl acetate EA extracts (EAEE). EAWE treatment reduced significantly ($P < 0.01$) the intestinal and pancreatic lipase activity in obese rats by 35 and 36%, respectively. Furthermore, administration of EAWE to obese rats reduced α -amylase activity in the small intestine and pancreas by 26 and 31%, respectively ($P < 0.01$), resulting in a 20.8% decrease in serum glucose level ($P < 0.05$). Additionally, EAWE treatment in type 2 diabetes prevented obesity-related changes to the liver, kidneys, and testicles. The variety of phenolic compounds may have an impact on the powerful protective effect of EAWE. This study thus demonstrated for the first time that EAWE are effective for the mitigation of obesity, hyperglycemia, and different organ toxicity.

Keywords: *Ephedra alata*, obesity, type 2 diabetes



GIDA SEKTÖRÜNDE YENİ TREND: BİTKİSEL BAZLI SÜT ÜRÜNLERİ ALTERNATİFLERİ

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ÖZET

Günümüzde yaşam tarzının değişmesi, sürdürülebilir gıda üretiminin öneminin anlaşılması ve sağlık bilincine sahip tüketicilerin artması ile alternatif diyetlere yönelim de artmıştır. Bu bağlamda, yeni geliştirilen gıda ürünleri kategorisinde bitkisel bazlı süt alternatiflerine yönelik hızla büyüyen bir talep bulunmaktadır. Süt hayvancılığının olumsuz çevresel etkileri konusunda artan farkındalık, etik kaygılar, laktoz intoleransı ve inek sütü alerjisi gibi sağlık nedenleri, tüketicilerin süt ve süt ürünleri yerine bitki bazlı alternatifleri seçmesine sebep olmaktadır. Bitkisel bazlı sütlerin üretiminde hayvansal bazlı ürünlere kıyasla daha az enerji kullanılmakta ve gram protein başına daha az sera gazı emisyonu sağlanmaktadır. Böylece bu ürünler, karbon ayak izini azaltmak için etkili bir seçenek haline gelmektedir. Soya sütü, pirinç, badem ve fındık bazlı süt ikameleri en popüler süt alternatifleridir. İnek sütünde bulunan laktozu içermediklerinden özellikle laktoz intoleransı olan kişiler için iyi birer seçenektirler. Bunun yanında bu ürünlerin yağ oranı, özellikle doymuş yağ oranı daha düşüktür ve bu nedenle daha az yağlı ürünler talep eden tüketiciler için de iyi bir opsiyon olarak karşımıza çıkmaktadırlar. Süt benzeri bitkisel bazlı içecekler de bu alternatifler arasında önemli bir yer kaplamaktadır ve genellikle tahıl, sert kabuklu meyve, baklagil ve tohum gibi çeşitli hammaddelerin suda ekstrakte edilmesi ile üretilmektedirler. Ek olarak, bitki bazlı süt alternatifleri, diyet lifi, kalsiyum ve B12 vitamini gibi besinlerle takviye edilerek bu ürünlere fonksiyonel özellik kazandırılmaktadır. Sonuç olarak bitkisel bazlı süt alternatifleri pazarı sürekli genişleyerek gelecek vaad etmektedir. Bitkisel bazlı süt ikameleri beslenme ve sürdürülebilirlik açısından önem arz ettiğinden tüketicilerin ilgisini ve talebini çekmeye devam etmesi beklenmektedir.

Anahtar kelimeler: Süt içermeyen ürünler, bitkisel bazlı ürünler, süt alternatifleri



NEW TREND IN FOOD INDUSTRY: PLANT-BASED DAIRY ALTERNATIVES

ABSTRACT

Nowadays, the lean towards alternative diets has also increased with the change of lifestyle, understanding of the importance of sustainable food production and the increase in health-conscious consumers. In this context, there is a rapidly growing demand for plant-based dairy alternatives in the newly developed food products category. Growing awareness around the negative environmental effects of dairy farming, ethical concerns, health reasons including lactose intolerance and cow's milk allergy cause consumers to choose plant-based alternatives over milk and dairy products. In the production of plant-based alternatives, less energy is used, and less greenhouse gas emissions are provided per gram of protein compared to animal-based products. Thus, these products become an effective option to reduce the carbon footprint. Soy milk, rice, almond, and nut-based milk substitutes are the most popular milk alternatives. Since they do not contain the lactose found in cow's milk, they are a good choose especially for people with lactose intolerance. Furthermore, these products are lower in fat, especially saturated fat, and therefore they are a good option for consumers who demand products with less fat. Milk-like plant-based beverages also occupy an important place among these alternatives and are generally produced by extracting various raw materials such as grains, nuts, legumes and seeds in water. In addition, plant-based milk alternatives can be supplemented with nutrients such as dietary fiber, calcium, and vitamin B12 to add functional properties to these products. Consequently, the plant-based milk alternatives market is continuously expanding and promoting. Since plant-based milk substitutes are important in terms of nutrition and sustainability, it is expected that they will continue to attract the attention and demand of consumers.

Keywords: Non-dairy, plant-based products, milk alternatives



POWER SUPPLY FOR EMERGENCY PURPOSE

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ABSTRACT

The purpose of this research is to design a toolkit that contains components which can provide electrical power when such electricity is needed in certain environments where there is no or limited access to constant electrical supply. The device which is referred to as “Multipurpose Box” is a waterproof, light and portable box that contains light bulbs, batteries, sockets, USB port and a compass. It was discovered that people who travel to certain places like forests, mountains and seas where there is no access to electricity need to endure the experience of being in the dark with no reliable method to recharge their electronic devices and power electrical appliances. Thus, this project is intended to design a tool that can help to improve the experience and safety of people who travel to these places. It has been proposed that a group of respondents will be selected to be interviewed in order to elicit their opinions on this project. If this project proves to be successful, it can be potentially scaled up and possibly marketed to the public.

Keywords: electricity, power supply, electronic devices



MYCELIAL EVALUATION OF MILKY MUSHROOM ON CRACK CORN AND SORGHUM SUBCULTURE MEDIA

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ABSTRACT

The study aims to evaluate the mycelial growth of milky mushroom pure culture media in cracked corn and sorghum as subculture media. It focused on the average number of days to mycelial appearance, the average growth increment of mycelia every 3 days, and the average number of days to mycelial full colonization in a comparative study. The treatments were the following: Treatment 1 (cracked corn), and Treatment 2 (sorghum) with 3 replications and 5 samples per replication. Based on the results, it was concluded that Treatment 2 (Sorghum media) performed significantly with Treatment 1 (Cracked corn media) in terms of the average number of days to mycelial appearance, the average surface area covered by mycelia in subculture media every 3 days, and the average number of days to mycelial full colonization. Therefore, the use of sorghum as subculture media for milky mushrooms is recommended. Meanwhile, there are researchable areas to be addressed, such as the evaluation of other grains as subculture media and its combination.

Keywords: Milky mushroom, appearance, colonization, crack corn, sorghum



GEOBOTANICAL AND COMPARATIVE DATA ON VEGETATION IN SSELECTED AREAS OF CENTRAL ALBANIA, ELBASAN REGION

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ABSTRACT

At the current circumstances phytocenosis – agroecosystems and geobotanical approaches has been more difficult to avoid the transformation associated with the growth of global anthropogenic pressure. Concurrently, anthropogenic factors affect all parts of ecosystems, causing changes in the living component of nature. The study of the real state of ecosystems, their changes and stability under the load of anthropogenic factors is impossible without a comprehensive, in-depth study of them. In this contribution are presented vegetation data of the region of Elbasan, central Albania following comparative features from the systematic spectrum, biological forms and floristic element. It is worth to mention that survey area and associated vegetation is of particular interest due to its location and influences by the multifaceted Mediterranean-Atlantic climate with the continental one which enables this region to have rich biodiversity values and particular floristic composition. This survey is dedicated the region of Elbasan and covers three areas: Byshek, Xibraka-Shkumbini Valley and Elbasan. Based on geographical location and field expeditions there are identified and compared well-developed plant species, which are spontaneously growing, as well as plants that are rare and grow in limited areas in different climates and microclimates. Following the identified plant lists, systematic spectra and the percentage occupied by each family are constructed. The floristic diversity of this region is of scientific, economic and medical importance as the collection of plants provides a significant amount of raw materials for export, the pharmaceutical and chemical industries, making a valuable contribution to the country. Compliance with the requirements of environmental management, environmental protection and optimization of management of landscapes is becoming one of the main conditions for increasing ecosystems and associated species and habitats conservation.

Key words: conservation, vegetation, floristic element, biological forms, habitats



FLAVONOIDS: AN IMPORTANT DIETARY SUPPLEMENT IN PREVENTION OF CARDIOVASCULAR DISEASES.

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ABSTRACT

In recent years extensive study has proved a strong association between oxidative stress and different diseases like cancers, cardiovascular complications, diabetes, osteoporosis, and neurodegenerative diseases. Polyphenols with its remarkable antioxidant property has emerged as a magic bullet for prevention of such diseases. In initial years research on these compounds started through “French paradox,” which showed that despite of high fat diet people in France had low risk of cardiovascular complications. Study showed that wine which was made from grapes led to such outcome. Resveratrol which is a polyphenol found in *Vitis vinisera* had a strong antioxidant property and was responsible for this effect. Polyphenols such as flavonoids, phenolic acids, lignans, stilbenes, tannins, catechins and anthocyanidins has been extensively studied since these polyphenolic compounds offer protection against development of various ailments. It was found in the study that some biologically active molecule like flavonoids in various plant foods help to prevent production and accumulation of reactive oxygen species (ROS)/Cellular oxidative stress (OS) and thus shows antioxidant property. Cardiovascular complication resulting from accumulation of ROS can be prevented by these compounds present in polyphenols. Evidence suggests that nitric oxide bioavailability is increased by dietary polyphenols or their metabolites which act as signalling molecules and can induce protective enzymes. Some of the key issues in dietary polyphenol study is its bioavailability and through this study ADME profiling along with bioavailability study, structural mechanistic insights of the action of these bioactive compounds are highlighted. In this research the biological and pharmacological significance of dietary polyphenols in context of relevance to cardiovascular disease has been delineated.

Keywords: Polyphenols, oxidative stress, antioxidant, flavonoids



ECOLOGY, DIVERSITY AND CONSERVATION OF THE FLORA OF THE HUNZA VALLEY, CENTRAL KARAKORUM MOUNTAINS, NORTHERN PAKISTAN

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ABSTRACT

The present paper elaborates the results of vegetation and floristic research conducted in the valley of hunza, central karakorum mountains, northern Pakistan. the field surveys carried out from 2009 – 2010 yielded altogether 324 plant taxa in 183 genera and 48 families. based on climatic conditions, floristic assemblage, and species distribution the vegetation of the studied area can be categorized into three altitudinal belts i.e. temperate, sub-alpine, and alpine. altitude exhibits profound impacts on the species richness, composition, and surrogacy. maximum species richness was observed at the temperate belts. asteraceae was the prevailed family with 83 species followed by poaceae (29), fabaceae (16), and cyperaceous (16). perennial herbs (77%) were the leading habit with sub-dominating shrubs (11%) and annuals (9%). in life-form categories, hemicryptophytes presented 249 species followed by therophytes and nanophanerophytes with 29 taxa each. similarly, dry mountain slopes support maximum species i.e. 106 species followed by ruderal (90), and moist mountain slopes 84. the assessment for quantitative thresholds for conservation revealed that habitats of 28 taxa were observed unstable, 255 taxa exhibited habitat specificity, 75 displayed small population size, and 65 indicated small geographical range. based on quantitative thresholds analysis, the application of iucn red list criteria 2001 (version 3.1) disclosed that 38 species fell in critically endangered, 32 vulnerable, and 10 endangered categories. the current ecological and floristic appraisal of the studied area would be effective to devise and strengthen the conservation strategies of climatically fragile mountain ecosystems.

Keywords: Phytodiversity, vegetation zones, ecology, mountain ecosystem



DÜNYADA ve TÜRKİYE'DE ALTINOTU (*Helichrysum italicum*) TARIMI VE GELECEĞİ

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ÖZET

Dünyada 600 türü bulunan altınotu bitkisinin sadece *Helichrysum italicum* türünün alt varyetelerinin tarımı yapılmaktadır. Bu alt varyeteler arasında parfümeri ve kozmetik sektöründe en fazla kabul gören tür İtalya ve Fransa (özellikle Corsica adası) florasında bulunan subsp. *italicum* ve subsp. *microphyllum* alt türleridir. 2014 yılında kültüre alınmaya başlayan altınotu günümüzde dünyada en fazla Hırvatistan'da tarımı yapılmakta ve 3 ton civarında uçucu yağ üretildiği tahmin edilmektedir. Bosna-Hersek, Arnavutluk ve Fransa'da altınotu tarımı yapan ülkelerin başında gelmektedir. Ülkemizde altınotu tarımı ile ilgili bir veri bulunmamaktadır. Ancak Manisa, İzmir, Burdur, Ankara, Balıkesir, Çanakkale, Kütahya, Afyonkarahisar ve Isparta illerinde küçük alanlarda üretimlerin olduğu bilinmektedir. Son 10 yılda altınotu üretimi ve ekstrakt pazarında ivmeli bir artış gözlenmektedir. Ancak halen altınotu pazarında standartların belirlenmemiş olması ve özellikle bitkiden kaynaklanan uçucu yağ verimi ve bileşen farklılığı gibi olası riskler arasında bulunmaktadır. Altınotu bitkisinde birim alandan hasat edilen çiçek verimi, uçucu yağ oranı ve uçucu yağ bileşenleri farklılık göstermektedir. Yüksek polimorfizmden dolayı aynı alttürde bile farklı uçucu yağ oranı ve bileşenlerine sahip bireyler ortaya çıkmaktadır. Zira ölmez çiçekte birim alan çiçek verimliliği 0.5-1.5 ton/da arasında ve uçucu yağ oranı ise %0.12-0.35 arasında değişim göstermektedir. Uçucu yağ bileşenlerinde ise α -pinene, *ar*-curcumene veya neryl acetate bileşenlerinin yüksek olduğu alt türleri bulunmaktadır. Ülkemizde altınotu üretiminde dış pazar verileri analiz edilerek uçucu yağ veya diğer ekstraktların kullanım alanları ve şekilleri ile pazar potansiyeli değerlendirilerek üretime başlanması daha uygun olacaktır. Özellikle uçucu yağ profilinin sektörün talep ettiği bir ürün dışında olması ürünlerin değerlendirilmeme olasılığını artıracaktır. Bu nedenle ölmez çiçek ve ürünlerinin sektörün talep ettiği verimlilikte ve kalitede çeşit geliştirmeye ihtiyaç bulunmaktadır.

Anahtar kelimeler: Altınotu, *Helichrysum italicum*, tarım, verim, kalite, sorunlar ve geleceği



IMMORTELLE (*Helichrysum italicum*) FARMING AND FUTURE IN THE WORLD AND IN TURKEY

ABSTRACT

Only sub-varieties of *Helichrysum italicum* of the immortelle plant, which has 600 species in the world, are cultivated. Among these sub-varieties, the most accepted species in the perfumery and cosmetics industry is subsp. *italicum* and subsp. *microphyllum* subspecies. Immortelle, which started to be cultivated in 2014, is mostly cultivated in Croatia in the world and it is estimated that around 3 tons of essential oil is produced. Bosnia and Herzegovina is one of the countries that cultivate immortelle in Albania and France. There is no data on immortelle cultivation in our country. However, it is known that there are small areas of production in the provinces of Manisa, İzmir, Burdur, Ankara, Balıkesir, Çanakkale, Kütahya, Afyonkarahisar and Isparta. In the last 10 years, an accelerated increase has been observed in immortelle production and extracts market. However, there are still possible risks such as the lack of standards in the immortelle market and especially the essential oil yield and component differences arising from the plant. The flower yield, essential oil content and essential oil components harvested from the unit area differ in the immortelle plant. Due to the high polymorphism, individuals with different essential oil content and components emerge even in the same subspecies. Because the unit area flower productivity in immortelle varies between 0.5-1.5 tons/da and the essential oil content varies between 0.12-0.35%. In essential oil components, there are subspecies with high α -pinene, *ar*-curcumene or neryl acetate components. In our country, it would be more appropriate to start production by analysing foreign market data and evaluating the usage areas and forms of essential oil or other extracts and the market potential. In particular, the fact that the essential oil profile is not a product demanded by the industry will increase the possibility of products not being evaluated. For this reason, there is a need to develop varieties with the productivity and quality demanded by the industry of immortelle flowers and their products.

Keywords: Immortelle, *Helichrysum italicum*, farming, yield, quality, problems and future



SYNTHESIS OF BIOLOGICAL ACTIVE AMIDES AND ESTERS THROUGH VARIOUS CATALYTIC REACTIONS

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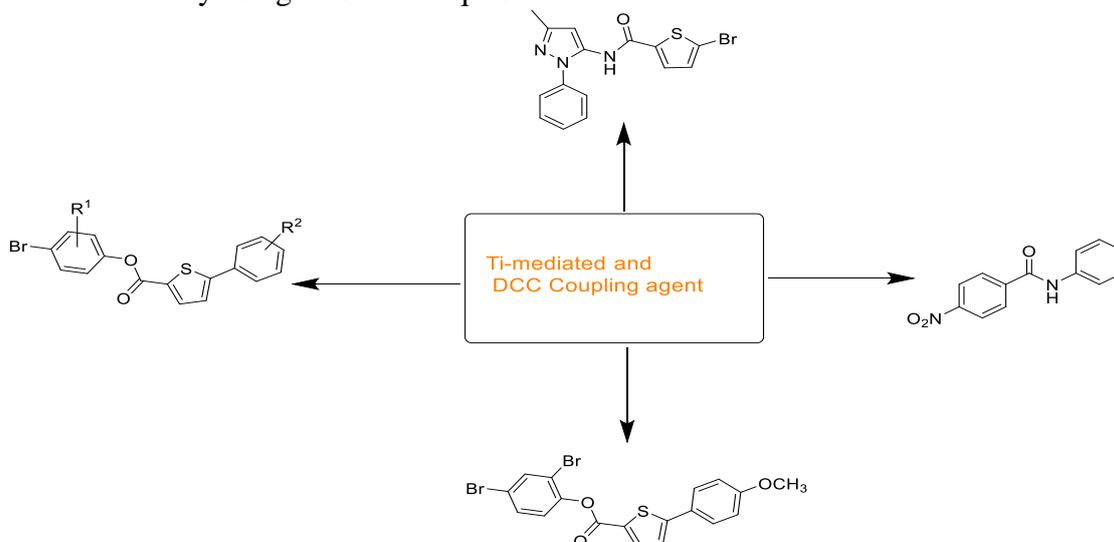
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ABSTRACT

In recent years, a number of organocatalysts (coupling agent, DCC, EDC, etc.) and Titanium mediated, methods have been developed for the formation of ester and amide in various organic synthesis. Esters and Amides show biological activities like anti-tumor, anti-fungal, antimicrobial and anti-hypertensive. Esters and Amides formation through titanium mediated and DCC coupling agent give very good yield. Our group has been synthesized various bio-active molecules by using these techniques.





THE SHORT-TERM IMPACT OF HIGH ENERGY NUTRITIONAL SUPPLEMENTS ON ENERGY BALANCE IN UNDERWEIGHT PRIMI-GRAVIDAE; A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Objectives: To determine the impact of high energy nutritional supplements on appetite, appetite regulators, energy intake and macronutrients level among underweight primi gravidae.

Methods: This study was a single blinded randomized controlled trial that included 37 underweight primigravida. The participants were randomly allocated to receive either high energy nutritional supplement (HENS) or Placebo. They were requested to come for the main trial in the fasting state. Appetite questionnaires were filled & blood samples were obtained in the fasted state, at 30, 60, 120, 210 and 270 minutes to measure blood glucose, Insulin, Peptide YY and Cholecystokinin. Breakfast and lunch was served at 30 minutes and 210 minutes after supplementation respectively.

Results: Energy intake after taking HENS was significantly higher than Placebo (HENS: 283.25 ± 102.650 kc, Placebo: 97.65 ± 62.291 kc, $p=0.000$). The mean protein (HENS: 7.23 ± 2.89 g, Placebo: 1.79 ± 0.88 g; $p=0.00$) and fats intake (HENS: 17.92 ± 4.79 g, Placebo: 0.36 ± 0.16 g; $p=0.00$) was significantly higher in HENS group after supplementation. The subjective appetite perceptions for 'hunger' and 'desire to eat' were significantly lower (calculated as AUC, $p=0.000$) before lunch in the HENS group. The plasma concentrations of appetite hormones corresponded to the appetite perceptions & were significantly higher after supplementation (HENS: 44.68 ± 10.16 pg/ml, Placebo: 32.83 ± 5.95 pg/ml; $p=0.00$), breakfast (HENS: 67.00 ± 9.53 pg/ml, Placebo: 54.05 ± 7.90 pg/ml; $p=0.00$) & lunch (HENS: 104.84 ± 13.05 pg/ml, Placebo: 90.66 ± 9.72 pg/ml; $p=0.001$) for PYY while CCK (HENS: 5.40 ± 2.90 ng/L, Placebo: 3.62 ± 1.40 ng/L; $p=0.025$) & Insulin (HENS: 9.64 ± 5.18 uU/ml, Placebo: 5.04 ± 1.93 uU/ml ; $p=0.001$) in the post supplementation period only.

Conclusion: We conclude that high energy nutritional supplement have short-term suppressive effect on energy intake and appetite.

Trial registration: ClinicalTrials.gov Identifier: ISRCTN 10088578. Registered on 27 March 2018. <https://www.isrctn.com/ISRCTN10088578>

Ethical approval number: (DIR/KMU-EB/EH/000453)

MeSH terms: Primi-gravida, Supplements, energy, macronutrients, appetite, appetite regulators



LOW BIRTH WEIGHT AMONG ADOLESCENT MOTHERS IN MURTALA MUHAMMAD SPECIALIST HOSPITAL, KANO, NIGERIA

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ABSTRACT

Background: Low birth weight (LBW) remains a global health challenge with both short and long term adverse consequences. It is an important indicator of the health status of an infant and a principal factor that determines the infant survival, physical and mental development in the future. Its etiology is complex and may vary from one setting to another. It is considered as sensitive index of nation's health and development.

Objective: This study was carried out to determine the prevalence of low birth weight among adolescent mothers in Murtala Muhammad specialist hospital.

Methodology: This study is a retrospective cross-sectional study in which 196 subjects' data were retrieved from delivery register of the maternity ward of Murtala Muhammad specialist hospital. Age of the mothers and weight of the babies were recorded. The data obtained was analyzed using both descriptive and inferential statistics. The descriptive (mean, standard deviation, range & percentage) and inferential (Pearson & Spearman) statistics were used to summarize the data. Alpha level was set at <0.05 P. All statistical analyses were performed using the Statistical Package for Social Science (SPSS) version 21.0.

Result: Out of 196 subject data, 22 (11.2%) were under weight, 165 (84.2%) were normal weight and 9 (4.6%) were overweight. On average, weight category was 3.00kg and mothers age range 14-19 years. Prevalence of low birth weight was found to be 11.2%. Age of the mother was found to be significantly not associated with the weight of the baby ($p=0.490$, $R=0.050$).

Conclusion/recommendation: A moderate prevalence of low birth weight was found among adolescent mothers. Age of the mother was found to be significantly not associated with weight of the baby. Therefore, adequate maternal nutrition during pregnancy is recommended.



DEVELOPMENT AND PERFORMANCE EVALUATION OF A JAT PLANTER

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ABSTRACT

Planting is a very important cultural practice associated with seed production. However, the stresses (especially postural such as back ache and musculoskeletal disorders) associated with planting at the appropriate seed depth and spacing is enormous especially for local farmers who do not have access to the mechanised method. Maize (*Zea Mays*) is a popular and common cereal crop which is grown amongst most farmers in Nigeria. A jat planter is a mini and innovative planter fabricated to keep farmers comfortable and upright while planting. This work was conducted to develop and evaluate the performance of a manually operated jat planter. The prototype Jat planter was fabricated from locally sourced materials to aid local farmers afford and easily adopt its use for planting. The Jat planter was fabricated in the fabrication workshop of the Department of Mechanical Engineering, Kogi State Polytechnic, Itakpe, Nigeria. The planter was evaluated using maize (*Zea Mays*) seeds. The average seed depth and average seed spacing using the planter were observed and evaluated. Data collected from the performance evaluation of the planter were presented and analysed with the use of representative statistics and average. The results obtained showed that the average seed depth of planting for Maize was 2.92cm and the average seed spacing for maize was 46.6cm.

Keywords: Jat planter, maize, locally sourced materials, local farmers



THE IMPACT OF SUBSIDIES ON INCREASING ECONOMIC PRODUCTIVITY IN THE AGRICULTURAL INDUSTRY AT THE LOCAL LEVEL – EVIDENCE FROM KOSOVO

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ABSTRACT

This study aims to investigate the impact of subsidies on increasing economic productivity in the agricultural industry at the local level. To achieve this goal, various data obtained from farmers and local authorities were used, which were analyzed using statistical and econometric methods. The results of this study show that subsidies have a positive impact on the economic productivity of farmers in the agricultural industry at the local level. Farmers who receive subsidies tend to have higher production and lower costs compared to those who do not receive subsidies. In addition, subsidies have a significant impact on increasing product quality and developing production technology. Farmers who receive subsidies tend to invest more in production technology and equipment needed to increase their productivity in agricultural activities. The study also shows that factors such as the level of education of farmers, size of farmers and access to product markets have a significant impact on economic productivity in the agricultural industry at the local level. Based on these results, the local government authorities, but not only - based on the positive legal provisions that regulate the field of support to the agricultural sector through grants, subsidies, donations, etc. - can take measures to encourage receiving subsidies from farmers and to help those who do not have access to production markets. This may include improving rural infrastructure, providing training and financial assistance to increase farmers' productivity and increase competitiveness in local markets.

Keywords: Subsidies, economic productivity, agricultural industry, farmers, technology, competition in markets.



MICROBIAL EXAMINATION OF READYTO EAT FRUITS SOLD WITHIN THE VICINITY OF AKWA IBOM STATE POLYTECHNIC, NIGERIA

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ABSTRACT

Bacterial examination of ready-to-eat fruits sold within Akwa Ibom State Polytechnic, Nigeria was carried out using standard bacteriological techniques. The result of the study revealed that sliced ready-to-eat watermelon fruit had the highest bacterial count of $(3.6 \times 10^4 \text{ cfu/g})$, while ready-to-eat pawpaw had count of $(2.4 \times 10^4 \text{ cfu/g})$. The result also revealed the presence of five bacteria genera which includes: *Bacillus* sp, *Klebsiella* sp, *Staphylococcus* sp, *Lactobacillus* sp and *Proteus* sp. *Klebsiella* sp recorded the highest frequency and percentage occurrence 17(28.3%), followed by *Staphylococcus* sp 15(25.0%). *Bacillus* sp had 11(18.3%), *Proteus* 9(15.0%) while *Lactobacillus* sp had 8(13.3%) as the least. The study indicated that ready-to-eat fruits could serve as a vehicle for the transmission of pathogens to human body thereby causes foodborne illness to human such as diarrhea, dysentery, cholera, septicemia, meningitis, traveler's diarrhea and leukemia. Therefore, good personal and environmental hygienic practices should be observed by vendors.

Keywords: Bacteria, transmission, environmental hygiene, vendors



TREATMENT OF CHRONIC LOW BACK PAIN WITH GABAPENTIN IN A TERTIARY CARE CENTRE

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ABSTRACT

The anticonvulsant Gabapentin (GAB) is commonly used to treat partial seizures, as well as neuropathic pain from diabetic neuropathy, pain after surgery, and central pain. About 70% of people will experience low back pain (LBP) at some point in their lives. Our goal with this prospective observational study was to determine how well works GAB for LBP patients. To determine if GAB helps people with LBP, researchers tracked their progress over the course of 6 months. Patients' responses to a pre-made questionnaire about their demographics, medical history, sleep habits (using the Pittsburgh sleep quality index), and pain perception were collected. Parametric paired t test analysis was carried out in SPSS. One hundred patients were enrolled, with a mean age of 39.1010.59 years. Forty percent of the participants fell into the 36-45 age range. The percentage of men to women was 0.53 to 1. LBP with no radiating symptoms was the most common symptom presentation. Prior to treatment, the average pain and sleep scores on the visual analogue scale (VAS) and the Pittsburgh sleep quality index (PQSI) for all patients with low back pain were 7.7 and 10.95, respectively. The average pain score after GAB treatment was 2.75, and the average sleep score was 4.90. In the end, 62% of patients who used GAB for LBP reported high levels of satisfaction with the treatment (Adverse Drug Reaction). Three-in-ten patients were not completely content with their treatment, and seven percent were very unhappy. According to our research, GAB is effective in enhancing sleep quality and decreasing instances of lower back pain. It indicates that the efficacy of this drug was relatively good, but that further improvement is required.

Keywords: Gabapentin, low back pain, pittsburgh sleep quality index, visual analogue scale



TÜRKİYE, KONYA İLİN'DE AŞILANMAMIŞ SÜT SIĞIRI SÜRÜLERİNDE BOVİNE RESPIRATORİK SİNSİTYAL VİRUSUNUN SEROPREVALANSI

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ÖZET

Sığırlarda alt solunum yolu enfeksiyonlarına neden olan sığır solunum hastalık kompleksi (BRD), süt ve besi sığır yetiştiriciliğinde önemli ekonomik kayıplarına neden olan hastalıklardan birisidir. Bovine respiratorik sinsityal virusunun (BRSV), BRD kompleksinin ortaya çıkmasında predominant bir role sahip olduğu bildirilmektedir. BRSV enfeksiyonu genellikle 6 aylıktan küçük buzağılarda görülmektedir. Bununla birlikte, yetişkin hayvanlarda subklinik enfeksiyon yaygındır ve bu hayvanlar asıl enfeksiyon kaynağıdır, çünkü sürülerde re-enfeksiyon ortaya çıkabilmektedir. Bu çalışma, Türkiye'de Konya ilin 'deki süt sığırlarında BRSV prevalansını belirlemek amacıyla yapıldı. Süt sığırı sürülerinden (n = 20) rastgele örnekleme ile toplam 151 sığır serumu toplandı. Sığır serumlarında BRSV'ye karşı antikorların varlığını belirlemek için ticari bir enzime bağlı immünosorbent analiz (ELISA) kiti kullanıldı. Yüz elli bir sığırdan 65'inde BRSV antikorları tespit edildi (%43,0, %95 CI: 35,2 – 50,1). Sonuçlar, 3 yaşından büyük hayvanların, 3 yaşından küçük hayvanlara göre önemli ölçüde daha yüksek BRSV seropozitifliğine sahip olduğunu gösterdi (p < 0.05). Ayrıca, BRSV seropozitivitesi dışı hayvanlarda erkek hayvanlara göre anlamlı olarak daha yüksekti (p < 0.05). Mevcut çalışmanın sonuçları, BRSV'nin incelenen sürülerdeki süt sığırı popülasyonunda sirküle olduğunu ortaya koymuştur, ancak bu çalışmada elde edilen sonuçlar, Türkiye'deki BRSV epidemiyolojik durumunu belirlemek için yeterli değildir. Sığır popülasyonunda BRSV enfeksiyonunun prevalansını ve ilişkili risk faktörlerini belirlemek için gelecekteki araştırmalara ihtiyaç vardır. Aşılama, sığırları BRSV enfeksiyonundan korumaya yardımcı olabilir. Bu nedenle, aşılama ve biyogüvenlik uygulamalarının yararları konusunda çiftçi farkındalığının artırılması önerilmektedir.

Anahtar kelimeler: Bovine respiratorik sinsityal virus, sığır, seroprevalans, risk faktörleri, Türkiye



BOVINE RESPIRATORY SYNCYTIAL VIRUS SEROPREVALENCE IN NON-VACCINATED DAIRY CATTLE HERDS IN KONYA PROVINCE, TÜRKİYE

ABSTRACT

Bovine respiratory disease (BRD) complex, which causes lower respiratory tract infections in cattle, is one of the main diseases of economic losses in dairy and beef cattle breeding. It has been reported that bovine respiratory syncytial virus (BRSV) plays a predominant role in the occurrence of BRD complex. BRSV infection usually occurs in calves less than 6 months of age. However, subclinical infection is common in adult animals, and they are the main source of infection, because reinfections are common in the herds. This study was carried out to determine the prevalence of BRSV in dairy cattle in the Konya Province in Türkiye. A total of 151 cattle sera were randomly collected from dairy herds (n = 20). A commercial enzyme-linked immunosorbent assay (ELISA) kit was used to determine the presence of antibodies to BRSV in cattle sera. Antibodies to BRSV were detected in 65 cattle out of the 151 cattle (43.0%, 95% CI: 35.2 - 50.9). Results showed that animals older than 3 years old had significantly higher BRSV seropositivity than animals younger than 3 years old ($p < 0.05$). Also, BRSV seropositivity was significantly higher in female animals than in male animals ($p < 0.05$). Results of the current study revealed that BRSV circulates in dairy cattle population in the investigated herds, but results of this study are not enough to determine epidemiological status of the BRSV infection in Türkiye. Future researches are needed to determine the prevalence and associated risk factors of BRSV infection in cattle population. Vaccination can help to protect cattle from BRSV infection. Therefore, increasing farmer awareness about vaccination and biosecurity practices benefits are recommended.

Keywords: Bovine respiratory syncytial virus, cattle, seroprevalence, risk factors, Türkiye



SÜTÇÜ RUMİNANLARDA ANYONİK BESLEME UYGULAMASI

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ÖZET

Anyonik besleme rasyon katyon anyon dengesinin negatife çevrilmesi ile yapılabilmektedir. Anyonik beslemedeki temel amaç doğum sonrası şekillenen bir metabolik hastalık olan hipokalsemiyi engellemektir. Bazı çalışmalarda anyonik besleme uygulaması sayesinde meme ödeminin azaldığı bildirilmiştir. Bu amaçla rasyona amonyum sülfat, amonyum klorür, magnezyum sülfat, magnezyum klorür, kalsiyum sülfat ve kalsiyum klorür gibi anyonik tuzlar katılmaktadır. Rasyona katılan anyonik tuzlar hayvanlarda hafif bir metabolik asidoza sebep olmaktadır. Asidozu engellemek için parathormon aktivitesi artmakta ve kemiklerden kalsiyum karbonat mobilize olmaktadır. Buna ek olarak böbreklerden kalsiyum rezorpsiyonu ve bağırsaklardan kalsiyumun emilimi artmaktadır. Bu sayede parathormon aktif olarak görev yapmakta ve doğum sonrasında kalsiyum metabolizması aksamadan devam edebilmektedir. Anyonik beslemenin etkili olması için katyon anyon dengesinin -80 ile -120 mEq/kg KM aralığında olması yeterli olmaktadır. Anyonik rasyon uygulamasının doğru yapıp yapılmadığı idrar pH'sı ölçülerek kontrol edilebilmektedir. Anyonik rasyona geçiş yapıldığında idrar pH'sı 2-3 gün içerisinde etkilenmektedir. İdrar pH'sının 6-6,8 arasında olması vücutta hafif metabolik asidoz şekillendiğinin göstergesidir. Anyonik beslemenin süresi ve dozu hakkında birçok çalışma yapılmıştır. Gebe hayvanların doğumuna 21 ve 42 gün kala anyonik besleme uygulamasına geçilmesi arasında bir fark olmadığı sadece 42 gün beslemede maliyetin arttığı anlaşılmıştır. Anyonik beslemenin şiddeti arttığında şiddetli metabolik asidoz olabileceği ve bunun hem gebe hayvana hem de yavrusuna zarar vereceği bildirilmiştir. Buna ek olarak anyonik beslemenin şiddeti arttığında gebe hayvanlarda kuru madde tüketiminde azalma olduğu bildirilmektedir. Sütçü sığırlarda yaygın olarak kullanılan anyonik besleme son yıllarda sütçü koyun ve keçilerde de denenmektedir. Sütçü koyun ve keçilerde çoklu gebeliğe bağlı gebeliğin son bölümünde fetüsün kalsiyum ihtiyacının arttığı buna bağlı olarak da doğuma yakın hipokalsemi olgularının görülebileceği bildirilmiştir. Sonuç olarak anyonik besleme sütçü ruminantlarda hipokalsemiyi engellemek amacıyla gebeliğin son dönemlerinde kullanılabilir.

Anahtar kelimeler: Anyonik besleme, hipokalsemi, metabolik asidoz, parathormon



THE APPLICATION OF ANIONIC FEEDING IN DAIRY RUMINANTS

ABSTRACT

Anionic feeding can be done by converting the ration cation anion balance to negative. The main purpose of anionic feeding is to prevent hypocalcemia, a metabolic disease formed postpartum. In some studies, it has been reported that udder edema is reduced by anionic feeding application. For this purpose, anionic salts such as ammonium sulfate, ammonium chloride, magnesium sulfate, magnesium chloride, calcium sulfate and calcium chloride are added to the ration. Anionic salts added to the diet cause a mild metabolic acidosis in animals. In order to prevent acidosis, parathormone activity increases and calcium carbonate is mobilized from the bones. In addition, renal calcium resorption and intestinal calcium absorption are increased. In this way, parathormone functions actively and calcium metabolism can continue without interruption postpartum. For anionic feeding to be effective, it is sufficient for the cation anion balance to be in the range of -80 to -120 mEq/kg DM. Whether the anionic ration is applied correctly or not can be checked by measuring the urine pH. When switching to an anionic diet, urine pH is affected within 2-3 days. Urine pH between 6 and 6.8 is an indication of mild metabolic acidosis in the body. Many studies have been conducted on the duration and dose of anionic feeding. It was understood that there was no difference between switching to anionic feeding application 21 and 42 days before the birth of pregnant animals, but the cost increased only in 42 days of feeding. It has been reported that when the severity of anionic feeding increases, severe metabolic acidosis may occur and this will harm both the pregnant animal and its offspring. In addition, it is reported that when the severity of anionic feeding increases, dry matter intake decreases in pregnant animals. Anionic feeding, which is widely used in dairy cattle, has not been tried in dairy sheep and goats in recent years. It has been reported that the calcium requirement of the fetus increases in the last part of pregnancy due to multiple pregnancies in dairy sheep and goats. In conclusion, anionic feeding can be used in late pregnancy to prevent hypocalcemia in dairy ruminants.

Keywords: Anionic nutrition, hypocalcemia, metabolic acidosis, parathormone



RUMİNANTLARDA ENTERİK METAN SALINIMINI AZALTICI ÖNLEMLER

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ÖZET

Metan önemli bir sera gazıdır ve küresel ısınmaya sebep olmaktadır. Metan üretiminde hayvancılık sektörünün önemli bir payı vardır. Hayvancılık sektöründe metan hem enterik metan olarak üretilmekte hem de hayvan dışkılarının yönetimine bağlı olarak üretilmektedir. Enterik metan salınımı hayvansal kaynaklı metan salınımı anlamına gelmektedir. Enterik metan salınımı daha çok ruminantlarda oluşmaktadır. Ruminantlarda enterik metan salınımı iki bölgede oluşmaktadır. Bu yerler rumen ve kalın bağırsaktır. Rumen ve kalın bağırsakta mikroorganizmaların anaerobik fermantasyonu sonucunda metan oluşmaktadır. Enterik metan üretiminin yaklaşık %90'ı rumen fermantasyonu sonucu oluşurken %10'lük kısmı kalın bağırsak fermantasyonu sonucu oluşmaktadır. Rumende oluşan metan ruktus yoluyla atmosfere verilirken kalın bağırsakta oluşan metan anüsten atmosfere salınmaktadır. Son yıllarda metan salınımının azaltılması amacıyla birçok çalışma yapılmaktadır. Bunun temel sebebi metanın küresel ısınmaya sebep olması ve rumen fermantasyonu sonucunda oluşan metanın atmosfere verilmesiyle besinlerle alınan enerjinin yaklaşık %10'unun hayvan tarafından kullanılmadan atılmasıdır. Metan salınımının azaltılması amacıyla rasyon kaba-konsantre yem oranının azaltılması, genetik seleksiyonla metan salınımı az olan hayvanların üretilmesi, rasyona İonofor antibiyotik, Saponin, tanen, maya, alg, uçucu yağ, propolis özü, organik asit, eksojen enzimler, nanopartikül, nitrat ve sülfat katılması, rumende Defaunasyon işleminin yapılması gibi yöntemler denenmiştir. İonofor antibiyotik gibi bazı yöntemler başlangıçta metan salınımını azaltırken uzun vadede metan salınımına olan etkisi kaybolmaktadır. Nitrat katıldığında toksikasyon şekillenebilmekte fakat uzun vadede rumen adaptasyonu sonucunda toksikasyon riski azalmaktadır. Sonuç olarak bu derlemede ruminantlarda enterik metan salınımını azaltmak amacıyla yapılan çalışmalar incelenmiş ve metan salınımını azaltıcı yöntemlerin pozitif ve negatif yönleri değerlendirilmiştir

Anahtar kelimeler: Metan, enterik metan salınımı, sera gazı, küresel ısınma



MEASURES TO REDUCE ENTERIC METHANE RELEASE IN RUMINANTS

ABSTRACT

Methane is an important greenhouse gas and causes global warming. Livestock sector has an important share in methane production. In the livestock sector, methane is produced both as enteric methane and depending on the management of animal feces. Enteric methane release means methane release of animal origin. Enteric methane release occurs mostly in ruminants. Enteric methane release occurs in two places in ruminants. These places are the rumen and large intestine. Methane is formed as a result of anaerobic fermentation of microorganisms in the rumen and large intestine. While approximately 90% of enteric methane production occurs as a result of rumen fermentation, 10% is formed as a result of large intestine fermentation. The methane formed in the large intestine is released into the atmosphere through the anus, while the methane is released to the atmosphere through the ructus. In recent years, many studies have been carried out to reduce methane emissions. The main reason for this is that methane causes global warming and approximately 10% of the energy taken with food is thrown away by the animal without being used by the release of methane, which is formed as a result of rumen fermentation, to the atmosphere. Reducing the ratio of rough-concentrated feed in the ration in order to reduce methane release, producing animals with low methane release by genetic selection, Ionophore antibiotic, Saponin, tannin, yeast, algae, essential oil, propolis extract, organic acid, exogenous enzymes, nanoparticles, nitrate and sulfate into the ration. Methods such as the addition of rumen, defaunation in the rumen have been tried. While some methods such as ionophore antibiotics initially reduce methane release, their effect on methane release is lost in the long term. Toxicity can occur when nitrate is added, but in the long term, the risk of toxication decreases as a result of rumen adaptation. As a result, in this review, studies to reduce enteric methane release in ruminants were examined and the positive and negative aspects of methods to reduce methane release were evaluated.

Keywords: methane, enteric methane emission, greenhouse gas, global warming



MATERIAL PHYSICOCHEMICAL PROPERTIES ANALYSIS AND FIBRE CHARACTERIZATION OF MUSA SPECIES PSEUDOSTEM WASTES FOR PULP AND PAPER PRODUCTION

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ABSTRACT

In view of the use of wood over the decades as the chief material for conventional pulp and paper making; the many other applications of wood as an engineering material (timbers, lumbering, carpentry, pattern-making, etc.) with the attendant problems of deforestation, environmental pollution, effects of greenhouse gases (GHGs), desertification as well as climate change; there exists an urgent need for an alternative source of non-woody materials for pulp and paper production especially from the wastes of a renewable agricultural products readily available in our environments. The aforementioned yardsticks together with the important role pulp and paper play in our day to day documentations and transactions, have extended the frontiers of research towards the determination of the suitability of Musa Species; *Musa sapientum* (banana) and *Musa paradisiaca* (plantain) pseudo-stem wastes as feedstock for pulp and paper production thereby putting into practice the principle of wastes to wealth. The physicochemical properties (solubility in cold and hot water, 1.0% and 18.0% NaOH, bulk density) and fibre characteristics of banana and plantain pseudo-stem wastes were analyzed via solubility test apparatus and reflux boiling bath for 3 hours, and the variations in the fibre length, diameter and width for both test samples were examined using electron microscope following other standard test procedures. The water solubility test showed a subtle variation in cold water (23.0% and 23.5%) and in hot water (20.0% and 21.0%) for banana and plantain pseudo-stem fibres respectively, whereas the pulverized pseudo-stem fibres recorded a higher solubility in 1.0% and 18.0% NaOH than cold or hot water. The bulk density had respectively 0.039 g/ml and 0.031 g/ml for banana and plantain, the low bulk density indicating low contents of solid matter in their respective pseudo-stem wastes. Moreover, the derived values recorded respectively lumen width (15.8 mm and 11.5 mm), cell wall thickness (7.59 and 5.69), runkel ratio (0.5 for both), flexibility coefficient (50 for both) and slenderness ratio (0.074 and 0.083). Therefore, can be concluded that both banana and plantain pseudo-stem wastes are considered good engineering materials feedstock for pulp and paper making.

Keywords: Deforestation, desertification, musa sapientum, musa paradisiaca, physicochemical properties, fiber characteristics, pulp, paper-making



OPTIMISATION OF THE FLOCCULATION PROCESS FOR THE REMOVAL OF TURBIDITY IN WATER USING POLYSTYRENE WASTE

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ABSTRACT

In this work, we have focused on the recycling of waste expanded polystyrene, which allows us to obtain a new copolymer based on polystyrene. The properties of the obtained copolymer as well as its structure and composition were established by UV-visible, FTIR spectroscopy and TGA analysis. The prepared copolymer was used as a flocculant for the purpose of removing turbidity from wastewater. Several experimental parameters such as water pH, initial turbidity, flocculant concentration, and their effects on the flocculation process were studied. The considered results show that the studied copolymer is a good flocculant and effective at a very low optimum concentration.

Keywords: polystyrene, copolymer, UV-visible, flocculant, turbidity



BAZI SOĞAN GENOTİPLERİNDE MİLDİYÖ (*Peronospora destructor*) HASTALIĞINA KARŞI DAYANIKLILIK GENİNİN VARLIĞININ ARAŞTIRILMASI

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ÖZET

Soğan (*Allium cepa* L.) Alliaceae familyası içerisinde yer alan iki yıllık bir bitkidir. Diğer birçok sebze türüne göre tüketimi belirli bir mevsimle sınırlı değildir. Ayrıca içerdiği vitamin, mineral ve fenolik bileşikler sayesinde insan sağlığı açısından pek çok yararı bulunmaktadır. Dolayısı ile dünyanın her yerinde insanlar için önemli bir sebze olmuştur. Yetiştiricilikte hastalık ve zararlılar bitkileri etkilemektedir. Fungal, bakteriyel ve viral hastalıklar soğanda ekonomik olarak zarara neden olmaktadır. Bu hastalıklar arasında *Peronospora destructor*'un neden olduğu soğan mildiyö hastalığı dünyadaki soğan üretim bölgelerinin çoğunda yaygın olarak görülen, nemli hava koşullarında soğana zarar veren, verimin düşmesine ve tohumluk üretiminde önemli kayıplara neden olan bir fungal hastalıktır. Hastalık ile mücadelede en etkili yöntemlerden biri dayanıklı çeşit kullanımıdır. Dayanıklı çeşitler verim ve kaliteyi arttırmakla birlikte üretimde pestisit kullanımını azaltmakta ve ürünün sağlık değerinin de yükselmesini sağlamaktadır. Soğana dayanıklılık genlerinin aktarılmasında yabancı türler ekonomik olarak istenen özelliklerin donörleri olarak kullanılabilir. Bu çalışma, bazı soğan genotiplerinde soğan mildiyösüne karşı dayanıklılık geninin varlığını incelemek amacıyla yapılmıştır. 111 soğan genotipinden alınan yaprak örnekleri 3 gün süre ile liyofilizatörde kurutulmuştur. Kurutulan yaprak örneklerinden DNA izole edilmiştir. Elde edilen DNAlar DMR1 ve DMR2 moleküler işaretleyicileri kullanılarak PCR cihazında protokole uygun sıcaklık ve döngüler ayarlanarak reaksiyona başlatılmıştır. PCR ürünleri etidium bromit ile boyanarak %1,5 agoroz jel üzerinde görüntülenmiştir. Moleküler işaretleyici analizleri sonucunda hangilerinin dayanıklılık genini taşıdığı ve taşımadığı belirlenmiştir. İslah sürecinde moleküler işaretleyici kullanılması dayanıklı soğan çeşitlerinin geliştirilebilmesinde, dayanıklı bir bitkinin genotip özelliklerine bakılarak analiz edilmesi ve genetik çeşitliliği hakkında bilgi alınabilmesi adına güvenilir sonuçlar elde edilmesini sağlamaktadır. Moleküler işaretleyicilerin ıslah programlarıyla entegre edilmesi yer, masraf ve iş gücünden kazanç sağladığı gibi zaman tasarrufu da sağlamaktadır.

Anahtar kelimeler: Soğan (*Allium cepa* L.), mildiyö hastalığı, dayanıklılık, moleküler işaretleyici



INVESTIGATION OF THE PRESENCE OF A RESISTANCE GENE AGAINST *Peronospora destructor* DISEASE IN SOME ONION GENOTYPE

ABSTRACT

Onion (*Allium cepa* L.) is a biennial plant which belongs to Alliaceae family. Compared to many other types of vegetables, its consumption is not limited with a certain season. In addition, it has many benefits for human health thanks to the vitamins, minerals and phenolic compounds it contains. Therefore, it has been an important vegetable for people all over the world. Diseases and pests has affection on plants in cultivation process. Fungal, bacterial and viral diseases cause economical damage to onions. Among these diseases, onion downy mildew disease caused by *Peronospora destructor* is widespread in most of the onion producing regions in the world and is a fungal disease that affects onions, causes a decrease in yield and significant losses in seed production under humid weather conditions. One of the most effective methods to combat this disease is the use of resistant varieties. Resistant varieties increases yield and quality, reduces the use of pesticides in production and increases the health value of the product. In the transfer of onion resistance genes, wild species can be used as donors of economically desirable traits. This study was carried out to investigate the presence of onion downy mildew resistance gene in some onion genotypes. Leaf samples from 111 onion genotypes dried in lyophilizer for 3 days. DNA was isolated from dried leaf samples. The reaction was initiated using DMR1 and DMR2 molecular markers by adjusting the temperature and cycles according to the protocol in the PCR device. PCR products were stained with ethidium bromide and visualized on 1.5% agarose gel. As a result of molecular marker analysis, it was determined which ones carried the resistance gene and which did not. The use of molecular markers in the breeding process provides reliable results in order to develop resistant onion varieties, to analyze a resistant plant by looking at its genotype characteristics and to obtain information about its genetic diversity. Integration of molecular markers with breeding programs saves space, cost and labor, as well as time.

Keywords: Onion (*Allium cepa* L.), downy mildew, resistance, molecular marker



TWEAKING A TRADITIONAL STEAMED CAKE WITH A FRUIT FLAVOR

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ABSTRACT

This food product is a variant of the famous steamed cake locally known as “Nyonya Manis” with the addition of mango as its primary flavor. Mango is a tropical fruit that grows wildly in Southeast Asia including Malaysia and it is loved by many as either a snack that can be eaten raw or a main ingredient for a local dish. Despite its abundance, it is rarely used as a flavour in local desserts like steamed cakes. Hence, this project was intended to create a new variant of a popular local cakes, Nyonya Manis, that is often made with Pandan by substituting it with mangoes. This could reintroduce mangoes in the culinary field as main flavour in cakes and pastries which might encourage more bakers, chefs and cooks to use the fruit as main ingredients in their recipe since it is already one of the most popular seasonal fruits in Southeast Asia. The process of creating this new variant of steamed cake required a series of experiments that a panel of experts would sample and offer their feedback on in order to attain an ideal recipe in making this new type of Nyonya Manis. After a series of experimentation, two formulas were identified and examined. A group of respondents were randomly selected to answer questionnaire after sampling the cakes. The findings revealed that the respondents expressed approval on the texture and taste of the mango flavoured Nyonya Manis. This indicate that this dessert might have commercial value that can boost local economic market and growth especially in financially empowering the low-income villagers.

Keywords: Nyonya manis, steamed cake, mango



ASETİK ve LAKTİK ASİT İLE JELATİNİZE EDİLMİŞ KİTOSANIN YONCA SİLAJI KALİTESİNE ETKİSİ

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ÖZET

Fermantasyon performansı iyi olmayan yoncanın, silaj olarak kalitesi genellikle istenilen seviyelerde olmamaktadır. Buna rağmen bazı zorunluluklar ve üretici-tüketici tercihleri, yonca silajını yaygın kullanılan bir yem hammaddesi haline getirmiştir. Bu nedenle fermantasyon ve kalite parametrelerini iyileştirmek amacıyla, yonca silajı yapımında uygun katkı maddelerinin kullanımı neredeyse kaçınılmaz bir durum olarak karşımıza çıkmaktadır ve bu doğrultuda katkı maddesi olarak jelatinize kitosan kullanılmıştır. Kitosan selülozdan sonra dünyada en çok bulunan biyopolimerlerden biridir ve biyobozunur, non-toksik, antimikrobiyal, antifungal karakteristikleri bir çok çalışma ile ortaya konulmuştur. Kitosan, asetik ve laktik asit gibi organik asit çözeltilerinde jelatinize özellik kazanmaktadır. Bu kapsamda hazırlanan jelatinize çözeltiler ile yonca silajı yapılarak, silaj kalitesi ve fermantasyon sürecindeki etkilenimler değerlendirilmiştir. Çalışma kapsamında, %2'lik asetik ve laktik asit çözeltilerine ayrı ayrı %0.0, %1.0 ve %2.0 oranlarında granül kitosan ilave edilerek jelatinize çözeltiler hazırlanmıştır (%0.0, %1.0, %2.0 chts-act ve %0.0, %1.0, %2.0 chts-lac). Bu çözeltiler, yeni hasat bir gün soldurulmuş ve küçük parçalara (~2-3 cm) doğranmış yoncaya, ağırlıkça %10 oranında püskürtülmüştür. Hazırlanan numune grupları havası alınmış vakum poşetlerinde 90 gün fermantasyona bırakılmıştır. Çalışma, 2 farklı grup (chts-act, chts-lac), her grup içerisinde 3 seviye (%0.0, %1.0, %2.0) ve kontrol grubu olarak planlanmıştır. Besin maddeleri yönünden, gruplar arasında istatistiksel olarak anlamlı farklar meydana gelmiştir fakat bu farklılıklar uygulama seviyelerine göre kademeli gerçekleşmemiştir. %2.0 chts-lac grubunda, ham protein önemli seviyede düşük, yine aynı grupta ADF, NDF ve ham selüloz değerleri ise önemli seviyede yüksek bulunmuştur ($P<0.05$). Enerji ve sindirilebilirlik parametreleri bakımından %1.0 ve %2.0 chts-lac gruplarında diğer gruplara göre daha düşük değerli sonuçlar elde edilmiştir ($P<0.05$). Fermantasyon kalitesi bakımından (laktik, asetik, propiyonik ve bütirik asit, $\text{NH}_3\text{-N}$, pH) %0.0 chts-act grubu olumlu yönde etkilenmiştir. Bu grupta laktik asit en yüksek, pH seviyesi ise en düşük değer olarak bulunmuştur ($P<0.05$). Chts-lac (%0.0, %1.0, %2.0) grupları fermantasyon profili bakımından olumsuz etkilenmiştir. Mikrobiyolojik sonuçlar bakımından, chts-lac (%0.0, %1.0, %2.0) gruplarında laktik asit bakterileri daha fazla gelişim göstermiştir fakat bu durum fermantasyon kalitesine pozitif anlamda etki göstermemiştir. Enterobakteri, chts-act (%0.0, %1.0, %2.0) gruplarında tespit edilmemiş, diğer gruplarda tespit edilmiştir. Maya gelişimi en fazla chts-lac gruplarında görülmüştür. Küf bakımından gruplarda anlamlı bir farklılık görülmemiştir. Sonuç olarak, jelatinize kitosan uygulaması silaj kalitesinde önemli değişimlere sebep olmasına rağmen özellikle fermantatif ve mikrobiyolojik bakımından istenilen düzeyde iyileştirme sağlamamıştır. Bu durumun, kitosanın yapısında bulunan aktif amin ($-\text{NH}_2$) gruplarının asiditeyi yavaşlatması ve ortamdaki tamponlama kapasitesini artırması sonucu meydana geldiği değerlendirilmiştir.

Anahtar kelimeler: Kitosan, laktik asit, asetik asit, silaj kalitesi, yonca



THE EFFECT OF CHITOSAN GELATINIZED WITH ACETIC AND LACTIC ACID ON ALFALFA SILAGE QUALITY

ABSTRACT

The quality of alfalfa, whose fermentation performance is not good, is generally not at the desired level as silage. However, some necessities and producer-consumer preferences have made alfalfa silage a widely used feed raw material. Therefore, in order to improve the fermentation and quality parameters, the use of appropriate additives in alfalfa silage production is almost inevitable, and gelatinized chitosan has been used as an additive in this direction. Chitosan is one of the most abundant biopolymers in the world after cellulose, and its biodegradable, non-toxic, antimicrobial, antifungal characteristics have been demonstrated by many studies. Chitosan becomes gelatinized in organic acid solutions such as acetic and lactic acid. In this context, alfalfa silage was made with the prepared gelatinized solutions, and the effects on the silage quality and fermentation process were evaluated. Within the scope of the study, gelatinized solutions were prepared by adding 0.0%, 1.0% and 2.0% granular chitosan to 2% acetic and lactic acid solutions separately (0.0%, 1.0%, 2.0% chts-act and 0.0%, 1.0%, 2.0% chts-lac). These solutions were sprayed on the freshly harvested 1 day withered, chopped alfalfa into small pieces (~2-3 cm) at a rate of 10% by weight. The prepared sample groups were left to ferment for 90 days in deaerated vacuum bags. The study was planned as 2 different groups (chts-act, chts-lac), 3 levels within each group (0.0%, 1.0%, 2.0%) and a control group. In terms of nutrients, statistically significant differences occurred between the groups, but these differences were not gradual according to the application levels. Crude protein was significantly low in 2.0% chts-lac group and ADF, NDF, crude cellulose values were significantly higher in the same group ($P < 0.05$). In terms of energy and digestibility parameters, results with lower values were obtained in 1.0% and 2.0% chts-lac groups compared to the other groups ($P < 0.05$). In terms of fermentation quality (lactic, acetic, propionic and butyric acid, $\text{NH}_3\text{-N}$, pH) 0.0% chts-act group was positively affected. In this group, lactic acid was found to be the highest and the pH level to be the lowest ($P < 0.05$). Chts-lac (0.0%, 1.0%, 2.0%) groups were negatively affected in terms of fermentation profile. According to microbiological results, lactic acid bacteria showed more growth in chts-lac (0.0%, 1.0%, 2.0%) groups, but this did not positively affect the fermentation quality. Enterobacteria were not detected in chts-act (0.0%, 1.0%, 2.0%) groups, but were detected in other groups. Yeast growth was mostly seen in chts-lac groups. There was no significant difference between the groups in terms of mold. In conclusion, although the application of gelatinized chitosan caused significant changes in silage quality, it did not provide the desired level of improvement, especially in terms of fermentation and microbiology. It has been evaluated that this situation occurs as a result of the active amine ($-\text{NH}_2$) groups in the structure of chitosan slowing down the acidity and increasing the buffering capacity in the environment.

Keywords: Chitosan, lactic acid, acetic acid, silage quality, alfalfa



TEACHING CONSTRUCTION TECHNOLOGY WITH MINIATURE FORMWORK

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ABSTRACT

The purpose of this project was to create a 3D replica of a miniature structure that resembles the usual formwork for an actual building that is under construction. Since vocational colleges were closed for months in 2020 and again in 2021 due to the several waves of COVID 19 infection, it became challenging for construction technology teachers to teach their students on formwork since such topic that was always taught in construction areas where the students learned through practical experience. If the students could not master the concept of formwork, it might hinder them from learning about other related concepts since formwork serves as their basics in learning on how to construct a structure. Thus, this replica was created to help teachers familiarize the students with the concept by demonstrating the process and explaining the aspects of the procedure through this replica. This teaching tool was used for a series of online classes on this topic during school closure in 2021 on an intact class of 16 students. The test and the questionnaire administered to these students revealed that they found the teaching tool to be practical and adequate in helping them to learn about formwork. This signified the potential of this replica as a teaching aid for construction technology programme in vocational colleges in Malaysia.

Keywords: Formwork, teaching tool, construction, 3 dimensions



**THE EFFECT OF INHALATION OF FUMES FROM ESBIOTHRIN BASED
MOSQUITO COIL ON SOME RENAL FUNCTION MARKERS AND
HEMATOLOGICAL PARAMETERS IN MALE WISTAR ALBINO RATS**

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ABSTRACT

Esbiothrin is a synthetic pyrethroid with quick activity used in public health against mosquitoes, houseflies, ectoparasites and cockroaches as well as agricultural applications. These coils and the inhalation of their fumes have been reported and proved to cause grave consequences to the respiratory tract majorly. Hence, this current study was aimed at assessing the renal and



hematological effect of inhalation of fumes from esbiothrin based mosquito coil using experimental animal models. Ten (10) male wistar albino rats were divided into two (2) groups (A and F) of five rats each. Rats in group F were exposed to esbiothrin based mosquito coil fumes for about 6 hours per day, five (5) days per week for four (4) weeks and were weighed weekly, while the group A served as the control group and therefore was not exposed. The weight of the rats in group A was increased and the weight of the rats in group F was fluctuating. At the end of the experimental period, blood was collected from each rat for the hematological analysis of Red Blood Cell (RBC), White Blood Cell (WBC), Packed Cell Volume and platelets Count using automated hematology analyzer and also for the analysis of some renal function markers (urea and creatinine). Result on hematological analysis revealed that group F had a significant decrease ($p>0.05$) in both urea and creatinine levels as well as WBC count, RBC count, PCV and PLT count. Results from this study indicates that esbiothrin based mosquito coil fumes, though considered the least toxic insecticide, are very capable of causing harm.

Keywords: Esbiothrin, mosquito coil, hematology, renal function



THE EFFECT OF PASTURE TYPE, AGE AND TIME ON RANGE USE AND DISTRIBUTION OF SLOWER GROWING BROILER CHICKENS ON THE RANGE IN FREE-RANGE PRODUCTION SYSTEM

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ABSTRACT

The type of pasture and time may have a significant impact on range use and distribution of slower growing broilers in free-range production system. A study was conducted to investigate if allowing broilers access to outdoor pens covered with either *Medicago sativa* (A), *Trifolium repens* (WC), *Lolium perenne* (PR) or their mixture (Mix) affected the range use and distribution of broilers on the range. A total of 240 mixed-sex Hubbard ISA Red JA chicks (12 pens of 20 birds; 3 replicates per pasture type) were reared in deep litter system for the first 3 weeks and afterward, allowed access to outdoor pens cultivated with one of the above pasture species. Range use and distribution of broilers on the range was recorded by counting the birds on the range while considering the distance (metres) from the pop hole; 0-2.5, 2.5-5.0, 5.0-7.5, 7.5-10 and 10-12.5 at 09:00 am, 12:30 noon and 14:30 pm from 5 to 11 weeks of broiler age. In the study, pasture type, age of broilers and time of the day did not affect range use and distribution of broilers on the range ($P>0.05$). Distribution of birds on the range significantly decreased with the increasing distance from the pop hole ($P<0.01$). Additionally, interaction between; time and distance and pasture, age and distance, time and distance and pasture and age and time and distance significantly influenced the distribution of broilers on the range ($P<0.01$). However, interaction between; pasture and time, age and time, pasture and distance, and pasture and age and time did not affect distribution of broilers on the range ($P>0.05$). Our results suggest that distance from the pop hole may influence distribution of birds on the range whereby, most of the birds that access outdoor areas are close ranging (stay close to pop hole).

Keywords: Slower growing broilers, pasture plants, free-range production system



ORGANOLEOTIC CHARACTERISTIC OF *ARCHATINA ARCHATINA* SNAIL FED *IXORA COCCINEA*

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ABSTRACT

An experiment was conducted to investigate the effect of *Ixora coccinea* on snail meat, one hundred and fifty (150) *Archatia-archatina* snail was fed for a period of four (4) month of the experiment, the inclusion level of *Ixora coccinea* in their water was 1ml, 2ml, 3ml, 4ml and 5ml while 0ml is the control, the addition was always carried out three (3) times a week and at the end of the experiment, at least three snail was sacrificed from each treatment and one each from a replicate for organoleptic characteristics making a total of fifteen (15) snail was used for the organoleptics exercise, fifteen (15) panelist was invited with their ages ranging from 19years old to 22year old and they are briefed on what to do before the exercise is carried out and the organoleptic exercise was carried out, they were all given snail, eat from a treatment at same time and before meat from another treatment was served, the panelist were made to rinse their mouth, so that the taste of meat from one treatment did not interfere with taste of another and at the end of the exercise, it was then observed that there was no significant difference in all the parameters of the organoleptics characteristics ($P>0.05$) except the juiciness that shows a significant difference in the control and the 1ml inclusion levels.

Keywords: *Ixora coccinea*, *archatina-archatina*, inclusion level, organoleptic characteristic



***Limoniastrum guyonianum* DUR. (BOISS.) OUED SOUF BÖLGESİNİN (GÜNEY
CEZAYİR) SAHARA BÖLGESİNDE YETİŞTİRİLEN BİTKİ**

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ÖZET

Bu çalışmanın amacı, Oued Soud bölgesindeki *Limoniastrum guyonianum*'un metanolik ekstraktının *in vitro* antioksidan aktivitesini değerlendirmektir. Bitkiyi değerlendirmek için DPPH (1.1 difenil 2-pikrilhidrazil radikali) radikal süpürücü deneyi, indirgeme gücü deneyi ve fosfomolibdnum yöntemi kullanıldı. Numunenin toplam fenolik içeriği, Folin-Ciocalteu yöntemi kullanılarak tahlil edildi ve toplam flavonoid içeriği, bir alüminyum klorür kolorimetrik tahlil kullanılarak ölçüldü. Fitokimya açısından, bitkinin kimyasal taramasının sonuçları, alkaloidlerin tamamen yokluğuna ek olarak flavonoidler, tanenler, antosiyaninler, steroller, triterpenler ve saponinlerin sunumunu ortaya çıkardı. Bu ekstraktın verimi ise %4.403 olarak hesaplanmıştır. Bu ekstrakt 36.372±0.768 mg GAE/g fenolik bileşen içerirken, 27.516±0.536 mg QuE/g flavonoid değerlendirildi. Antioksidan aktivitede DPPH radikali üzerindeki IC₅₀ 0,028±0,006 mg/ml, EC_{0,5} değerleri ise 0,488±0,001 mg/ml olarak hesaplanmıştır. Bitki ekstraktının fosfomolibdat antioksidan aktivitesi 191.641±0.009 µg EA A/g Örn.

Anahtar kelimeler: *Limoniastrum guyonianum* dur. (boiss.), metanolik ekstrakt, antioksidan aktivite, fenolik bileşikler, flavonoid bileşik, dpph, indirgeyici güç, fosfomolibdat.



**EVALUATION OF ANTIOXIDANTS ACTIVITY OF CRUDE EXTRACT OF
Limoniastrum guyonianum DUR. (BOISS.) PLANT GROWING IN SAHARA OF
OUED SOUF REGION (SOUTH ALGERIA).**

ABSTRACT

The aim of this study was to evaluate the *in vitro* antioxidant activity of the methanolic extract of the Oued Soud region's *Limoniastrum guyonianum*. The DPPH (1.1 diphenyl 2-picrylhydrazyl radical) radical scavenger assay, the reducing power assay, and the phosphomolybdenum method were used to evaluate the plant. The total phenolic content of the sample was assayed using the Folin-Ciocalteu method, and the total flavonoid content was measured using an aluminum chloride colorimetric assay. In terms of phytochemistry, the results of the chemical screening of the plant revealed the presence of flavonoids, tannins, anthocyanins, sterols, triterpenes and saponins, in addition to the complete absence of alkaloids. On the other hand, this extract's yield was calculated to be 4.403%. This extract included 36.372±0.768 mg GAE/g of phenolic components, while 27.516±0.536 mg QuE/g of flavonoids were assessed. In antioxidant activity, the IC₅₀ on DPPH radical was estimated at 0.028±0.006 mg/ml, as for the EC_{0.5} values, it was estimated to be 0.488±0.001 mg/ml. While the Phosphomolybdate antioxidant activity of the plant extract reached 191.641±0.009 µg EAs A/g Ex.

Keywords: *Limoniastrum guyonianum* Dur. (Boiss.), methanolic extract, antioxidant activity, phenolics compounds, flavonoid compound, dpph, reducing power, phosphomolybdate.



BAZI YERLİ VE YABANCI ZEYTİNYAĞLARININ BİYOAKTİF ÖZELLİKLERİ

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ÖZET

Sağlıklı bir yaşam için beslenme profili kritik bir öneme sahiptir. Özellikle, belirli besinlerdeki bazı bileşenler vücutta biyolojik aktivite (biyoaktif) göstererek insan sağlığını doğrudan etkileyebilmektedir. Bu bağlamda, natürel sızma zeytinyağı, sağlık üzerindeki pozitif etkilerinden ötürü son zamanlarda tüketimi önem kazanan bir besindir. Bu çalışmada, 5 farklı zeytin çeşidine (Domat, Uslu, Arbequina, Taggiasca, Koroneiki) ait natürel sızma zeytinyağlarının fenolik bileşik profilleri (oleuropein, hidroksitirozol, tirozol, kateşin, pinosresinol, luteolin, apigenin, kafeik asit, vanilik asit, *t*-ferulik asit ve *p*-kumarik asit), toplam fenolik madde (TFM) içerikleri ve toplam antioksidan kapasiteleri (TAK) belirlenmiştir. Yağ örneklerinin fenolik bileşik içeriklerinin belirlenmesinde yüksek basınç sıvı kromatografisi sistemi (HPLC) kullanılırken, TFM ve TAC düzeyleri spektrofotometrik metotlarla saptanmıştır. Majör fenolik bileşik olarak hidroksitirozol, Koroneiki zeytinyağında en yüksek (129.375 mg/kg), Domat zeytinyağında ise en düşük (14.485 mg/kg) içerikte bulunmuştur ($P<0.05$). Koroneiki zeytinyağı tirozol için de en yüksek miktarı sergilerken, Uslu ve Arbequina zeytinyağları bu bileşik için en düşük içeriklere sahip olmuştur ($P<0.05$). Pinosresinol, Domat (16.817 mg/kg) ve Koroneiki (15.160 mg/kg) örneklerinde maksimum, Uslu (5.260 mg/kg) yağında ise minimum içeriklerde bulunmuştur. Fenolik asitler örneklerde minör düzeyde bulunmuştur. Spektrofotometrik sonuçlara göre Koroneiki zeytinyağının TFM düzeyi en yüksek (294.822 mg gallik asit eşdeğeri (GAE)/kg) olsa da bu değer Domat (259.950 mg GAE/kg) ve Uslu (284.267 mg GAE/kg) yağlarındaki değerlerden istatistiksel olarak farklı bulunmamıştır ($P>0.05$). Benzer şekilde, Arbequina (208.962 mg GAE/kg) ve Taggiasca (219.526 mg GAE/kg) yağlarının TFM'leri arasındaki fark da anlamlı bulunmamıştır ($P>0.05$). Örneklerin TAC verileri, Koroneiki yağının en yüksek (110.396 mg troloks eşdeğeri (TE)/kg), Taggiasca yağının ise en düşük (58.465 mg TE/kg) antioksidan aktivite gösteren örnekler olduğunu göstermiştir ($P<0.05$). Bu çalışmanın sonuçları, incelenen biyoaktif özelliklerin zeytinyağı çeşitleri için ayırt edici bir özellik olarak kullanılabilceğini göstermektedir.

Anahtar kelimeler: Fenolik bileşikler, zeytinyağı, antioksidan kapasite, toplam fenolik madde



BIOACTIVE PROPERTIES OF SOME LOCAL AND FOREIGN OLIVE OILS

ABSTRACT

Nutrition profile is critical for a healthy life. In particular, some components in certain foods can directly affect human health by showing biological activity (bioactive) in the body. In this context, extra virgin olive oil is a food that has recently gained importance due to its positive effects on health. In this study, phenolic compound profiles (oleuropein, hydroxytyrosol, tyrosol, catechin, pinoreosinol, luteolin, apigenin, caffeic acid, vanillic acid, t-ferulic acid, and p-coumaric acid), total phenolic content (TFC) and total antioxidant capacity (TAC) of 5 different extra virgin olive oils obtained from different olive varieties (Domat, Uslu, Arbequina, Taggiasca, Koroneiki) were investigated. The amounts of the individual phenolic compound in the oil samples were determined by a high-pressure liquid chromatography system (HPLC), while TFC and TAC were determined by using spectrophotometric methods. Hydroxytyrosol, as the major phenolic compound, was found at the highest content (129.375 mg/kg) in Koroneiki olive oil, whereas its lowest (14.485 mg/kg) content was found in Domat olive oil ($P < 0.05$). Koroneiki olive oil also showed the highest content for tyrosol, while Uslu and Arbequina olive oils had the lowest contents for this compound ($P < 0.05$). For pinoreosinol, the maximum contents were found in Domat (16,817 mg/kg) and Koroneiki (15,160 mg/kg) samples, whereas the Uslu oils (5,260 mg/kg) exhibited the minimum content. Phenolic acids were found at minor levels in all samples. According to the spectrophotometric results, although the TFC level in Koroneiki olive oil was the highest (294.822 mg gallic acid equivalent (GAE)/kg), this value was not statistically different from the values in Domat (259.950 mg GAE/kg) and Uslu (284.267 mg GAE/kg) oils ($P > 0.05$). Similarly, the difference between the TFC of Arbequina (208.962 mg GAE/kg) and Taggiasca (219.526 mg GAE/kg) oils were not significant ($P > 0.05$). The results of TAC demonstrated that Koroneiki oil showed the highest (110.396 mg trolox equivalent (TE)/kg) value for antioksidan activity, while Taggiasca oil showed the lowest (58.465 mg TE/kg) value ($P < 0.05$). The results of this study show that the investigated bioactive properties can be used as a distinguishing feature for olive oil from different olive varieties.

Keywords: Phenolic compounds, olive oils, antioxidant capacity, total phenolic content



RECENT ADVANCES OF MAGNETIC GOLD HYBRIDS AND NANOCOMPOSITES, AND THEIR POTENTIAL BIOLOGICAL APPLICATIONS

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ABSTRACT

Magnetic gold nanoparticles (mGNP) have become a great interest of research for nanomaterial scientists because of their significant magnetic and plasmonic properties applicable in biomedical applications. Various synthetic approaches and surface modification techniques have been used for mGNP including the most common being the coprecipitation, thermal decomposition, and microemulsion methods in addition to the Brust Schiffrin technique, which involves the reduction of metal precursors in a two-phase system (water and toluene) in the presence of alkanethiol. The hybrid magnetic–plasmonic nanoparticles based on iron core and gold shell are being considered as potential theragnostic agents. Herein, in addition to future works, we will discuss recent developments for synthesis and surface modification of mGNP with their applications in modern biomedical science such as drug and gene delivery, bioimaging, biosensing, and neuro-regenerative disorders. I shall also discuss the techniques based on my research related to the biological applications of mGNP.

Keywords: Nanohybrids; magnetic gold nanoparticles; nanocomposites; surface functionalization; core-shell nanocomposites; magnetic-plasmonic nanoparticles; biological applications



ANALYSIS OF DETECTORS AND SENSORS FOR MONITORING THE STATE OF ANIMALS

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ABSTRACT

The purpose of this work is to analyze sensors and sensors for monitoring the condition of animals in order to identify problem areas in this area. At the moment, sensors and sensors for monitoring the condition of animals are present not only in the medical field of activity, but are gradually becoming part of everyday life. Based on the analysis of sensors and sensors for animals, collars and fitness trackers for dogs and cats, including GPS navigators for dogs, turned out to be the most relevant. The price of these modules in the US market varies from \$30 to \$99. Trackers with GPS tags that track the location of the bird with an accuracy of about 10 meters turned out to be relevant for the poultry industry. The weight of the tracker is 1 gram, which makes it possible to operate even on the smallest birds. Also the most popular were GPS navigators for cows. These modules allow not only to track the location of the animal, but also monitor its condition, and also determine the perimeter of the zone beyond which the animal cannot go - this perimeter is controlled by drones that drive the cattle back into the territory. Based on the results of the study, a wide variety of sensors and sensors for tracking health and location for dogs, cats and birds, as well as various modules for monitoring health and location for cows, were identified. The problem is the lack of modules for monitoring the health status of cattle and small cattle, as well as reptiles.

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Keywords: monitoring, detectors, sensors, zoomonitoring



DETECTION OF URBAN EXPANSION AND LAND SURFACE TEMPERATURE CHANGE USING REMOTE SENSING AND GIS TECHNIQUES

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ABSTRACT

Rapid urbanization in India has fascinated the attention of researchers from different regions due to its potential environmental consequences. In this study, Thiruvananthapuram Corporation and its peri-urban region were chosen as a study area to establish the process of urban expansion as well as the associated land surface temperature (LST) change over a long time period (1988-2021). Maximum likelihood with supervised classification method was used for LU/LC classification, carried out in Erdas Imagine software, and mono window algorithm was used for retrieval of LST. The result showed that the urban area (built-up area and impervious surface) in the study area was increased. Most of the vegetated and agricultural regions were converted into the built-up area. The mean LST over the entire study domain increased considerably between 1988 and 2021, due to urbanization, decrease of the green regions, and increasing built-up areas. Mean LST increased from 26⁰C to 29⁰C during the 33-year period, with a significant increase of 3⁰C between 1988 and 2021. For ensuring proper sustainable urban development and minimizing the impact of urban heat island, this study will play a significant role by providing practical guidelines for urban planners and policymakers.

Keywords: Land use/land cover, land surface temperature, urban expansion



INFLUENCE OF GRASSLAND MANAGEMENT TYPES ON SOIL MITES COMMUNITIES FROM ROMANIA

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ABSTRACT

Natural grasslands support a high diversity of invertebrates' species and provide many ecological services, as: the amelioration of climate change, revitalizing arable land, the quality and quantity of food production, protecting water quality and the cultural heritage. One of the main perturbations of grasslands is change in land-use management, which has become more intensive in order to increase food production. The study proposed to evidence the impact of management type (grazed vs ungrazed grasslands) on structure of soil mites' communities; to quantify some environmental variables characteristic for grassland ecosystems and to highlight the influence of the management type and of environmental variables on the composition of mite communities from four sublpine pastures from Romania. Comparing soil mites' communities from these grasslands, the following parameters were quantified: species richness, numerical abundance, dominance, Shannon index of diversity, evenness and equitability. The ungrazed pastures were characterized by the highest value of species diversity, equitability, evenness and Shannon index of diversity. The grazed grasslands were characterized by the highest numerical abundance and dominance. In order to correlate the mite fauna abundances with environmental variables, the following abiotic and biotic factors were quantified: vegetation coverage, air temperature, air relative humidity, soil temperature, soil moisture content, soil electrical conductivity, soil acidity and soil penetration resistance. Using a multivariate analysis we demonstrated that investigated environmental parameters influenced in differ manner the soil mites' communities. All these results confirm that the type of grassland management is one of the most important driving factors that influence the soil invertebrates' fauna.

Keywords: community, correlation, grassland, mite, soil



SYSTEMS OF ASSOCIATED NANOPARTICLES BASED ON DYE SOLUTIONS FOR SPECTROPHOTOMETRIC DETERMINATION OF WATER-SOLUBLE SALTS OF ALKYL BENZENESULFOACIDS

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ABSTRACT

Studies of systems of associated and complex nanoparticles based on dyes and functionalized substances are of increased scientific and practical interest. This is due to the fact that the association of dye can significantly affect the spectral properties of the solution. Numerous observations indicate that dyes form self- or heterogeneous associates even at fairly low concentrations (at the level of 10^{-6} mol/L). We have investigated some nanosystems “dye + surfactant” and “dye ionic associate + surfactant” in order to develop methods for the quantitative determination of surfactants in aqueous media. The use of dyes (sulfonephthalein dyes, rhodamines, pinacyanol and others cyanines) increases the sensitivity of the analysis. This announcement concerns the spectrophotometric determination of water-soluble salts of alkylbenzenesulfoacids as anionic surfactants. The determination of water-soluble salts of alkyl derivatives of benzene sulfonic acids in aqueous solution is carried out using the cyanine dye 1,1'-diethyl-2,2'-cyanine (IUPAC name (2E)-1-ethyl-2-[(1-ethylquinolin-1-yl-2-yl)methylidene]quinoline; $C_{23}H_{23}IN_2$; CAS 977-96-8). The spectrum of the $C_{23}H_{23}IN_2$ dilute aqueous solution is the spectrum of the monomer. However, the absorption in the region of the main maximum (524 nm) decreases with increasing concentration, and the narrow (half-width of the absorption band of 140 cm^{-1}) maximum (approximately 574 nm), which is characteristic of the dye self-associate, increases. The ability to change the absorption spectrum depending on the concentration of $C_{23}H_{23}IN_2$ with the formation of self-associate is the principle of determination of water-soluble salts of alkylbenzenesulfoacids in solution.

The method is characterized by a lower determination limit ($1 \cdot 10^{-6}$ mol/L according to the standard “dodecylbenzene sulfonate $CH_3-(CH_2)_{11}-SO_3Na$ ”) and high selectivity. Similar structural analogs of benzenesulfoacids at 20–100 excess concentrations do not affect the spectrophotometric determination of alkylbenzenesulfoacids.

Keywords: Dye, spectroscopy, solutions, alkylbenzenesulfoacids



DEVELOPMENT AND IN VITRO EVALUATION OF CURCUMIN-LOADED NANOCRYSTALS

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ABSTRACT

The aim of the study was to formulate and evaluate curcumin-loaded nanocrystals. Curcumin has antioxidant, anti-inflammatory, anti-viral, anti-bacterial, anti-fungal, and anti-cancer properties, but its main disadvantage is its poor solubility and bioavailability. The drug's solubility and dissolution profile were improved using the nanocrystallization technique, resulting in increased bioavailability. Top-down method was used to prepare nine batches (F1 to F9) of curcumin-loaded nanocrystals using different concentrations of pluronic F-127 as a solubilizer, stabilizer, and micelles agent and menthol as a cryoprotector. Melting point, percentage drug content, solubility, and an in-vitro dissolution study were used to select the batch of the best two optimized formulations. Fourier Transform Infrared analysis, Differential Scanning Calorimetric (DSC) analysis, X-Ray Diffraction (XRD) studies, zeta sizer, zeta potential studies, and surface morphology study using scanning electron microscope were performed to characterize the optimized formulation (F5 and F6). The zeta sizer evaluation results revealed that the average diameter of the F5 batch was 805nm, and the average diameter of the F6 batch was 144.2nm. The FESEM revealed that the batch of curcumin-loaded nanocrystals was mostly spherical and rod-shaped. The batch F5 curcumin-loaded nanocrystal solubility in distilled water was 4.23 folds higher, and the batch F6 was 6.01 folds higher than the pure curcumin results. The study concluded that the F6 curcumin-loaded nanocrystal batch could be used to improve curcumin solubility and dissolution profile in order to increase bioavailability. The composition and method of preparation could be useful for future research into retinoblastoma and other cancerous diseases.

Keywords: Curcumin nanocrystals, top-down method, solubility, dissolution, pluronic.



ENHANCED BACTERICIDAL ACTION AND DYE DEGRADATION OF SPICY ROOTS' EXTRACT-INCORPORATED FINE-TUNED METAL OXIDE NANOPARTICLES

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ABSTRACT

Nanoparticles fabricated with biological reducing agents to minimize toxic effects of chemicals are being focused worldwide. Biologically synthesized metal oxide nanomaterials have become integral part of nanotechnology. The current work is providing an insight on ZnO nanoparticles having root extract of *Z. officinale* and *A. sativum* in terms of catalytic and antimicrobial action potential. The synthesized nanoparticles were characterized by X-ray Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FTIR), X-ray Photoelectron Spectroscopy (XPS), Ultra-Violet visible spectroscopy (UV-vis), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Energy-Dispersive X-ray Spectroscopy (EDS) analysis. The synthesized nanoparticles showed strong absorption at 365 nm with size range between 31.64 and 44 nm for *Z. officinale* and 28–45 nm in case of *A. sativum*-doped ZnO as revealed by UV-vis and XRD. The *Z. officinale*-doped nanoparticles demonstrated enhanced antibacterial activity against multiple drug-resistant *S. aureus* at increasing concentrations (0.5, 1.0 mg/50 µl) and also actively degraded methylene blue (MB) dye. ZnO nanoparticles synthesized by green approach have potential to resolve emerging drug resistance against pathogenic bacterial diseases. Conclusively, significant inhibition zones resulted against (MDR) *S. aureus* ranging 1.80–2.25 mm and 2.3–3 mm at low and high concentrations for *Z. officinale* while, 1.7–2.05 mm and 2.2–2.7 mm for *A. sativum*-doped ZnO-NPs. Published in Applied Nanoscience.

Keywords: Metal oxide, particle size, diseases, antimicrobial, nanomaterials



QUALITY EVALUATION OF GINGER-SPICED OGI FLOURS PRODUCED FROM BLENDS OF YELLOW MAIZE AND AFRICAN YAM BEAN

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ABSTRACT

“Ogi”, a weaning food for infants in West Africa, is a starchy porridge usually prepared from fermented maize, sorghum or millet but its quality can be improved. This study was conducted to produce and evaluate the proximate, functional, physicochemical, anti-nutrient composition and microbial plate counts of ginger spiced *Ogi* flours from blends of yellow maize and African yam bean which can serve as a cheap source of plant-based protein. No particular trend was observed in the moisture content of the composite flours (5.73-6.19 %) however, increasing values were recorded for the protein (6.76-15.28 %), fat (5.33-6.17 %), ash (0.60-1.22 %) and fibre (0.43-1.50 %) while the carbohydrates content (71.14-81.13 %) decreased with increasing African yam bean flour. The water absorption capacity (1.28-1.52 ml/g), bulk density (0.54-0.74 g/cm³) and oil absorption capacity (0.88-1.56 ml/g) increased while the swelling index (2.16-2.51) reduced with additional African yam bean flour. The pH (3.82-4.34) increased but titratable acidity (0.50-0.95 %) reduced. There was a significant (P<0.05) increase in the Trypsin inhibitors content (0.23-2.03 mg/kg), tannin (0.97-3.06 mg/kg) and saponin (3.27-5.06 mg/kg) of the *Ogi* flour upon complementation but phytate (3.80-6.33 mg/kg) reduced. Total bacterial (22.50 x 10²-42.0 x 10² cfu/g), total fungal (3.00 x 10²-10.5 x 10² cfu/g), and lactic acid bacteria counts (12.50 x 10²-29.00 x 10² cfu/g) decreased while coliforms were detected in just two samples. The incorporation of African yam bean improved the nutritional status, especially the protein content. Hence, it has high potential as a fortificant and in other product development. Further research can explore the consumer acceptability levels of African yam bean inclusion in *ogi*

Keywords: Yellow maize, African yam bean, ginger, *ogi*



THE APPLICATION OF GENOMICS IN AGRICULTURE

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ABSTRACT

Agrigenomics research is growing as climate change, population growth, and urbanization threaten the ability of farmers to meet the world's food demands. To address these needs, breeders and farmers are employing new genomic strategies in order to use fewer environmental resources to develop higher-producing livestock, poultry, and crops, and to use fewer antibiotics and pesticides. It is important that your agrigenomics genotyping solution be reliable and flexible, and incorporates markers to address the following applications:

Genomic selection: Genomic selection aims to improve quantitative traits in large breeding populations through the use of whole-genome molecular markers. Genomic prediction combines marker data with phenotypic and pedigree data, when available, to increase the accuracy of predicting breeding and genotypic values.

Marker-assisted selection (MAS) and marker-assisted breeding (MAB): MAS and MAB efficiently select for desirable traits during breeding, where a trait of interest is selected based on a marker linked to that trait, rather than based on the trait itself.

Parentage : DNA parentage testing is a valuable tool that allows breeders to confidently select elite animals, knowing their ancestry is correct. It can be used to fast-track genetic progress or confirm parentage, and may determine if an animal carries defective genes, helping to avoid defects in future offspring.

Characterization of genetically modified organisms (GMOs): Researchers develop genetically modified animals and plants to increase yield, decrease susceptibility to disease, and minimize use of antibiotics in production facilities.



BIOSTIMULATORY EFFECT OF CATTLE DUNG ON LEAD DECONTAMINATION POTENTIAL OF INDIGENOUS FUNGAL POPULATION IN SPENT ENGINE OIL-POLLUTED SOIL

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ABSTRACT

The toxic effects of Lead (Pb) on plants, animals and humans have made it one of the heavy metals of environmental concern. The aim of this study was to assess the effect of cattle dung (CD) on Lead decontamination potential of indigenous fungal population from spent engine oil (SEO)-polluted soil. Fungi associated with SEO-utilization were isolated from SEO-polluted soil in Dutse mechanic village using standard procedures. Twenty (20) plastic bottles containing twenty grams (20 g) of soil each were prepared with varying weights of CD and volumes of fungal isolates in potato dextrose broth each. Four (4) plastic bottles devoid of CD and fungal inoculants were used as the controls. The mixture was incubated at room temperature for twenty four (24) days. It was a 4 x 2 factorial experiment set out in completely randomized design (CRD). Atomic absorption spectrophotometer (AAS) was employed to determine Pb decontamination prowess of the bio-enhanced fungal consortium in the second, fourth and sixth week of incubation. Results obtained from the decontamination assay indicate that at the second week, there was no significant ($p > 0.05$) difference between the addition of 10 g of CD (0.1750 mg/kg) and 15 g of CD (0.1750 mg/kg). The combinatorial effect of the addition of 20 g of CD and inoculation with fungal isolate at 15 mL resulted in the least concentration (0.1000 mg/kg) of Pb at the second week. The combinatorial effect of CD at 20 g (C_{20}) and 15 mL of fungal isolate resulted in a significant ($p < 0.05$) reduction in Pb concentration (0.0900 mg/kg) at the fourth week. However, at the sixth week, the lowest concentration (0.0400 mg/kg) of Pb was recorded with the addition of 20 g of CD and inoculation with fungal isolate (15 mL). Based on the results obtained in this study, it can be concluded that indigenous fungal population, bio-enhanced with CD has the ability to influence decontamination of Pb in SEO-polluted soils.

Keywords: Spent engine oil, soil, lead, pollution, biostimulation, decontamination



EFFECT OF INSULIN-LOADED NANOEMULSION TOPICAL GEL ON WOUND HEALING IN DIABETES SKIN DISEASES

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ABSTRACT

Diabetes skin infection is a very common disorder in hyperglycemia patients. The study's aim was concerned with the effect of insulin-loaded nanoemulsion topical gel for wound healing in diabetes skin diseases. Insulin is useful in treating diabetes associated skin diseases, but its higher molecular weight and low permeability through transdermal routes limit its clinical application. Even topical insulin has accelerated wound healing properties in diabetes. It is due to the enhancing insulin signaling pathway via IRS-1, IRS-2, SHC, ERK, and AKT. In this context, an attempt was made to prepare a topical formulation of insulin-loaded nanoemulsion for better permeation of insulin and better treatment of wound healing in diabetes skin diseases. The insulin-loaded nanoemulsion topical gel was prepared using oleic acid as oil phase, tween 80 as the surfactant, and polyethylene glycol 400 as co-surfactant. Amongst the entire batch, formulations with the best physical stability and maximum permeation were selected to prepare topical gel of insulin-loaded nanoemulsion. Post evaluation parameters like particle size, zeta potential, entrapment efficacy, scanning electron microscope surface morphology, and drug diffusion study using dialysis membrane, skin irritation study and *in vivo* study was performed. The wound healing effect substantiate the biochemical data as evidenced by greater wound contraction (63% in 15 days) with gel formulation containing insulin-loaded nanoemulsion. This study concludes that insulin-loaded nanoemulsion topical gel showed synergistic effect towards effective wound healing in diabetes skin diseases and could be a promising and effective approach in the treatment of diabetes wound and skin diseases.

Keywords: skin diseases; topical wound; topical gel; nanoemulsion; insulin



INVESTIGATING THE EFFICACY OF LYOPHILIZED AS1411- GOLD NANOSPHERE CONJUGATED APTAMER AGAINST BREAST CANCER

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ABSTRACT

Gold nanoparticles (AuNPs) have been widely exploited for many medical applications due to their unique functional properties. Despite the widespread applications, their colloidal stability and active targeting to cancer cells remain a major challenge. In this study, we successfully designed and synthesized an AuNPs conjugated with anti-nucleolin (AS1411) aptamer (AuNPs/NCL-APT). The prepared AuNPs/NCL-APT was fully characterized, lyophilized (utilizing different cryoprotectants), and investigated for their colloidal stability and cellular activity against MCF-7 breast cancer cell line. Trehalose and sucrose exhibited a significant cryoprotectant effect compared to irreversible aggregates produced upon using mannitol. Addition of 10 % sucrose prior freeze-drying enabled maximum post-lyophilization colloidal stability as confirmed by UV-VIS spectroscopy and dynamic light scattering (DLS) measurements. Moreover, the lyophilized AuNPs/NCL-APT maintained their targeting and cytotoxic functionality against MCF-7 cell lines as proven by the cellular uptake assays utilizing flow cytometry and confocal laser scanning microscopy (CLSM). Quantitative PCR (Q-PCR) of nucleolin-target gene expression also confirmed the effectiveness of AuNPs/NCL-APT. This study is vital for future preclinical testing and offers new tools for cancer therapeutics and diagnosis.

Keywords: Aptamer AS1411, gold nanoparticles, lyophilization, bio conjugated nanoparticles, cryoprotectants.



SENSORY AND MEAT QUALITY EVALUATION OF YANKASA RAMS FED SORGHUM STOVER SUPPLEMENTED WITH VARYING LEVELS OF DRIED POULTRY DROPPINGS BASED DIET

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ABSTRACT

Sensory attributes and meat quality from Yankasa rams fed sorghum Stover supplemented with varying levels of dried poultry droppings based diet were determined in this study. Meats from the experimental animals were sampled to determine their chemical composition, meat PH and cooking loss. Untrained panelists were used to assess the meat samples for sensory attributes these include: colour, flavour, texture, juiciness, tenderness and overall acceptability of cooked meat samples using nine-point scoring scale. Results from the chemical constituent of meat samples indicated that as the level of inclusion of the supplemental diet increases, the value obtained for crude protein and fat also increases. No significant difference among the treatment groups for cooking loss. While Meat PH values obtained in this study shows that treatment groups fed supplemental diets were within the range of 5.4 and 5.8 (low) PH which is a measure of good quality. Significant differences existed among the treatment groups for colour, flavour, texture and overall acceptability. It was concluded that meat from supplemented treatment groups had better meat qualities and overall acceptability.

Keywords: Dried poultry droppings, meat quality, sensory attribute, sorghum stover, yankasa ram



**EVALUATION OF EXTERNAL AND INTERNAL EGG GEOMETRY TRAITS
OF VANARAJA AND GIRIRAJA IN KONKAN REGION OF MAHARASHTRA,
INDIA**

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ABSTRACT

This study was conducted to assess egg quality traits of two dual purpose Vanaraja and Giriraja chicken. A total number of 40 Fresh and cleaneggs (20 from eachbreed) were studied for various egg quality traits. Inner thick albumen height; albumen weight; the height and diameter of the yolk; the thickness of egg shell were measured using sensitive electronic



Vernier caliper.. Albumen percentage was calculated by albumen weight/ egg weight x100. The yolk was then separated carefully and weighed by digitalelectronic weighing machine. The albumen index (AI) was calculated as albumen height/ albumen width and Yolk index was calculated as yolk height/yolk width. Weight of the shell was determined after drying at 55°C for 72 h. Haugh unit was calculated as the ratio between egg weight and albumin height. The means of egg weight, shape index, specific gravity, shell thickness, albumen index, yolk index and haugh unit of Giriraja chicken were 57.05±0.90 g, 76.03±1.88, 1.03±0.00, 0.38±0.01 mm, 8.26±0.43, 43.41±0.54 and 77.67±1.78. Whereas, means of egg weight, shape index, specific gravity, shell thickness, albumen index, yolk index and Haugh unit of Vanaraja chicken were 57.08±0.98 g, 73.37±1.50, 1.03±0.00, 0.38±0.01 mm, 8.0±0.46, 41.83±0.98, and 75.09±1.95. There were no significant differences between Giriraja and Vanaraja chicken for egg weight; shape index; specific gravity and shell thickness; however, Giriraja fowl eggs had higher Haugh unit score. It can be concluded that Giriraja fowl had better egg quality than Vanaraja birds under Konkan agro-climatic condition

Keywords: Albumin, shell, yolk, giriraja, vanaraja



KISINTILI SULAMA REJİMİ ALTINDA FARKLI ORANLARDA FINDIK ZURUFU KOMPOSTU UYGULANMIŞ TOPRAĞIN SICAKLIĞI İLE H₂O VE CO₂ SALINIMLARI

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ÖZET

Toprak yeryüzündeki tüm canlılar için hayati önem taşıyan ekosistem dinamiklerine önemli katkıda bulunduğu için çok fonksiyonlu bir kaynak olarak yönetilmelidir. Bu nedenle tarımsal üretimde ekonomik ve çevresel stratejilerin benimsenmesi toprakların sürdürülebilirliği açısından oldukça önemlidir. Ayrıca toprağın verimlilik döngüsünde yer alan toprak suyunun etkin kullanılması ve küresel karbon döngüsünün daha iyi yönetilmesi için arazi yönetimi uygulamalarında karbon stoklarının uzun vadeli olarak korunması topraktan CO₂ ve H₂O salınımlarının azaltılmasıyla çevresel sürdürülebilirliği önemli ölçüde desteklemektedir. Tarımsal ekosistemleri çevresel olarak güvenli bir şekilde sürdürebilmek için toprağa compost uygulaması ve üretimde kısıntılı sulama uygulamaları sürdürülebilir bir strateji olarak kabul edilmektedir. Böylece 3 farklı oranda (0%, 1.5%, 3%) fındık kabuğu kompostunun çıplak toprağa uygulanması ve 3 farklı seviyede sulanması (100%, 67%, 33%) koşullarında 3 tekerrürlü olarak yürütülmüş bu çalışma toplam 27 saksıda 1 ay süreyle laboratuvar koşullarında gerçekleştirilmiştir. Çalışmada farklı dozlarda fındık zurufu kompostu uygulanmış toprağın değişen seviyelerde sulanmasının toprak sıcaklığına ve topraktan H₂O ve CO₂ salınımlarına etkilerinin incelenmesi amaçlanmıştır. Çalışma sonucunda tam sulama koşullarında toprak sıcaklığının azaldığı ve topraktan H₂O salınımının arttığı buna karşın artan fındık zurufu kompostu uygulamasıyla topraktan H₂O salınım miktarının azaldığı ve CO₂ salınımının arttığı ancak CO₂ salınımının kısıntılı sulama uygulamasıyla azaltılabileceği belirlenmiştir. Bu çalışmanın bulguları ile kısıntılı sulama rejimi altında toprağa compost uygulamasının salınımları azaltıcı bir yaklaşım olarak kullanılması ve toprak neminin kontrol altına alınması konusunda çevreci bir tarımsal faaliyet programı olarak önerilebileceği sonucuna ulaşılmıştır.

Anahtar kelimeler: CO₂ salınımı, fındık zurufu kompostu, H₂O salınımı, kısıntılı sulama, toprak sıcaklığı



SOIL TEMPERATURE AND H₂O AND CO₂ RELEASES FROM SOIL TREATED WITH HAZELNUT HUSK COMPOST AT DIFFERENT RATES UNDER DEFICIT IRRIGATION REGIME

ABSTRACT

Soil should be managed as a multifunctional resource as it contributes significantly to ecosystem dynamics that are vital for all living things on earth. Therefore, the adoption of economic and environmental strategies in agricultural production is very important for the sustainability of soils. In addition, long-term protection of carbon stocks in land management practices for the effective use of soil water in the soil fertility cycle and better management of the global carbon cycle significantly supports environmental sustainability by reducing CO₂ and H₂O releases from the soil. To sustain agricultural ecosystems in an environmentally safe manner, compost application to the soil and deficit irrigation practices in production is accepted as sustainable strategy. Thus, this study, which was conducted in 3 replications under different ratios of hazelnut husk compost (0%, 1.5%, 3%) applied to bare soil and irrigated at 3 different levels (100%, 67%, 33%), was carried out in a total of 27 pots for 1 month under laboratory conditions. In this study, it was aimed to examine the effects of varying levels of irrigation of the soil applied with different doses of hazelnut husk compost on soil temperature and H₂O and CO₂ releases from the soil. As a result of the study, it was determined that the soil temperature decreased and the H₂O release from the soil increased under full irrigation conditions, however, the amount of H₂O release from the soil decreased with the application of increased hazelnut husk compost, and the CO₂ release increased, but the CO₂ release could be reduced with the deficit irrigation application. With the findings of this study, it was concluded that the application of compost to the soil under the deficit irrigation regime can be recommended as an environmentally friendly agricultural activity program for the use of an approach to reduce the releases and to control soil moisture.

Keywords: CO₂ release, deficit irrigation, H₂O release, hazelnut husk compost, soil temperature



SORGHUM'DA (*Sorghum bicolor* (L) Moench) DUVARDA İLİŞKİLİ KİNAZLAR GEN AİLESİNİN GENOM BOYU TANIMLANMASI VE KARAKTERİZASYONU

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ÖZET

Dünyanın en önemli beşinci tahılı olan sorgum (*Sorghum bicolor* L. Moench), gıda, yem, lif ve biyoyakıt için yetiştirilen verimli bir mahsuldür. Duvarla ilişkili kinazlar (WAK'lar) gen ailesi, çevresel stres ve bitki patojen tepkisi de dahil olmak üzere bitki biyolojisinde çok önemli bir düzenleyici rol oynamaktadır. Bu nedenle sorgumdaki WAK gen ailesini incelemek ve tanımlamak önemlidir. Bu çalışmada, biyoinformatik araçlar kullanılarak WAK protein ailesi üyelerinin sayısı, hücre lokalizasyonları, filogenetik ilişkiler, kromozomal lokalizasyonlar, senteni, gen duplikasyonları, promotör cis-elementler, gen yapısal özellikleri, protein-protein ilişkileri ve miRNA etkileşimleri belirlenerek sorgumda WAK protein ailesinin genom çapında karakterizasyonu gerçekleştirilmiştir. 30 SbWAK ve 65 SbWAKL içeren toplam 95 SbWAK /S bWAKL geni tanımlanmış ve altı filogenetik gruba ayrılmıştır. SbWAK / SbWAKL'lar on kromozoma eşit olmayan bir şekilde dağılmış ve dokuz kromozomda 33 duplikasyon olayı gözlenmiştir. SbWAAK / SbWAKL'ların amino asit sayısı ve moleküler ağırlığı sırasıyla 496 ila 1149 aa ve 55.38 ila 124.89 kDa arasında değişmiştir. Kırk yedi SbWAK / SbWAKL'in, test tüplerinde instabiliteyi gösteren 40'tan büyük bir instabilite indeksi ile kararsız olduğu bulunmuştur. Türlerin evrimsel ilişkilerini anlamada, sinteny analizleri, on beş SbWAK / SbWAKL geninin cin darı genomunda benzer olduğunu ortaya çıkardı. Ek olarak, bilinen hücre duvarı ile ilişkili miRNA'lar da dahil olmak üzere 105 miRNA, 82 SbWAAK /SbWAKL genini hedef almıştır. Cis-etkili elementlerin analizi, SbWAK/WAKL'lerin ışık, hormon, gelişim ve çevresel stres tepkilerine dahil olduğunu göstermiştir. Sorgumdaki WAK gen ailesi üzerine yapılan bir araştırma yoluyla, bu çalışma, gen düzenleme araçlarını kullanarak genlerin işlevlerini ayrıntılı olarak tanımlamak gibi daha ileri araştırmalar için bir temel oluşturmaktadır. Sorgumda WAK/WAKL gen fonksiyonunu araştırmak için olası aday genleri önermenin yanı sıra, miRNA ve cis etkili elementler analizi, WAK gen ailesinin abiyotik ve biyotik stres tepkisine potansiyel katılımını da ortaya koymuştur.

Anahtar kelimeler: Sorgum, duvar ilişkili kinazlar, biyoinformatik

Teşekkür: Bu çalışma Eskişehir Osmangazi Üniversitesi Bilimsel Araştırma Projeleri Koordinasyon Birimi tarafından **FYL-2022-2613** no'lu proje kapsamında desteklenmiştir.



GENOME-WIDE IDENTIFICATION AND CHARACTERIZATION OF THE WALL ASSOCIATED KINASES GENE FAMILY IN SORGHUM (*Sorghum bicolor* (L) Moench).

ABSTRACT

Sorghum (*Sorghum bicolor* L. Moench), the world's fifth most important cereal, is a productive crop cultivated for food, feed, fiber, and biofuel. The wall-associated kinases (WAKs) gene family play a crucial regulatory role in plant biology, including gene family, environmental stress, and plant pathogen response. It is therefore important to study and identify the WAK gene family in sorghum. In this study, genome-wide characterization of WAK protein family in sorghum was performed by determining the number of WAK protein family members, subcellular localizations, phylogenetic relationships, chromosomal localizations, synteny, gene duplications, promoter cis-elements, gene structural features, protein-protein relationships and miRNA interactions using bioinformatics tools. A total of 95 SbWAK/WAKL genes containing 30 SbWAK and 65 SbWAKL were identified and classified into six phylogenetic groups. The SbWAK/SbWAKLs were unevenly distributed across ten chromosomes and 33 duplication events were observed on nine chromosomes. The number of amino acids and molecular weight of SbWAK/SbWAKLs ranged from 496 to 1149 aa and 55.38 to 124.89 kDa respectively. Forty-seven SbWAK/SbWAKLs were found to be unstable with an instability index greater than 40, indicating instability in test tubes. In understanding species evolutionary relationships, synteny analyses revealed fifteen SbWAK/WAKL genes that were similar in the foxtail millet genome. Additionally, 105 miRNAs including known cell wall-related miRNAs targeted 82 SbWAK/SbWAKL genes. The analysis of cis-acting elements indicated the involvement of SbWAK/SbWAKLs in light, hormone, development, and environmental stress responses. Through an investigation into WAK gene family in sorghum, this study provides a basis for further research such as identifying the functions of genes in detail using gene editing tools. In addition to offering possible candidate genes for researching WAK/WAKL gene function in sorghum, the miRNA and cis-acting elements analysis also revealed the potential involvement of the WAK gene family in abiotic and biotic stress response.

Keywords: Sorghum, wall associated kinases (WAKs), bioinformatics.

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EFFECT OF STERILIZATION ON THE BIOACTIVE COMPOUNDS AND ANTIMICROBIAL PROPERTIES OF *Nymphaea lotus* L. LEAVES

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ABSTRACT

Preclinical studies further use of plant extract mixtures as herbal formulas in clinical studies and the commercialization of herbal antibiotics need sterile materials. The study investigated the effect of sterilization on phytochemical compounds and antimicrobial properties of *Nymphaea lotus* against some selected strains of bacteria. The plant extract was prepared by 48 hrs maceration in ethanol which was further sterilized using 0.45 µM syringe filter and then with an autoclave at 121 °C for 15 mins. The presence of terpenoids, alkaloids, glycosides, flavonoids, tannins and saponins in the sterilized extracts was determined using standard qualitative procedures. The results showed that the syringe filtered extract exerts least adverse effect on the presence of phytochemical compounds than the autoclaved extract in comparison with the control (extract without sterilization). The antimicrobial properties of the sterilized extracts were carried out by agar disk diffusion method against *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli* and *Pseudomonas aeruginosa*. The syringe filtered extract showed better antimicrobial property against all the bacterial strains (in comparison with the controls) with the highest zone of 17 and 14 mm than the autoclaved extract with the highest zone of 13 and 11 mm, respectively. The study revealed that syringe filter sterilization is the best method of sterilization that exerts least adverse effects on the phytochemical compounds and could support the antibacterial properties against the tested bacterial strains. Therefore, *Nymphaea lotus* leaves are good sources of active phytochemicals and can be used as an antimicrobial agent.

Keywords: *Nymphaea lotus*, sterilization, autoclave, syringe filter.



ASSESSMENT OF POULTRY FARMERS' KNOWLEDGE LEVEL OF CLIMATE CHANGE ADAPTATION STRATEGIES IN IMO STATE, NIGERIA

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ABSTRACT

The study assessed poultry farmers' knowledge level of climate change adaptation strategies in Imo State, Nigeria. A multi-staged sampling procedure was used in selecting 120 poultry farmers that participated in the study and structured questionnaire was used to elicit information from them. Data collected were analyzed using both descriptive and inferential statistics. Major findings revealed that 90% of the farmers main source of agricultural information was from fellow farmers while proper housing system ($\bar{x}=100.0$), adaptation of extensive poultry management system ($\bar{x}=100.0$) and prompt vaccination of birds ($\bar{x}=100.0$) topped the list of various climate change adaptation strategies used by the farmers. Also, the poultry farmers' knowledge level of climate change adaptation strategies was high with a grand mean of 2.28 which was above the bench mark mean of 2.00. The hypothesis results showed that there is a significant relationship between the farmers' sources of information on climate change adaptation strategies and their level of knowledge of these strategies. The study concluded that poultry farmers in the study area have high knowledge of various climate change adaptation strategies though from fellow farmers and therefore, recommended that government should make extension services more available to poultry farmers in order to have access to tested, proven and scientific information on adaptation strategies for increased and sustainable knowledge in the study area.

Keywords: Climate change, adaptation strategies, knowledge level, poultry farmers



CRISPR-CAS9 MEDIATED MUTAGENESIS OF TWO ISOFORMS OF STARCH BRANCHING ENZYMES *SBE 2.1* AND *SBE 2.2* GENES IN POTATO CULTIVAR K. CHIPSONA-I.

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ABSTRACT

CRISPR-cas9 base genome editing is done to induce mutations in two starch branching enzyme genes *SBE 2.1* and *SBE 2.2* in tetraploid potato to obtain the potatoes with elevated ratio on amylose to amylopectin. This is done to develop starch with an increased amylose, which is resistant to rapid digestion and thus acts as dietary fiber that controls the blood sugar levels in diabetic patients. In this study, we have done *In silico* analysis of starch branching enzyme target genes *SBE 2.1* and *SBE 2.2*. Next the multicistronic SBE CRISPR/Cas9 cassette is constructed. The multicistronic SBE CRISPR/Cas9 cassette is designed to alter the genes *SBE 2.1* with gRNA targeting at exonic position 1 and 2 of the chromosome number 4 and *SBE 2.2* is targeted with gRNA at exon 3 of the chromosome number 9 in potato cultivar K. Chipsona-I. Agrobacterium-mediated internodal tissue transformation, and molecular analysis of the transgenic plants is done to identify desired mutant lines. We got 8 positive genome-edited lines in the T₀ generation with knockout mutations at two *SBE* genes target gRNA sites. Sequencing analysis revealed deletion of 1-3 nucleotides in potato cultivar K. Chipsona-I. The analysis of the genome-edited lines to revealed a significant decrease in the amylopectin content and an increase in amylose content is currently in progress. Our study demonstrates the potential application of CRISPR/Cas9 technique for the generation of dietary fiber rich potato plants.

Keywords: CRISPR/Cas9 system, dietary fiber, *SBE* gene



**BAZI PAMUK (*Gossypium hirsutum* L.) ÇEŞİTLERİNDE TOHUM ÖN
UYGULAMALARININ ÇİMLENME VE FİDE GELİŞİMİ ÜZERİNE OLAN
ETKİLERİNİN BELİRLENMESİ**

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ÖZET

Bu çalışma, farklı gibberellik asit (GA₃) dozlarının bazı pamuk tohumlarının çimlenme ve çıkış performansını değerlendirmek amacıyla Dicle Üniversitesi Ziraat Fakültesi Teknoloji Uygulama ve Araştırma Merkezi (DUPTAM)'nde laboratuvar koşullarında yürütülmüştür. Denemede, Berke ve Stoneville-468 pamuk çeşitleri materyal olarak kullanılmıştır. Deneme tesadüf parsellerinde faktöriyel deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Tohumlar saf su, 500 ppm, 250 ppm, ve 100 ppm'lik GA₃ dozları ile 12 saat süre muamele edilmiş ve 25° C oda sıcaklığında çimlendirilmiştir. Laboratuvar koşullarında çimlenen tohumlarda çimlenme yüzdesi (%) belirlenmiş ve fidelerde; kök ve fide yaş ağırlıkları (g/fide), kök ve fide uzunluğu (mm/fide) gibi parametreler incelenmiştir. Araştırma sonucunda, en yüksek çimlenme hızı 500 ppm GA₃ uygulamasından, en düşük çimlenme hızı ise kontrol uygulamasından elde edilmiştir. Kök ve fide yaş ağırlığı, kök ve fide uzunluğu gibi özellikler yönünden 250 ppm ve 500 ppm dozlarının ön plana çıktığı belirlenmiştir. Genel olarak gibberellik asit (GA₃) dozlarının söz konusu pamuk çeşitlerinde çimlenme ve çıkış performansını artırmada olumlu etkilerinin olduğu sonucuna varılmıştır.

Anahtar kelimeler: Çimlenme, GA₃, *gossypium hirsutum* l., tohum



**DETERMINATION OF THE EFFECTS OF SEED PRETREATMENT ON
GERMINATION AND SEEDLING GROWTH IN SOME COTTON (*Gossypium
hirsutum* L.) VARIETIES**

ABSTRACT

This study was carried out at Dicle University Technology Application and Research Center in laboratory condition to evaluate the germination and emergence performance of some cotton seeds treated with different gibberellic acid (GA₃) doses. Berke and Stoneville-468 cotton varieties were used as material in the experiment. The experiment was established in randomized plots according to the factorial design with three replications. Seeds were treated with distilled water, 500 ppm, 250 ppm, and 100 ppm GA₃ doses for 12 hours and germinated at 25° C room temperature. In the study, some parameters were investigated such as germination rate (%), root and seedling fresh weights (g/seedling), root and seedling length (mm/seedling) under laboratory conditions. As a result of the research, the highest germination rate was obtained from 500 ppm GA₃ application, and the lowest germination rate was obtained from the control application. It was determined that 250 ppm and 500 ppm doses were prominent in terms of root and seedling fresh weight, root and seedling length characteristics. It was concluded that gibberellic acid (GA₃) doses have positive effects on increasing germination and emergence performance of cotton varieties used.

Keywords: Germination, gibberellic acid, *Gossypium hirsutum* l., seed



Tuckerella japonica (ACARI: TUCKERELLIDAE)' NİN DOĞU KARADENİZ BÖLGESİ ÇAY BAHÇELERİNDEKİ DAĞILIMI

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ÖZET

Camellia sinensis (Theales: Theaceae) bilimsel ismi ile bilinen çay, yapraklarını dökmeyen çalı veya küçük ağaç formunda bir bitkidir. Çayın en genç yaprakları ve yaprak tomurcukları çay yapımında kullanılır. Türkiye hem önemli bir çay tüketicisi hem de üreticisi konumunda olan bir ülkedir. *Tuckerella japonica* (Trombidiformes: Tuckerellidae), dünya çapında çay da dahil çeşitli tarımsal ürünlerde zararlı olabilen bir akar türüdür. Bu çalışma, Türkiye'de Doğu Karadeniz Bölgesi çay bahçelerinde *T. japonica* türünün yayılışını belirlemek amacıyla yürütülmüştür. Bu amaçla, Artvin, Giresun, Ordu, Rize ve Trabzon illerinde bulunan organik, konvansiyonel ticari ve bakımsız/ihtimal edilmiş çay bahçelerinde sörveyler gerçekleştirilmiştir. Bölgede toplam 20 ilçede bulunan 91 adet çay bahçesi, 2022 yılı Nisan-Kasım ayları arasında örneklenmiştir. Örneklenen her bahçeden 45 adet sürgün (15-20 cm uzunluğunda), 60 yaprak, 25 meyve (varsa) ve 25 çiçek (varsa) toplanmıştır. Sürgün ve yaprak örneklemeleri çay ocaklarının alt, orta ve üst olmak üzere farklı kısımlarından yapılmıştır. Örneklemeler farklı rakımlardaki (1-575 m) çay bahçelerinde yürütülmüştür. Örnekleme yerinin koordinatları, Global Positioning System (GPS) cihazı ile belirlenerek kaydedilmiştir. Toplanan örnekler kese kağıtlarına konulup, polietilen torbalara yerleştirilerek etiketlendikten sonra incelemek ve üzerlerindeki akarları toplamak için laboratuvara getirilmişlerdir. Akarlar %70'lik etil alkol içeren eppendorf tüplerde saklanmıştır. Laktofenol solüsyonunda berraklaştırılan akarların Hoyer ortamında preparatları yapılarak, etüvde 50°C'de 5-7 gün kurutulmuşlardır. Ordu ili hariç, örnek alınan tüm illerde *T. japonica* akarı tespit edilmiştir. Tür, genellikle sahil kesimindeki daha düşük rakımlı (1-347 m) bahçelerde bulunmuştur. *T. japonica*'ya organik ve bakımsız çay bahçelerinde rastlanmamıştır. Ancak bu bir ön çalışmadır ve bulguları netleştirmek için bu kapsamda daha fazla bahçede daha fazla araştırma yapılması gerekmektedir.

Anahtar kelimeler: *Camellia sinensis*, *Tuckerella japonica*, çay, dağılım



DISTRIBUTION OF *Tuckerella japonica* (ACARI: TUCKERELLIDAE) IN TEA PLANTATIONS OF THE EASTERN BLACK SEA REGION, TURKEY

ABSTRACT

The tea, which is botanically known as *Camellia sinensis* (Theales: Theaceae), is an evergreen shrub or small tree. The tea plant's young leaves and leaf buds are used for tea production. Turkey is both a major consumer and producer of tea. *Tuckerella japonica* (Trombidiformes: Tuckerellidae) is a pest mite species on a variety of agricultural crops including tea worldwide. This study was carried out to determine the distribution of *T. japonica* in tea plantations of the Eastern Black Sea Region, Turkey. Surveys were conducted in organic, conventional commercial and neglected tea plantations of Artvin, Giresun, Ordu, Rize and Trabzon provinces. 91 tea plantations in 20 districts in this region were sampled from April to November 2022. 45 shoots (15-20 cm in length), 60 leaves, 25 fruits (if any) and 25 flowers (if any) were collected from each sampled plantation. Shoots and leaves were taken from different parts of the shrub canopy, i.e. lower, middle, and upper canopy. Sampling was made from tea plantations at different altitudes (1-575 m). Geographical coordinates were recorded using a GPS mobile device. The samples were placed in paper bags and then later in Ziplock plastic bags, labeled and transferred to the laboratory for the extraction of mites from samples. Specimens were preserved in Eppendorf tubes containing 70% ethanol. Mites were cleared in lactophenol solution. Each mite was then mounted in a drop of Hoyer's medium on microscope slides and dried in an oven at 50°C for 5-7 days. *T. japonica* was detected in all sampled provinces except Ordu. It was usually found in the lower-altitude plantations close to the coast (1- 347 m). This species was not detected in organic or neglected tea plantations. However, this is a preliminary study and more research in more gardens should be carried out to substantiate the findings.

Keywords: *Camellia sinensis*, *Tuckerella japonica*, tea, distribution

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BIOSTIMULATION AND BIOCONTROL POTENTIALS OF BACTERIAL STRAINS AND MANURE IN TOMATO (*Solanum lycopersicum* L.) CULTIVATED IN A NUTRIENT DEFICIENT SOIL

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ABSTRACT

Consequent upon global urbanization, industrialization and growing pressure on the availability of farmland, it is imperative to develop sustainable nutrient revitalization mechanisms of available farmland, to ensure optimum yield for all-year-round cultivation. In this field experiment, nutrient-deficient soil was bio-fortified with *Bacillus* species (1×10^8 CFU/mL) and poultry manure (5 t/ha) for tomato production, and the study was laid out in a randomized complete block design. Treatments included *B. subtilis* and poultry manure, *B. licheniformis* and poultry manure, both *Bacillus* spp. and poultry manure, sole poultry manure and a control treatment, replicated three times. Application of organic fertilizers influenced the growth parameters (stem girth, leaf and branch number) of Roma tomato variety. The highest flower cluster number (10.02) was expressed by plants treated with the combination of both *Bacillus* species and poultry manure. The treatments, especially, combination of *Bacillus* species and poultry manure, appeared to have expressed promising biocontrol potential against the onset of tomato plant disease symptoms. The symptoms included leaf spot, chlorosis, necrosis, wilt, as well as plant death, and the biocontrol efficacy of *Bacillus* species and poultry manure ranged between 100% and 71.46%. To improve seed development, seedling properties, tolerance to disease complexes, flowering and overall health of tomato, biofortification of soil with *Bacillus* species and poultry manure should be adopted in nutrient-depleted soil. In addition to increasing nutrient availability to plant roots, the residual effect of microbial application (which fit as both plant-growth promoters and bio-protectors) should be investigated for sustainable crop production models.

Keywords: *Bacillus* strains, biocontrol, biostimulants, poultry manure, tomato



DETERMINATION OF HEAVY METALS IN BEE HONEY AS A BIOINDICATOR, IN THE REGIONS: ISTOG, DRENAS AND KASTRIOT

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ABSTRACT

The major goal of this research was to employ honey as a bio indicator to identify heavy metal levels in bee honey in the Istog, Drenas, and Kastriot regions. As a result, honey was purposely tested in these locations, and two industrial specific areas were chosen for examination and analysis: Kastriot (Graboc) and Drenas (Vrboc) as these are considered to be among the most industrial polluted area. A honey sample was also taken in the Istog (Vrell, as a clean area) region in order to compare not just honey but also the area where the bee obtains nectar, as well as the sources of pollution discharge into the environment. Concentrations of heavy metals in honey, (min. and max.) resulted for; Zn (8.705- 9.804 mg/ kg), Mn (5.620- 5.718 mg/ kg), Fe (3.635- 3.745 mg/ kg) and Cu (2.295-2.299 mg/ kg). While lower concentrations of metals, have been observed for; Ni (0.640- 1.126 mg/ kg), Pb (0.235- 0.268 mg/ kg), As (0.107- 0.199 mg/ kg), Cd (0.040- 0.058 mg/kg) and Cr (0.025- 0.036 mg/kg) while elements such as; Hg, and Co, are almost undetected. The study of hierarchical clusters revealed several groupings of elements with geogenic and anthropogenic origins. The concentrations of heavy metals selected for honey were compared to standards of other countries, such as Poland and other European Union countries. Samples were taken in October 2020 and September 2021. The concentration of heavy metals was determined using inductively coupled plasma optical emission spectrometry, ICP OES.

Keywords: Pollution, environment, honey, heavy metals



PRACTICAL WORK IN FUNCTION OF ACHIEVING THE LEARNING RESULTS IN CONTENT OF BIOLOGY SUBJECT

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ABSTRACT

This research aims to determine the degree of implementation of practical work in the subject of biology and their impact on the learning of biology. It also aims to identify potential difficulties that may affect the non-implementation of practical work. The research question we aimed to answer is: To what extent are practical works applied in achieving learning results in some biology course contents? The focus of the study were ninth grade students from two different schools. The participants are a total of 265 students. The methodology used in this study is quantitative and qualitative. Data were obtained with the help of research techniques such as: poll, interview, analysis and synthesis. Instruments such as poll questionnaires with pupils and individual interview with teachers are used to collect data. From the results of this study we can conclude that students in lower secondary schools, mainly apply practical work in the subject of biology, through which it is also facilitated for them to learn in certain content of the biology subject. The same was confirmed by teachers, although they say there are many obstacles in this regard. However, they point out that with alternative forms, they realize practical work because of the positive effect that they have in the learning of biology.

Keywords: Biology, learning results, practice work, pupils, teachers



APPLICATION OF KNOWLEDGE FROM FIGURATIVE ART AND PHYSICAL EDUCATION IN ACHIEVING LEARNING OUTCOMES IN BIOLOGY

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ABSTRACT

This paper aims to highlight the interrelationship between subjects (of different curricular areas) but also to identify the assistance that can be to offer a possible cooperation of teachers of different subjects to the satisfactory achievement of learning outcomes in the subject of biology. We are dealing with the application of knowledge of fine arts and physical education in achieving learning outcomes in the contents of the subject of biology in certain chapters in the eleventh and twelfth grades, ie students in the age group 16-17 years. The study was conducted by surveying students and teachers of two high schools "Xhevdet Doda" in Pristina and the private school "International Maarif Schools of Kosovo" located in Qollopek, Lipjan. The research methodology used is qualitative and quantitative. Data collected through questionnaires were analyzed through relevant research programs. Survey questionnaires and protocols for individual interviews were used to collect data. The results found out between figurative art and biology there is a significant positive relationship in the use of schemes and drawings in biology books, their application by the teacher during the explanation but also their use by students during learning. It is worth mentioning that biology teachers stated the lack of cooperation with the teachers of the above mentioned subjects for various reasons.

Keywords: Application, art, biology, learning outcomes, physical education.



DOLU ZARARI NEDENİYLE YAPRAK KAYBINA UĞRAMIŞ ŞEKER PANCARI BİTKİSİNİN GELİŞİMİ ÜZERİNE AZOT DOZLARININ ETKİLERİ

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ÖZET

Bu çalışmanın amacı, şeker pancarında erken gelişim döneminde dolu zararının neden olduğu yaprak kaybindan sonra uygulanacak azot dozlarının etkilerini belirlemektir. Araştırma, 2022 yılında Eskişehir Osmangazi Üniversitesi Ziraat Fakültesinde laboratuvar koşullarında saksı denemesi olarak yürütülmüştür. Çalışmada materyal olarak Smart Sephora şeker pancarı çeşidi ile azot kaynağı olarak kalsiyum amonyum nitrat (%26 N) gübresi kullanılmıştır. Tesadüf parselleri deneme desenine göre üç tekerrürlü olarak kurulan denemede, bitkiler dört yapraklı döneme kadar yetiştirildikten sonra yaprakları tamamen kesilerek uzaklaştırılmıştır. Her saksıya 0, 30, 60 ve 90 kg N ha⁻¹ hesabıyla azot dozları uygulanmıştır. Bir ay sonunda bitkilerde bitki boyu, yaprak sayısı, bitki yaş ağırlığı, bitki kuru ağırlığı, yaprak alanı, yaprak sıcaklığı ve klorofil oranı incelenmiştir. Araştırma sonuçlarına göre, artan azot dozlarının şeker pancarının yaprak sayısı, bitki yaş ağırlığı, kuru ağırlığı, yaprak alanı, yaprak sıcaklığı ve klorofil oranı üzerine etkileri önemli bulunmuştur. Yaprak sıcaklığının artan azot dozlarıyla azaldığı belirlenmiştir. Azot uygulanmayan kontrol bitkileri ile karşılaştırıldığında, azot uygulaması klorofil oranını %12,5, yaprak sayısını %20, bitki yaş ağırlığını %50 ve yaprak alanını ise yaklaşık %43 oranında arttırmıştır. En yüksek değerler 90 kg N ha⁻¹ uygulamasından elde edilmesine rağmen, bitki boyu, yaprak alanı, bitki yaş ve kuru ağırlığı bakımından 60 ve 90 kg N ha⁻¹ uygulamaları arasındaki farklar istatistiksel olarak önemli bulunmamıştır. Sonuç olarak, dolu zararı nedeniyle yaprakları zarar görmüş şeker pancarı bitkilerine 60-90 kg ha⁻¹ azot uygulamasının bitki gelişimini olumlu yönde etkileyebileceği söylenebilir.

Anahtar kelimeler: *Beta vulgaris* L., dolu zararı, azot, bitki gelişimi, yaprak alanı



THE EFFECTS OF NITROGEN DOSES ON THE DEVELOPMENT OF SUGAR BEET PLANTS WITH LEAF LOSS DUE TO HAIL DAMAGE

ABSTRACT

The aim of this study is to determine the effects of different nitrogen doses on plant growth in order to compensate for leaf loss due to hail damage in sugar beet during early development stage. The research was carried out as a pot experiment in laboratory conditions at Eskişehir Osmangazi University, Faculty of Agriculture in 2022. Sugar beet variety Smart Sephora was used as material, and calcium ammonium nitrate (26% N) were applied as nitrogen source. In the experiment established in three replications according to the randomized plots design, the leaves of sugar beet plants at four-leaf stage were removed by cutting them completely. Nitrogen doses of 0, 30, 60 and 90 kg N ha⁻¹ were applied to each pot. After thirty days, plant height, number of leaves, plant fresh weight, plant dry weight, leaf area, leaf temperature and chlorophyll content were investigated. According to the research results, increased nitrogen doses resulted in improving leaf number, plant fresh weight, dry weight, leaf area, leaf temperature and chlorophyll content of sugar beet. Leaf temperature decreased when nitrogen doses increased. Compared to control plants, nitrogen application increased chlorophyll content by 12.5%, leaf number by 20%, plant fresh weight by 50%, and leaf area by approximately 43%. Although the highest values were obtained from 90 kg N ha⁻¹ application, the differences between 60 and 90 kg N ha⁻¹ applications in terms of plant height, leaf area, plant fresh and dry weight were not found significant. As a result, it can be said that 60-90 kg ha⁻¹ of nitrogen application to sugar beet plants whose leaves are damaged due to hail can positively affect plant growth.

Keywords: *Beta vulgaris* L., hail damage, nitrogen, plant growth, leaf area



HAYVAN BESLEMEDE PROPOLİSİN YEM KATKI MADDESİ OLARAK KULLANIMI

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ÖZET

Propolis bal arıları tarafından ağaç kabukları, yaprakları ve bitki özularının toplanması ile kendi enzimlerini ve bal mumu katarak elde ettikleri reçinemsi bir maddedir. Arı tutkalı olarak bilinen propolis, arılar tarafından kovadaki hasarı onarmak, kovadaki nem ve sıcaklığı dengelemek, koloniyi patojen ve mikroorganizmalara karşı korumak için kullanılır. Propolis; toplanma zamanı, coğrafi köken ve ağaç tipleri gibi değişkenlere ve kaynağına göre çeşitlilik göstermekle beraber genel olarak % 50 reçine, % 30 mum, % 10 esansiyel ve aromatik yağlar, % 5 polen, % 5 diğer organik bileşikler ve mineral maddelerden oluşmaktadır Propolis, 300 den fazla kimyasal madde içeren karmaşık bir bileşim olmasıyla hayvancılık sektörünün umudu niteliğinde görülmektedir. Toplanan propolis ham haldedir ve saflaştırılması gerekir. Propolis için en pratik ve en doğru çözücü %96'lık etanol olarak araştırmalardan elde edilen bilgiler arasındadır. Hayvan beslemede kullanılan katkıların giderek daha pahalı oluşu, bazı kimyasalların ürünlerde kalıntı sorununa neden olması mevcut konjonktürde kullanımlarının sınırlandırılması veya tamamen yasaklanmasına neden olmuştur. Özellikle gelişmeyi uyarıcı olarak kullanılan antibiyotiklerin yemlerden çıkarılmasına ilişkin AB müktesebatına uyum gereği yaşanan ekonomi kayıpları giderebilmek için yem katkıları sektörü alternatif arayışlara yönelmiştir. Bu bağlamda değerli bir ürün olan propolis, özellikle yapısındaki zengin flavonoid, fenolik asit ve terpenoidler nedeniyle antibakteriyel, antifungal, antiviral özelliklerinden dolayı çeşitli türler üzerinde denenmiş ve olumlu sonuçlar alınmıştır. Araştırmalardan elde edilen bulgular propolisin söz konusu özelliklerinden dolayı gerek hayvancılık, gerek hayvan sağlığı ve gerekse alternatif büyütme faktörleri bakımından üzerinde durulması gereken alternatif bir yem katkısı olabileceğini göstermektedir. Bu derlemenin amacı, propolisin farklı özelliklerini ve bu konuda hayvan beslemede farklı türlerde yapılan araştırmaları değerlendirmektir.

Anahtar kelimeler: Propolis, hayvan besleme, katkı maddesi



USE OF PROPOLIS AS A FEED ADDITIVE IN ANIMAL NUTRITION

ABSTRACT

Propolis is a resinous substance obtained by honey bees by collecting their bark, leaf and plant juices and adding their own enzymes and wax. Propolis, known as bee glue, is used by bees to repair the damage in the hive, to balance the humidity and temperature in the hive, it is used to protect the colony against pathogens and microorganisms. propolis; Although the collection time varies according to variables such as geographical origin and tree species and source, it generally consists of 50% resin, 30% wax, 10% essential and aromatic oils, 5% pollen, 5% other organic compounds and minerals. materials. Since it is a complex composition containing many chemicals, it is seen as the hope of the livestock industry. The collected propolis is in crude form and needs to be purified. Among the information obtained from the researches, the most practical and most accurate solvent for propolis is 96% ethanol. The fact that additives used in animal nutrition are becoming more expensive and some chemicals cause residue problems in products have led to the restriction or prohibition of their use in the current conjuncture. The feed additive sector has turned to alternative searches to compensate for the economic losses due to harmonization with the EU acquis, especially in the removal of antibiotics used as growth promoters from feed. In this context, propolis, which is a valuable product, has been tested on various species and positive results have been obtained due to its antibacterial, antifungal and antiviral properties, especially the flavonoids, phenolic acids and terpenoids it contains. The findings obtained from the studies show that propolis can be an alternative feed additive that should be evaluated in terms of both animal husbandry, animal health and alternative growth factors due to these properties. The purpose of this review is to evaluate the different properties of propolis and research on different species in animal nutrition.

Keywords: Propolis, animal nutrition, additives



PRESENCE OF SMALL WAX MOTH (*Achroia grisella*) IN APIARIES IN SERBIA

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ABSTRACT

Achroia grisella is a small wax moth of the snout moth family (Pyralidae). Their spread was worldwide except in areas with cold climates. Females deposit their eggs in crevices in or near bee hives so that a food source will be close to the emerging larvae. Because lesser wax moths eat unoccupied honey bee combs, they are considered pests to bees and beekeepers. Feeding occurs only during the larval life stage. Larvae feed on weak bee colonies. Larvae move through the bee comb and spin silk tunnels. They cover the silk with their frass. Tunneling through honeycombs not only provides food, but also protects the larvae from the defending worker bees. The larvae prefer to eat honey bee larvae, pupae, and pollen, but will also feed on honey. A disorder called bald brood occurs in hives infested by lesser wax moths. When feeding on the comb, larvae tunnel under capped cells containing honey bee pupae. This movement causes the caps to become defective. The worker bees will then remove the defective caps. The name bald brood refers to the remaining uncapped cells that reveal the residing pupa. During research conducted in apiaries in Serbia, the presence of small wax moth was established in approximately 1.57% of apiaries. The damage caused by it did not cause the death of colonies, but caused economic losses in the production of bee products. Although they are present in a small percentage, it is necessary to control the small wax moth.

Keywords: *Achroia grisella*, small wax moth, honey bee, Serbia



**COMPARATIVE ANALYSIS OF CHEMICAL COMPOSITION, ANTIOXIDANT
AND ANTIMICROBIAL ACTIVITY OF WILD CARROT (*Daucus carota* L.) SEED
ESSENTIAL OIL FROM SERBIA AND GREECE**

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ABSTRACT

Wild carrot, *Daucus carota* L. ssp. *carota*, is an Umbelliferae family weed that grows in natural flora and is undesirable in agricultural production. Its essential oils can be used for various medicinal purposes in the food technology, pharmaceutical, cosmetic, and sanitary industries. Traditionally, wild carrot essential oil is used to treat urinary calculus, cystitis, gout, and lithuria. Essential oil also has anti-tumor and anti-cancer properties as well as antioxidant activity against a wide range of malignancies. Essential oils from the seeds of wild and cultivated carrot from Serbia are characterized by different contents and components. The aim of this study was to investigate the chemical composition, antioxidant and antimicrobial activity of the wild carrot seed essential oils from two countries (Leskovac, Serbia (WCEOS) and Nea Playa, Greece (WCEOG)). The essential oils were obtained by Clevenger-type hydrodistillation using hydromodule 1:10 m/V. The qualitative and quantitative composition of essential oils was determined by GC/MS and GC/FID analyses. Antioxidant potential was estimated by using the DPPH assay. The antimicrobial activity of essential oils was investigated by the disc-diffusion method in terms of their possible application as natural antioxidants and antimicrobial agents on the following microorganisms: *Escherichia coli* (ATCC 25922), *Pseudomonas aeruginosa* (ATCC 27853), *Proteus vulgaris* (ATCC 8427), *Staphylococcus aureus* (ATCC 25923), *Bacillus subtilis* (ATCC 6633), *Listeria monocytogenes* (ATCC 15313) and *Candida albicans* (ATCC 2091). The GC/MS analysis of WCEOS and WCEOG resulted in the identification of 49 and 37 compounds, respectively. Oxygenated monoterpenes were the main components found in both essential oils (60.5% and 60.4% in WCEOS and WCEOG,



respectively), followed by oxygenated sesquiterpenes and sesquiterpene hydrocarbons. The most abundant components in WCEOS were geranyl acetate (55.1%) and cubebol (10.5%), while geranyl acetate (58.9 %) and β -bisabolene (17.6%) were the main components in WCEOG. After 60 minutes of incubation with the DPPH radical, WCEOG showed better antioxidant activity (EC_{50} value of 30.39 mg/ml) than WCEOS (38.27 mg/ml). Both essential oils showed the best antimicrobial activity against *Escherichia coli*, with a diameter zone of 22.3 and 19.3 mm, respectively, while having no effect on *Pseudomonas aeruginosa*, *Proteus vulgaris*, and *Listeria monocytogenes*. Only WCEOG showed antifungal activity against *Candida albicans* (11.33 mm). It could be concluded that wild carrot seed essential oils from two countries differ in chemical composition and antioxidant and antimicrobial activity. The obtained results indicate their possible application in the food and pharmaceutical industries as a safer alternative to synthetic additives.

Keywords: Essential oil, *Daucus carota* L., Wild carrot, GC/MS analysis, Antioxidant activity, Antimicrobial activity.

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THE EFFECT OF VERMICOMPOST AND P FERTILIZER ON GROWTH, YIELD AND SOIL HEALTH OF SWEET CORN

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ABSTRACT

This study aims to determine the effect of organic fertilizer and phosphorus fertilizer on growth, yield, quality of sweet corn (*Zea mays* L.) and soil health. The study was conducted in Bandar Lampung from December 2017 to March 2018. This study was designed using a 2 x 4 factorial randomized block design with 3 replications. The first factor is vermicompost consisting of 2 levels, 0 tons / ha and 20 tons / ha, the second factor is the dose of P fertilizer consisting of 4 levels, 0 kg / ha P, 75 kg / ha P, 150 kg / ha P, and 225 kg / ha P. The results showed that vermicompost and P fertilizer increased growth, yield, quality of sweet corn and soil health. The combination of vermicompost and P fertilizer increased levels of chlorophyll and carotenoid pigments in the leaves of sweet corn plants. The treatment of vermicompost and P fertilizer increased crop production by 14.56%, the number of fungal microbes by 58.72%, bacterial microbes by 53.99%, and soil respiration by 57.06%. The combination of vermicompost and phosphorus fertilizer is useful for increasing crop production and improving soil health in the tropics.

Keywords: Vermicompost, sweet corn, soil health, phosphorous



DEVELOPMENT OF MOCAF (MODIFIED CASSAVA FLOUR)-BASED PASTRY FOR CASSAVA FOOD DIVERSIFICATION

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ABSTRACT

Cassava has a low glycemic index (GI) and is recommended for people with diabetes. Cassava can be used as a substitute for rice as an Indonesian staple food. Given Indonesia's high consumption of rice and wheat, diversification of cassava-based foods could reduce consumption and limit imports of the commodities. Efforts to develop various cassava-based foods are getting more attention today. Cassava strip pastry is a new pastry made with modified cassava flour (Mocaf). The development of cassava strip pastry was expected to expand cassava food varieties. This research aims to investigate the cassava strip pastry process, the panels' acceptance, the packaging, the brand, and the product price. In the process, a folding process is a critical step that determines the success of products. The baking process is carried out at 180°C for 20 minutes until golden brown, stored in an airtight jar, labeled, and can be sold for Rp 20.000 of price. The product must sell more than two units of airtight jars to have a profit. The preference test results for cassava strip pastry revealed that the panelists' preference level exceeded 50 %, with a preference for color at 66.7 %, taste at 58.3 %, texture at 50 %, and aroma at 50 %. Nutritional value information has been calculated using the Nutrisurvey tool based on the raw material formulation used. Branding on products can increase product value. As a result, to enter the modern and digital market, the product must have a new brand, be well-labeled, and be registered.

Keywords: Mocaf, cassava strip pastry, cassava-based product, brand



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ABSTRACT

Faced with health problems related to the consumption of sugars such as obesity and diabetes, the search for potent sweeteners as alternatives to sugar in such situations is ongoing. Sweeteners are characterized by a high sweetening power that can replace sugar in small quantities. Thus, manufacturers have moved towards the use of various sweeteners such as cyclamate and saccharin, but these artificial sweeteners have posed toxicological problems. Therefore, natural sweeteners extracted from plants are a good alternative to artificial ones.

Stevia rebaudiana is a plant species native to Paraguay. In traditional herbal medicine, it has been considered hypoglycemic, hypotensive, cardio-tonic and diuretic. Among the 100 chemical compounds discovered in *Stevia* are steviol glycosides which are responsible for the sweet taste. These natural chemical molecules have steviol in common, and are distinguished from each other by different carbohydrate residues attached to steviol in various configurations to form this variety of sweet compound. Steviol glycosides have several health benefits including anti-inflammatory and immuno-modulator, renal protector in renal insufficiency and diabetes, antioxidant, hepato-protector, anti diarrhoea, anti-cariogenic and non mutagenic. Currently, on an industrial scale, *Stevia* is used in a multitude of food products including yogurt, biscuits and herbal teas of various aromatic plants. In order to extract the maximum amount of steviol glycosides from the leaves of *Stevia rebaudiana*, different extraction methods have been developed, namely: conventional extraction methods, in addition to enzyme-assisted extraction, supercritical fluid extraction, ultrasonic assisted extraction, microwave extraction and pressurized fluid extraction. Each of these methods is characterized by particular advantages. Thus the optimization of extraction of steviol glycosides is extremely important so that to obtain high yield of these compounds which are truly a potential alternative to chemical sweeteners.

Keywords: *Stevia Rebaudiana*, history, phytochemistry, extraction techniques



**ANTIBACTERIAL ACTIVITY OF *ZIZIPHUS NUMMULARIA* AGAINST
COLIFORM BOVINE MASTITIS**

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ABSTRACT

The subsistence sector of Pakistan's livestock industry is comprised of farmers who maintain 3-4 milk-producing animals for their daily needs. Unfortunately, bovine mastitis, caused by coliform bacteria such as *Escherichia coli*, is a major issue that these farmers face, significantly reducing milk production. Risk factors for this type of mastitis include damage to teats and use of sawdust bedding. The infection is more commonly seen in confined animals than pastured cows. Recent studies have found that natural medicinal plants possess varying levels of antimicrobial activity, providing an opportunity to be used as new antibiotics. This study aimed



to assess the antimicrobial activity of *Ziziphus nummularia* (Jungli berry) leaves against bovine mastitis caused by *E.coli*. After confirming the antibacterial properties of the plant's methanolic extract via agar well diffusion method, the study was conducted for seven days on twelve crossbred cattle suffering from subclinical coliform mastitis during the second or third stage of lactation. Four groups of cows were prepared, with Group G0 (control group) receiving a normal diet and the other groups (T1, T2, and T3) receiving an additional 100g, 200g, and 300g of *Ziziphus nummularia* leaves powder in their normal diet respectively. After seven days, the results showed a significant decrease in the somatic cell count of the T3 group that received 300g of powder, as well as a significant decrease in WBCs, monocytes, MONO%, GRA%, RBCs, MCHC, and ESR, and an increase in MCV and MCH (in accordance with normal range of values). Biochemical analysis also revealed a significant decrease in the levels of Urea, ALT, AST, and ALP so that they came within the normal range as compared to the control group. Moreover, HPLC quantification detected significant amounts of gallic acid, caffeic acid, tannins, quercetin, and kaempferol in the methanolic extract of the plant. Current research concludes that the phytochemicals in *Ziziphus nummularia* play a significant role in controlling coliform mastitis in dairy cattle, suggesting that it may be used as an alternative medicine to treat the condition.

Keywords: *Ziziphus nummularia*, Antimicrobial activity, *E. coli*, Bovine mastitis, Haematological and Biochemical parameters, Somatic cell count

Conflicts of Interest: The authors declare no conflict of interest.



METRONIDAZOLE ADSORPTION FROM AQUEOUS SOLUTION USING NANO CRYSTALLINE CELLULOSE OBTAINED FROM *LUFFA AEGYPTIACA* SPONGE

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ABSTRACT

Water bodies may contain residues of antibiotics which may cause chemical contamination. The design of several waste water treatment plants may not be able to degrade and eliminate these contaminants completely. Hence in this study, the removal of metronidazole from aqueous solution using the adsorption method was investigated. *Luffa aegyptiaca* sponge was utilized to extract cellulose which was then used to prepare Nano crystalline cellulose (NCC) for the removal of the metronidazole. Acid hydrolysis method was used to extract the NCC from cellulose using 64 wt% sulphuric acid. The formed NCC was characterized by FTIR, BET, TGA & XRD. The BET result showed that NCC of surface area 114 m²/g, pore diameter 2.133nm and pore volume of 0.075 cm³/g was formed. On the other hand, XRD result confirmed the formation of the NCC and further showed that a typical cellulose I crystalline structure was formed. The changes in the FTIR spectra of the samples during the synthesis also confirmed the formation of NCC as shifting and disappearance of peaks was evident. Batch adsorption studies were conducted to investigate the effects of pH, adsorbent dosage, initial concentration, time and temperature. The metronidazole adsorption isotherm and kinetic data on the NCC were also analyzed. The results showed that maximum removal efficiency of 70.2 % was obtained at an initial metronidazole concentration of 50 mg/L, pH of 7, 0.08 g adsorbent mass and 60 mins contact time. The adsorption process was in agreement with the pseudo-second order kinetic model and the Langmuir adsorption isotherm. The thermodynamic study conducted revealed that the metronidazole removal by the NCC was thermodynamically feasible, spontaneous and endothermic in nature.

Keywords: *Luffa aegyptiaca*, nano crystalline cellulose, metronidazole, adsorption



BIOECONOMY: ACHIEVING SCIENTIFIC AND TECHNICAL PROGRESS IN AGRIBUSINESS

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ABSTRACT

The scientific and technological revolution had a huge impact on the change in the set of production productivity factors in agriculture, which led to the modification of the entire food system. During this stage of the scientific and technical revolution in agriculture, transformations of all types of technological development took place - land-saving, labor-saving and knowledge-intensive. The main consequence of the "chemical" revolution should be considered an increase in labor productivity in agriculture. The logical continuation of such radical changes was the redistribution of the balance of power on the world markets of agricultural products, geographical and commodity diversification of world trade, structural and institutional changes at the world level. According to many economists (primarily from developing countries), the chemical revolution in its classical form can still ensure an increase in the productivity of agricultural land, both due to the introduction of modern achievements of the scientific and technical revolution in the activities of progressive and efficient farms, and by spreading to regions where the processes of intensification. Undoubtedly, this requires a detailed study of modern agricultural systems, experiences, problems of farmers in poor countries, as well as development of measures of real support for intensification on the part of developed countries. According to most biologists, in developed countries, as a result of intensive selection, the yield limit of many crops has already been reached. Therefore, it is necessary to invent new ways of solving the food problem, which is possible only on the basis of further achievements of scientific and technical progress (primarily in the field of biotechnology) – bioeconomy.

Keywords: Food crisis, potential supplies, competitiveness of a country, agro-industrial complex, agriculture, sustainable bioeconomy strategy, biomass



WASTE TO ENERGY PLANTS PERFORMANCE ENHANCEMENT FOR BENEFIT OF AGRICULTURE AND RURAL ECONOMY

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ABSTRACT

Waste incinerators are an effective method for combustion of waste in developing countries especially where land resources are limited. Energy from these plants can be used to generate electricity and other purposes known as waste – to – energy plants. Agriculture waste such as cotton sticks can be collected from farms and used as fuel in these plants which will generate revenue to farmers. However globally the waste-to-energy plants are running at low efficiency as compared to fossil fuel based plants due to hot corrosion degradation failure of the heat exchanger components. The presence of mainly alkali and heavy metals along-with chlorine in the waste lowers the first melting point (FMT) of deposits on the surfaces, results in accelerated corrosion of the components. Though superalloys show better results compared to different boiler steels but still there is need of corrosion resistant coatings to improve the efficiency of the power plants. This paper presents the methods of enhancement of the efficiency of these waste – to – energy plants.

Keywords: Incinerators, waste to energy plants, agriculture



THE OPTIMIZATION OF PLANT GROWTH REGULATORS FOR INDUCTION AND MULTIPLICATION OF SOMATIC EMBRYOGENESIS IN ARABICA COFFEE PLANTS

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ABSTRACT

In Coffee is one of the most important trading commodities in the world. Arabica coffee is the most highly cultivated coffee plant. Supporting the development of the Arabica coffee industry requires an effective method for the propagation and breeding of coffee plants, therefore supply enough planting materials with uniform genotypes is needed. Propagation of coffee plants through direct or indirect somatic embryo induction and multiplication by using medium concentration and plant growth regulators (PGR) such as auxin and cytokinin are promising to be conducted. The combination of PGR such as NAA-TDZ, NAA-Kinetin, BAP-TDZ, BAP-Kinetin, 2,4-D-Kinetin, and 2,4-D-TDZ hormone combination are effective to induce and multiply somatic embryogenesis during *in vitro* cultivation. The objective of this study is to optimize an *in vitro* culture condition for the induction and multiplication of somatic embryos of Arabica coffee by various concentrations of medium and PGRs. Each treatment consisted of 4 replicates in 4 petri dish grown using Murashige and Skoog ($\frac{1}{2}$ MS and MS) which were added with a combination of 1 mg/L PGR into each *in vitro* medium for eight weeks of cultivation. The result showed that the appropriate media concentration of MS medium and the plant growth regulator for induction of somatic embryos in Arabica coffee is 90% with $\frac{1}{2}$ MS medium supplemented with 1 mg/L 2,4-D and 1 mg/L TDZ. The result shows the textures of friable calli with various colors such as white, brownish-white, brownish-yellow, yellow, and brown. The result of the appropriate medium for multiplication of somatic embryogenic calli in Arabica coffee is 100 % with $\frac{1}{2}$ MS medium + 1 mg/L BAP+ 1 mg/L Kinetin.

Keywords: Arabica coffee, somatic embryogenesis, induction, multiplication, plant growth regulators.



VISUALIZING THE INVISIBLE: 3-D PRINTING OF CELL DIVISION PHASES AS A TOOL IN SCIENCE EDUCATION

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ABSTRACT

Science education is most effective when it provides authentic experiences that reflect professional practices that approach that deal with challenges important to their lives and communities. These teaching experiences can be improved with digital fabrication and are becoming more transdisciplinary. Digital fabrication is the process of creating objects to be produced using equipment like 3D printers. In the past, these kinds of tools have been extremely expensive and challenging to obtain; nevertheless, recent improvements in technology design have been accompanied by decreasing costs. In this paper, we present the experience of Palestinian teachers in the employ of 3-D printing of cell division phases as an educational tool to support the learning of students in science classrooms in the Gaza Strip. We investigated the benefits of using 3D printing and designing to produce models of cell division phases for students and teachers. The results showed that using 3-D printing and designing promotes students' problem-solving skills, complements the science curriculum, gives access to knowledge previously unavailable, and supports hands-on learning. In Palestine, the integration of 3D printing technology in education has several problems such as the unavailability of a 3D printer, the high costs of raw materials required for printing, and the need to train teachers on design and modeling programs.

Keywords: 3-D printing, science education, digital fabrication, cell division, STEM.



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ÖZET

Bu çalışma, Muş İli merkeze bağlı Karacavuş (Haçreş) Dağlarının Florasını tespit etmek amacıyla yapılmıştır. Çalışma alanında 2020-2022 yılları arasında toplam 845 bitki örneği toplanmış, 68 familya, 256 cins ve 568 takson tespit edilmiştir. Bu taksonların iki tanesi Pteridophyta, 566 tanesi Spermatophyta divizyonu üyesidir. Spermatophyta bölümüne ait taksonların sekiz tanesi Gymnospermae alt divizyonu; 498 tanesi Angiospermae alt divizyonu üyesidir. Angiospermae alt divizyonundan geriye kalan bitkilerin ise 432 tanesi Dicotyledones ve 66 tanesi Monocotyledones sınıfına aittir. Çalışma alanındaki taksonların fitocoğrafik bölgelere göre dağılımı: İran-Turan 147 (%25.8), Avrupa-Sibirya 47 (%8.2), Akdeniz 20 (%3.5) ve çok bölgeli veya bilinmeyen fitocoğrafyaya sahip takson sayısı 355 (% 62.5) olarak tespit edildi. Çalışma alanında tespit edilen ilk 10 familya; Asteraceae (79 takson-% 13.4), Fabaceae (51 takson,-% 9), Poaceae (47 takson-% 8.2), Lamiaceae (43 takson-% 7.5), Rosaceae (36 takson-% 6.3), Brassicaceae (28 takson-% 4.9), Boraginaceae (28 takson-% 4.9), Caryophyllaceae (24 takson-% 3.6), Apiaceae (19 takson-% 3.3), Plantaginaceae (14 takson-% 2.4)'dir. En fazla takson içeren cinsler ise; Astragalus (13) Trifolium (11), Salvia (11), Centaurea (10), Renunculus (8), Myosotis (7), Allium (7) Achillea (6). Endemik takson sayısı 38 olup, bu oran % 6.5'tir. Tespit edilen endemik taksonların IUCN tehlike sınıfları; LC (30), VU (5), EN (1) ve CR (2) şeklindedir.

Anahtar kelimeler: Cicim, şanlıurfa, kültürel miras, geleneksel dokuma



THE FLORA OF KARAÇAVUŞ (HAÇREŞ) MOUNTAINS (MUŞ)

ABSTRACT

this study was carried out to determine the flora of the karaçavuş (haçreş) mountains belonging to center of muş province. a total of 845 plant samples were collected in the study area between the years 2020-2022, and 68 families, 256 genera and 568 taxa were identified. two of these taxa are members of pteridophyta and 566 of them are members of spermatophyta division. eight of the taxa belonging to the spermatophyta division are sub-division gymnospermae; 498 of them are members of the angiospermae subdivision. of the plants remaining from the angiospermae subdivision, 432 of them belong to the class dicotyledones and 66 of them belong to the class monocotyledones. distribution of taxa in the study area according to phytogeographic regions: iran-turanian 147 (25.8%), euro-siberian 47 (8.2%), mediterranean 20 (3.5%), and the number of taxa with multi-regional or unknown phytogeography is 355 (62.5%). the first ten families with the most taxa in the study area; asteraceae (79 takson-% 13.4), fabaceae (51 takson,-% 9), poaceae (47 takson-% 8.2), lamiaceae (43 taskon-% 7.5), rosaceae (36 takson-% 6.3), brassicaceae (28 taskon-% 4.9), boraginaceae (28 takson-% 4.9), caryophyllaceae (24 takson-% 3.6), apiaceae (19 takson-% 3.3), plantaginaceae (14 takson-% 2.4)'dir. the genera containing the most taxa are; astragalus (13) trifolium (11), salvia (11), centaurea (10), renunculus (8), myosotis (7), allium (7) achillea (6)'dir. the number of endemic taxa is 38 and this rate is 6.5%. the iucn threatened classifications of the detected endemic taxa are as follows: lc (30), vu (5), en (1) ve cr (2).

Keywords: flora, karaçavuş (haçreş), Muş



ASSESSING SCARIFICATION AND PRIMING PERIOD EFFECT ON PHYSIC NUT (*Jatropa curcas* L.) GERMINATION

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ABSTRACT

Poor germination is a major challenge in the production of oil seed crops. This study was aimed at investigating the possibility of enhancing germination rate of *Jatropa curcas* via scarification and priming. The experiment was conducted at the Horticulture Garden of Federal College of Agriculture Moor Plantation Ibadan, Nigeria located at latitude of 7° 22°N and longitude of 3° 50° E. The experiment was a 2 x 4 factorial experiment arranged in a completely randomized design, comprising of scarified and unscarified seeds of *Jatropa curcas* subjected to four priming period (0, 8, 16, 24) hours. Data collected include leave count, seedling length, stem girth, fresh plant weight, plant dry weight, number of seedling emergence, germination % and seedling vigor index (SVI), speed of germination (SOG), seedling growth rate (SGR). The result showed that *Jatropa curcas* seeds from scarified treatment increase seedling emergence to 12.6 at 12 days after sowing as against 7.8 in unscarified treatment. Of all the seedling vigour indices investigated; SVI, SGR and SOG, scarification and priming did not significantly affect germination of *Jatropa curcas*, except with the speed of germination, SOG that was significantly enhanced in scarified seeds (7.8) than unscarified seeds (4.4). Furthermore, there was no significant interaction between the scarification and priming period with respect to seedling vigour indices assessed, which implies that priming duration did not significantly improve seedling emergence of *Jatropa curcas* except in the numbers of leaves/plant. Hence, cracking of the hard coat of *Jatropa* seeds (scarification) was recommended as a pre-germination treatment to enhance germination in *Jatropa curcas* cultivation.

Keywords: germination; *Jatropa curcas*; priming; scarification



PROTOCOL FOR THE MEASUREMENTS OF CROPS AT RISK FROM CLIMATE CHANGE: A CASE OF STUDY ON *Lactuca sativa* L. SUBJECTED TO SALT STRESS

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ABSTRACT

Climate change has manifested itself more frequently in the last decade to become a constant scourge that puts the environment and biodiversity at risk. The variations of increasingly extreme temperatures and constant dry periods throughout the year, not only put at risk natural ecosystems, they also compromise crops and the entire agri-food sector. With ever-increasing water scarcity and salinization of river mouths, freshwater reserves are becoming less accessible, increasing salt stress for plant species. In this context, this study develops a protocol to evaluate the efficacy of different treatments (including biostimulants already on the market) on blocks of *Lactuca sativa* L. subjected to different concentrations of salt stress.

45 lettuce blocks were subjected to three salt concentrations (0 mol, 0.5 mol and 1 mol) and 15 different treatments (biostimulants, bacterial cultures, yeasts, etc.). The effects of stress and the effectiveness of the treatments were monitored over 60 days through the measurement of chlorophyll content and the analysis of SI-NDVI images taken with a modified camera. The chlorophyll content were made with an ATLEAF CHL PLUS portable chlorophyll meter (FT Green LLC, Wilmington, US). Three measurements were taken for each block, along a diagonal, choosing fully mature leaves and positioning the instrument at the same distance. The SI-NDVI photos were taken at a height of 70cm taking references to obtain photos for the 45 blocks in the same position. The measurements were taken at intervals of 30 days:

T₀ – at the beginning of the case study

T₁ – at an intermediate interval

T_f – at the conclusion of the case study

The photos were processed with ImageJ's Photo-monitoring plugin, resulting in a false-color image and an NDVI image used to assess stress.

The first results show a discrimination between treatments detectable with the protocol devised, useful to detect the effect of salt on plant species and the possible mitigation of salt stress on crops.

Keywords: Climate change, salt stress, monitoring, si-ndvi, agriculture.



GINGER TEA EFFECT ON DYSPEPSIA AMONG SENIOR CITIZENS

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ABSTRACT

Introduction: “Let your food be your medicine, and your medicine be your food” - Hippocrates.

Good nutrition is essential to good health throughout life, beginning with pre-natal life and continuing through old age. Dyspepsia is not a disease but a group of symptoms of upper gastrointestinal tract problems which is commonly seen among elderly.

It is reported that 50% of people with dyspepsia self-medicate using antacids and low dose H₂ receptor antagonists, possibly with advice from a community pharmacist. Dyspepsia can be managed in home by administration of Ginger. It has been used as a traditional home remedy for indigestion, nausea, cold and sore throats in Asia since ancient times.

Objective: To evaluate the effectiveness of ginger tea in relieving dyspepsia among senior citizens.

Background: The prevalence rate of dyspepsia varies considerably between different populations in specific more prevalent in adults > 40 years of age. A study on herbal medicine in GI system shows that ginger stimulates the flow of saliva, bile and gastric secretions. These findings appear to support to the traditional use of ginger in the treatment of GI discomfort and bloating.

Methods: A True experimental design was adopted in which 60 dyspeptic senior citizens were recruited from a geriatric unit of Christian mission Hospital, Madurai. In each experimental and control group 30 subjects assigned by simple random sampling using lottery method. A ginger tea of 100 ml with honey served once per day instead of ordinary tea for 10 days . Self-reported questionnaire and 7-point GOS Dyspepsia Scale was used to gather data. Pre and posttest difference was analysed using paired t-test.

Results: In pretest, the majority 16 (56.7%) had in experimental group and in the control group (53.3%) had moderate level of dyspepsia. In post-test 96.7% had no dyspepsia in experimental group and 46.6% had moderate level of dyspepsia in the control group. The paired t tests revealed ‘t’ value 14.1 of level of dyspepsia was highly significant at P= 0.05.

Conclusion: ginger tea was effective in reduction in the severity level of dyspeptic symptoms.

Index Terms: ginger, dyspepsia, senior citizens



INVESTIGATING AND MODELLING THE TRANSMISSION DYNAMICS OF COVID-19 VIRUS PANDEMIC

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ABSTRACT

Investigating and Modelling the transmission dynamics of the novel corona virus (COVID-19) cases is an important stride in decreasing/mitigating the persistent raise in cases of the pandemic, which is claiming several lives around the world today. COVID- 19, affects different people in different ways. Most infected people will develop mild to moderate illness and may recover without hospitalization. Hence, this paper, has developed and validated a mathematical model for the spread and control of Covid-19 using treatment centres. The proposed model is a first non-linear ordinary differential equation Model, the Model has been divided into six compartments namely: Susceptible Human (SH), Vector Source (VS), Infected Human (IH), Treatment Centre (TH), Discharged Human (DH) and Infectious Surfaces (IV). The equilibrium state was obtained and analysed for stability, and the effective reproductive number (R_0) was also obtained. The results revealed that the higher the treatment rate, the higher the number of discharged humans. Furthermore, it is recommended among others that early detection of infected persons with less common to serious symptoms is germane and such should seek immediate medical attention and further necessary steps be taken such as medications at treatment centres which will in turn lead to reduction of covid-19 transmission in the society at large.

Keywords: Transmission, mathematical model dynamics and covid-19.



AN EXPERT SYSTEM FOR EARLY DETECTION OF PEST ON CROPS USING IMAGE PROCESSING TECHNIQUES TO PROTECT THE CROP HEALTH AND YIELD

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ABSTRACT

Early pest detection is a major challenge in crop management. Agriculture not only provides food, but it also contributes significantly to the economy of any country. A timely examination of the crop is the most effective way to determine its health. If pests are discovered, appropriate measures to protect crop yield can be implemented. Design and implementation of an intelligent pest detection system that employs machine vision and image processing techniques to identify pests on crops earlier and more accurately, allowing farmers to use pesticides more effectively to protect yield. Crop images selected from random locations of crop are analyzed in this work to detect pest intensity using digital image processing techniques such as filtering, segmentation, and feature extraction, and the Support Vector Machine classifier is used to classify pest types for better results. Following image processing, the final results are forwarded to registered farmers via mobile messages so that they can take the necessary precautions to protect crop health and yield.

Keywords: Machine vision, image processing, filtering, segmentation, support vector machine



AGRI-TOURISM AND SUSTAINABLE RURAL DEVELOPMENT: RESEARCH FOR AGRICULTURAL TOURISM MODEL IN PHONG DIEN DISTRICT, CAN THO CITY, VIETNAM

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ABSTRACT

Agricultural tourism has been applied by many nations around the world as one of the effective economic models for rural development. Being a developing agricultural country with more than 70% of the population living in rural areas, where cultural and historical traditions associated with agricultural production are preserved, Vietnam advocates developing agri-tourism to build new countryside from 2021 through 2025. Dubbed a riverside city located in the center of the Mekong Delta region (Vietnam), Can Tho city takes advantage of available natural and cultural resources to develop agri-tourism. Agricultural tourism research to create and improve the value chain of agricultural tourism in potential localities, placed in regional agriculture-tourism linkages, oriented towards sustainable rural development is one of the current key contents. By choosing the case of 10 typical agritourism farming households in Phong Dien, a district that develop this type of tourism the earliest in Can Tho city, the present study aims to (1) identify the main factors in the model of local agricultural tourism development; (2) analyze and evaluate the importance and the development status of the main factors in the local agricultural tourism development model; (3) propose some management implications for developing a more effective local agritourism model. Used approaches for the study included documentary research, field observation, in-depth interviews, and survey questionnaires. Research results have revealed 05 main factors in the agri-tourism model (with different order of importance) including (1) Markets (Tourist Needs); (2) Materials (Natural and Cultural tourism resources); (3) Infrastructure and Utilities; (4) Labor (Human Resources); (5) Support of Local Authorities (like management, law, financial capital, training, promotion, cooperation, etc.) The current status of agri-tourism development in the locality has also indicated its strengths, weaknesses, opportunities, and challenges. Based on the reality of the research findings, some management implications were finally proposed to contribute to the model of agri-tourism development in the studied area.

Keywords: Agri-tourism, sustainable rural development, multiple criteria decision support, swot analysis, phong dien, can tho, vietnam



MEASURING HOUSEHOLD FOOD INSECURITY AND COPING STRATEGIES IN IBADAN, NIGERIA

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ABSTRACT

Food security could be defined as the access to adequate, safe and nutritious food required for healthy living by all people at all times. Optimal nutrition is essential for healthy life and development at state and national levels. The aim of this study is to assess the level of household food insecurity (HFI) and coping strategies among mother-child (24-59 months) pairs in an urban population. The household food insecurity and coping strategies were assessed using primary data collected from a sample of 200 apparently healthy mother-child pairs from Ibadan South West local government area, Oyo state. An interviewer-administered questionnaire was used for data collection. The prevalence of food insecurity was assessed using 9-item Household Food Insecurity Access Scale (HFIAS); the questions contained in the HFIAS were asked with a recall period of 12 months. Data were analyzed using SPSS (version 20) and presented as frequencies and percentages. The household food insecurity was categorized as 'food secured' and 'food insecure'. The results showed that the respondents had a mean age of 34.3 ± 8.2 years while less than half of them (40.5%) were aged 31-40 years. Less than a third of the women (29.6%) had secondary education while 31.2% were artisans. More than one-third of the respondents (35.0%) spent less than 20% of monthly income on food. While only 15.5% were food secure, about 40.4% were moderately food insecure as shown in Figure 1. Coping strategies identified in the study area include relying on less expensive meals, relying on less expensive/preferred meals, reduction in number of meals and limiting portions at meal times. The study revealed a high level of household food insecurity in the selected urban location. There is therefore an urgent need for women empowerment and increase in food production.

Keywords: Food Insecurity, Household Food Insecurity Access Scale, Coping strategies



BURSA YÖRESİNDE YETİŞTİRİLEN KIL KEÇİLERDE DÖL VERİMİ VE BÜYÜME ÖZELLİKLERİ

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ÖZET

Kıl keçi, Türkiye'nin bütün bölgelerine yayılmış olan ve toplam keçi varlığının yaklaşık %97'sini oluşturmaktadır. Genellikle kırsal bölgelerdeki diğer hayvan türlerinin faydalanamayacağı fakir meraları değerlendirebilmesinin yanında zorlu iklim koşullarına iyi adapte olmuş ve hastalıklara karşı dirençli bir keçi ırkıdır. Kıl keçi bu üstün özellikleri sayesinde çok geniş bir coğrafyaya yayılma imkânı bulmuş ve bulunduğu bölgelerdeki düşük gelirliliğin önemli bir geçim kaynağı haline gelmiştir. Kıl keçisi verim yönü bakımından hem et hem de süt veriminden faydalanılan, kombine verimli bir keçi ırkıdır. Yetiştirme amacı bölgelere göre farklılık göstermektedir. Keçi peynirinin fazlaca tüketildiği bölgelerde süt üretimi için, keçi ve oğlak etinin tercih edildiği bölgelerde ise daha çok et verimi için yetiştirilmektedir. Bu sebeple uygulanan seleksiyonlar sonucu Türkiye'nin farklı bölgelerde verim yönü bakımından değişkenlik gösteren Kıl keçi popülasyonlarına rastlamak mümkündür. Bu çalışmada, Bursa ilinin farklı ilçe ve köylerinde yetiştirilmekte olan, Tarım ve Orman Bakanlığı'nın "Halk Elinde Hayvan Islahı Ülkesel Projesi" kapsamındaki Kıl Keçilerin 5 yıllık kayıtlarından faydalanılmıştır. Toplam 37 farklı işletmede 11.196 baş keçi ve bunlardan doğan 11.395 baş oğlaktan elde edilen verilerin istatistiksel analizlerinde, keçilerde doğum ve kısırılık oranları sırasıyla; %97.6 ve %2,35, oğlakların doğum ağırlığı ortalamaları erkeklerde 2.65 ± 0.114 kg, dişilerde 2.60 ± 0.114 kg ($p < 0.001$), süttan kesim dönemi ağırlık ortalamaları ise erkeklerde 16.63 ± 0.670 kg, dişilerde 16.38 ± 0.671 kg olarak bulunmuştur ($p < 0.001$). Doğumdan süttan kesime kadar olan dönemde günlük canlı ağırlık kazançları erkek oğlaklarda 155.41 ± 7.30 g, dişi oğlaklarda 153.22 ± 7.31 g olarak hesaplanmıştır ($p < 0.01$). Ayrıca doğum ve süttan kesim dönemleri canlı ağırlık ortalamaları ile günlük canlı ağırlık kazançlarına ait ortalamalara, doğum tipi ve yıl faktörlerinin etkileri istatistiksel olarak çok önemli bulunmuştur ($p < 0.001$). Sonuç olarak bu çalışma, Türkiye'nin hemen hemen her bölgesinde yetiştirilmekte olan Kıl keçilerin, buldukları bölgelerdeki verim özelliklerinin belirlenmesi ve diğer bölgelerdeki keçilerin performanslarıyla karşılaştırılması bakımından önem arz etmektedir.

Anahtar kelimeler: Kıl keçi, döl verimi, canlı ağırlık, büyüme



FERTILITY AND GROWTH CHARACTERISTICS OF KIL GOATS IN THE BURSA REGION

ABSTRACT

Kıl goats make up about 97% of the total goat population and are common in all regions of Turkey. It is a breed of goat that is well adapted to harsh climatic conditions and resistant to diseases. It is also capable of using poor pasture land, which is not available for other animal species in rural areas. Because of these excellent characteristics, the Kıl goat has been able to spread over a large area and has become an important source of income for low-income breeders in the regions where it occurs. The Kıl goat is a combined productive breed of goat that offers advantages in both meat and milk production. The purpose of breeding varies from region to region. In regions where a lot of goat cheese is consumed, it is bred for milk production, in regions where goat and kid meat is preferred, it is also bred for meat production. For this reason, it is possible that there are Kıl goat populations in different regions of Turkey that differ in yield direction due to the selections applied. In this study, the 5-year records of Kıl goats bred in different districts and villages of Bursa under the "National Livestock Breeding Project in the Hands of the People" of the Ministry of Agriculture and Forestry were used. Statistical analysis of data from 11.196 goats and 11.395 kids in 37 different farms. The average birth and infertility rates of goats were 97.6% and 2.35%, respectively. The birth weight of kids was 2.65 ± 0.114 kg for males and 2.60 ± 0.114 kg for females ($p > 0.001$). The average weight after weaning was 16.63 ± 0.670 kg in males and 16.38 ± 0.671 kg in females ($p > 0.001$). In the period from birth to weaning, daily weight gain was 155.41 ± 7.30 g in male goats and 153.22 ± 7.31 g in female goats ($p > 0.01$). It was also found that the effects of birth type and year on average live weight at birth and weaning and on average daily live weight gain were statistically significant ($p > 0.001$). This study is important to determine the performance characteristics of Kıl goats bred in almost all regions of Turkey in their regions and compare them with the performance of goats in other regions.

Key words: Kıl goat, fertility, live weight, growth



**PRELIMINARY GEOPHYSICAL 1D AND GEOTECHNICAL INVESTIGATION
FOR PROPOSED BUILDING FOUNDATION AT UNITED GRAMMAR SCHOOL
IRELE COMMUNITY, SOUTHWESTERN NIGERIA**

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ABSTRACT

An integrated geophysical of 1D and geotechnical Soil investigation of trial pit was carried out at a proposed building foundation site across the entire community of united grammar school of Irele in Irele community, Ondo South of southwestern Nigeria to investigate the depth to bedrock, possible geologic structures, foundation conditions of the proposed building axis, abutments and choice of best location for construction of dam. The geophysical integration involved the Geoelectric Survey of 1D technique using the Wenner configuration and a geotechnical investigation. A total of five (5) stations were occupied within the study site. Evaluation of the engineering properties of the soil was carried out for some samples collected across the site location using atterberg limit, grain size analysis, and compaction characteristics of the soils. The geophysical result showed five geo-electric layers; topsoil, sandy layer, sandy/sandyclay layer sandy/sandyclay layer and sand basement layer. Analysis of the atterberg limit shows a dominance of inorganic clay size particles with high plasticity and moisture content while the grain sizes analysis reveals well gravelly clayey silty sand. The soil type classification, and compaction values obtained showed some significant agreement. This was done to provide controls on the geophysical of 2D interpretation. Four subsurface layers were delineated within the study area which include: the topsoil (mixture of sand, silt and clay), coarse sand, clayey sand and sand. This correlated with the sub-soil investigation. The study area is underlain by a stratum of medium stiff to stiff lateritic clayey/silty sand. The values of Geophysical 2D and Geotechnical Trial pit were computed and this showed that the sand/sandy magnitude of the site and other classification of soil in the unitrd grammar school as a community needs deep foundation for any structural building in the community, The integration of these methods helped in the choice of best foundation types for the building foundation axis. The aim of the study is to evaluate the sub-soil conditions, and electrical properties of the soil which may have effect on the proposed structural building foundation and components of the building system.

Keywords: Vertical Electrical Soundings (VES), foundation Axis, geotechnical investigation, Soil investigation and grain size analysis.



TÜRKİYE İLE İSPANYA VE İTALYA ZEYTİNCİLİĞİNİN VE ZEYTİN SANAYİSİNİN KARŞILAŞTIRMALI ANALİZİ

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ÖZET

Zeytin bitkisi (*Olea europaea* L.), Oleaceae botanik familyasından olup, dünyanın tropik ve ılık bölgelerinde yetişen bir bitki türüdür. Zeytin yetiştiriciliğinin ilk insanlarla birlikte başladığı kabul edilmekte ve “Zeytin bütün ağaçların ilkidir” denilmektedir. Zeytinin insanlık tarihindeki önemine kutsal kitaplar, yaratılış ve kuruluş efsanelerinde yer verilmekte, arkeolojik ve jeolojik bulgular zeytinin M.Ö. 4000 yılından beri kullanıldığını göstermektedir. Dünya zeytin alanları ve üretimi yıllara göre artış eğilimindedir. Zeytin üretimi; zeytin ağacının ekolojik isteklerinden dolayı başta Akdeniz olmak üzere belirli bölgelerle sınırlı durumdadır. Dünyada zeytinyağı tüketimi ise hızlı bir şekilde artmaktadır. Türkiye’de zeytinyağı sektöründe özellikle son on yılda olumlu gelişmelerin yaşandığı, fakat bu haliyle bile üretimde öncü (İspanya, İtalya) ülkelerle aynı düzeye gelinemediği, sonuçta bu durumun zeytin ve zeytinyağı kalitesini ve ihracatını olumsuz etkilediği anlaşılmaktadır. Türkiye’nin zeytinyağı sektörüyle ilgili yaşamakta olduğu sorunlardan biri, periyodisite nedeniyle zeytinyağı fabrikalarındaki kapasite kullanım oranındaki düşüklüktür ve bu sorun Türkiye’de söz konusu ülkelerden daha büyük boyutta yaşanmaktadır. Zeytin yetiştiren ve zeytinyağı işleyen işletmelerin yapısal sorunlarının çözülmesi gerekmektedir. Üretimi, kaliteyi ve verimi arttırmaya teşvik edecek teknik uygulama ve teknolojilerin desteklenmesi önemlidir. Türkiye zeytinyağı ihracatında ilk dört ülke arasında olmasına rağmen, ihracat değeri öncü ülke olan İspanya’nın yaklaşık beşte biri kadar ihracat gerçekleştirmektedir. Türkiye’de zeytinyağı üretiminin önemli bir kısmı uluslararası ticarete konu olmakta ancak Türkiye’de zeytinyağı ihracatı daha çok katma değeri düşük nitelikteki ham yağ şeklinde yapılmaktadır. İhraç edilen yağın küçük bir oranı dış piyasada ambalajlı olarak satılmaktadır. İhracatı ambalajlı ve Türk zeytinyağı olarak tanıtılabilmek ve daha çok bu şekilde ihraç edebilmek hedeflenmelidir.

Bu çalışmada Ülkemiz ile önemli zeytin üreticisi ülkeler arasında karşılaştırma yapılmıştır.

Anahtar Kelimeler: Zeytin, Zeytinyağı, Türkiye, Avrupa Zeytinciliği



A COMPARATIVE ANALYSIS OF TURKEY AND SPAIN AND ITALY OLIVE MANUFACTURING AND THE OLIVE INDUSTRY

ABSTRACT

The olive plant (*Olea europaea* L.) is from the Oleaceae botanical family. Olive is a type of plant that grows in tropical and warm regions of the world. It is accepted that olive cultivation started with the first humans. The importance of the olive in the history of humanity is given place in the sacred books, creation and foundation myths, and archaeological and geological findings indicate that olives date back to BC. It shows that it has been used since 4000 years. World olive areas and production tend to increase over the years. Olive production; Due to the ecological demands of the olive tree, it is limited to certain regions, especially the Mediterranean. The consumption of olive oil in the world is increasing rapidly. There have been positive developments in the olive oil sector in Turkey, especially in the last ten years. However, it is understood that even in this state, it cannot reach the same level with the leading countries (Spain, Italy) in production, and as a result, this situation negatively affects the quality and exports of olive and olive oil. One of the problems Turkey is experiencing regarding the olive oil sector is the low capacity utilization rate in olive oil factories due to periodicity, and this problem is experienced in Turkey on a larger scale than the countries in question. Structural problems of enterprises that grow olives and process olive oil need to be solved. It is important to support technical applications and technologies that will encourage production, quality and efficiency. Although Turkey is among the top four countries in olive oil exports, it exports about one-fifth of Spain, which is the leading country in export value. A significant part of olive oil production in Turkey is subject to international trade, but olive oil exports in Turkey are mostly made in the form of crude oil with low added value. Olive oil exports in Turkey are mostly made in the form of crude oil with low added value. A small proportion of the exported oil is sold in packaged form in the foreign market. It should be aimed to introduce the export as packaged and Turkish olive oil and to export more in this way. In this study, a comparison was made between our country and important olive producing countries.

Keywords: Olive, Olive Oil, Turkey, European Olive Farming



HOSTS OF BOUFAROUA *OLIGONYCHUS AFRASIATICUS* (McGregor) FROM WEEDS PLANTS IN THE BISKRA OASIS-ALGERIA

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Abstract

The yellow date palm mite, *Oligonychus afrasiaticus* (McGregor), commonly known as Boufaroua, it is one of the main date palm pests that can cause considerable damage. In order to bring out its outbreak as well as its secondary host plants, an inventory was carried out at 7 palm groves chosen in the Ziban oasis. During the monitoring period from February to July 2021, this mite affected almost the entire Ziban date basin; however, the infestation and the damage caused differ from region to another and from a farmer to another. Generally, the losses vary from 1 to 3%, although the Boufaroua can in some times affect all the palm trees of any palm grove. The Observations show that the infestation of dates by Boufaroua began on June 13, 2021 where the temperatures exceed 30 ° C and the humidity below 40%. The most attacked cultivars were from Deglet Nour in 1st order than Mech Degla and other infrequent cultivars including Tantboucht and Itima,....The results of the inventory of weed plants that grow under palm trees indicate a richness of 61 species belonging to 24 botanical families or 5 species that can be considered as host plants of Boufaroua in our oases; *Cynodon dactylon* (Poaceae), *Daucus carota* (Apiaceae), *Aster squamatus*, *Kochia scoparia* (Asteraceae) and *Salsola tetragnona* (Amaranthaceae). The Observations on field show that the first appearance of Boufaroua attacks were recorded in the palm groves of El Hadjeb, Sidi Okba and in El Outaya on 5 main host plants; *Cynodon dactylon*, *Daucus carota*, *Aster squamatus*, *Kochia scoparia* and *Salsola tetragnona*.

Keywords: date palm, Boufaroua, host plants, Biskra, attacks.



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FULL TEXTS



INVESTIGATION OF FIBER QUALITY TRAITS IN ADVANCED GENERATION OF SOME COTTON LINES (*Gossypium hirsutum* L.)

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ABSTRACT

This study was carried out to evaluate the fiber quality characteristics of 36 advanced generation (F_6) lines developed as a result of crossbreeding studies. The study was carried out in the experimental area of the GAP International Agricultural Research and Training Center Directorate in 2016 according to the 4 block Augmented trial design. In our study, Stonville-468, GW-Teks, BA-119, Gloria and Carmen cultivars with high adaptability in the region and wide cultivation areas in the Southeastern Anatolia Region were used as standard cultivars in the experiment. In the study, fiber fineness (mic), fiber strength (g/tex), fiber length (mm), short fiber ratio (%), fiber elongation (%), spinning consistency index (SCI) and fiber uniformity (%) were examined. The fiber technological traits in the study, fiber length, fiber fineness, fiber strength, spinning consistency index, short fiber index, fiber uniformity and fiber elongation values varied between, respectively, 26.79-31.54 mm, 3.80-5.64 mic., 26.81-36 g/tex, 107.33-166.99, %5.32-10.01, %80.87-87.42, %5.62-8.43 were determined. In terms of fiber length, which is one of the most important features in terms of fiber quality parameters, lines 44A, 31A and 22E were found to have longer fibers than the best standard genotype (Carmen 31.09 mm). Line 22E is also better than the standard genotype in terms of spinning consistency index, fiber strength, short fiber index, fiber uniformity and fiber elongation, and line 31A in terms of fiber strength, spinning consistency index, short fiber index and fiber uniformity found to perform well. In addition to these, it was determined that the lines 22 and 9 in terms of fiber fineness and the lines 31A, 12, 9, 3B, 22E and 27 in terms of short fiber index were lower than the smallest standard genotype. According to the results of the research, the lines that were seen as promising in terms of the parameters examined were transferred to an F_7 generation to establish preliminary yield trials.

Keywords: Cotton, fiber quality, genotype breeding



1. Introduction

Cotton, which includes fiber and oil plants among industrial plants, is the raw material of the gin industry in terms of processing, the textile industry with its fiber, the oil and feed industry with its core, and the paper industry with its linter. Cotton, as a natural fiber plant, is very important for the textile industry and is the backbone of some developing country economies (Shaban et al., 2018; Yaşar, 2022). As the population growth accelerated around the world, it has deeply affected many sectors, especially the food sector. In addition, the change in living standards has also led to an increase in the demand for the textile sector (Yaşar and Yalınkılıç, 2021). Cotton (*Gossypium hirsutum* L.) is an important worldwide source of fiber, oil, feed and biofuel products (Gao et al., 2011; Yaşar, 2022). Today, cotton, which is cultivated in more than 80 countries, is a plant with a very high economic value with its fiber, oil obtained from its seed and other by-products. It is preferred more than other vegetable and synthetic fibers due to its advantages such as being natural, absorbing sweat, staying strong compared to other fibers when heated and boiling, transmitting static electricity less, air permeability and being hygienic. In addition, in recent years, oil obtained from the kernel has been used as a raw material in the production of biodiesel in increasing amounts in order to reduce the dependence on foreign oil and environmental concerns caused by petroleum-derived fuels. In line with all these, cotton is an important and strategic product due to the employment it provides to the country's economy and the added value it creates.

According to world cotton consumption data, our country ranks 4th after China, India and Pakistan. Although our country is among the top 10 producer countries, it ranks 4th after China, Vietnam and Bangladesh in world cotton imports. According to the 2022 average data of Turkey, the cotton cultivation area was 573 thousand hectares, a total of 2.7 million tons of unseed cotton (Anonymous, 2022). Cotton is produced in three main regions in Turkey, namely Aegean (22%), Mediterranean (19%) and Southeastern Anatolia (58%) (Anonymous, 2015). In addition to the fact that cotton is an important fiber plant, the pulp remaining after the oil is removed by the extraction method of its seeds; It contains 41% crude protein, 1.5-3.9% crude oil, 11.3%-12.7% crude cellulose, 0.16% calcium, 0.32% usable phosphorus, and is rich in amino acids and is used in animal feeds (Demiray et al., 2019a). The vegetation of cotton takes a long time, and in conditions where the temperature does not fall below 15°C, leaf, comb, flower and boll development takes place and continuous growth is observed (Yaşar et al., 2019). Depending on the increasing world population, the raw material needs of the textile industry and the demands on fiber quality characteristics and the high yield demands of the producer



make it necessary to improve the existing cotton varieties and the development of new cotton varieties. Increasing the amount of product obtained from the unit area and increasing the fiber technological properties are the primary objectives of cotton breeding programs. In cotton breeding studies, it is possible to determine the parents with the characteristics suitable for the purpose and include them in the breeding program and to investigate the gene effects (additive, dominant and epistatic) of the desired characteristics in the population to be obtained after breeding is only possible with the correct determination of the selection methods, and it is important for the success of the cotton breeding study. (Demiray et al., 2019b). One of the breeding methods used in the development of new cotton varieties is hybridization (combination) breeding. This method is widely applied in cotton plant breeding in the form of single hybrid, triple hybrid, double hybrid, multiple hybrid and back hybrid, within or between species (Ekinci and Gençer, 2015). Since the double cross method creates a larger genetic pool than other crossbreeding methods, it can increase the success rate in the selection to be made in combination breeding (Ekinci and Gençer, 2014).

This study was carried out to evaluate and characterize the fiber technological properties of the populations in the advanced generations created by the double-cross method and to shed light on future breeding studies.

2. Material and Method

The study was carried out in the experimental area of the GAP International Agricultural Research and Training Center Directorate. Using Paum-15, STV-468, Nazilli-84S, Fantom, Delcero and Giza-75 genotypes, 36 advanced generation (F6) lines and 5 control cotton varieties (ST-468, BA-119, GW- Teks, Carmen, and Gloria) were used as material in the study. The trial was established on April 18, 2016 with 4 blocks according to the Augmented trial design. In the experiment, 8 kg da⁻¹ pure N and 8 kg da⁻¹ pure P₂O₅ were given before sowing. During the throat filling period, 6 kg da⁻¹ was given with a pure N hoe machine and the first irrigation was done on 15 June 2016. Irrigation was done 6 times in total. All of the harvest was done by hand. The first-hand harvest was done on September 23, 2016 and the second-hand harvest on October 14, 2016.

2.1. Climate feature of the research area

The experiment was carried out in Diyarbakır ecological conditions with suitable climatic conditions for cotton cultivation. Climate data of 2016, when the experiment was conducted, is given in Figure 1. The average annual precipitation is 491 mm, of which the majority usually falls in winter and early spring. The minimum, maximum and average



temperatures were 8.8, 22.5 and 15.8 °C, respectively, and the average relative humidity was 54%.

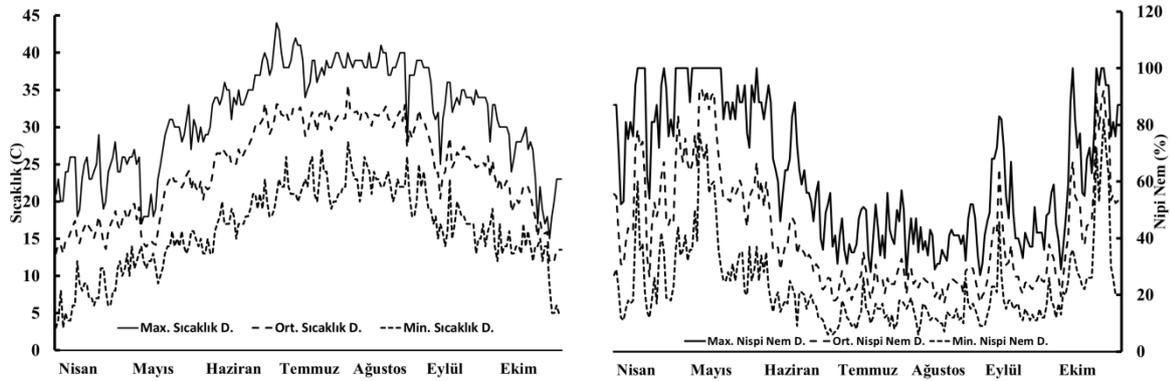


Figure 1. April–October of 2016 Min., Avg., Max. Temperature (°C) and Relative Humidity values (%)

The cotton plant can grow in a hot climate under irrigated farming conditions, but the extreme heat in the summer and the continuation of this temperature throughout the night greatly affect the plant development, accordingly the yield and fiber technological properties. As seen in the graph created in line with the data obtained from the General Directorate of Meteorology in 2016, it is observed that the average maximum temperatures in July and August exceed 40 °C. It is thought that the extreme temperatures in July-August, which is the critical period when flowering continues, affect the quality of the fibers that will occur in the first cocoon formation.

2.2. Soil features of the experimental area

In the laboratory analysis of the soil taken from a depth of 0-20 cm before planting in 2016 in the institution land where the study was carried out, the soil samples were clayey-loamy in texture, the total salt concentration was 0.144%, the soil pH was 7.65, the lime ratio was 11.72, the ratio of phosphorus, one of the nutrients useful to plants, was 3.29. In 2018, the soil samples were found to have a clayey texture, the total salt concentration was 0.002%, the soil pH was 8.12, the lime rate was 9.59%, the phosphorus available to plants was 2.46, and the organic matter amount was 1.15%.

In the study, all fiber quality characteristics of 36 genotypes were examined, including fiber length (mm), fiber fineness (mic), fiber strength (g/tex), spinning consistency index (SCI), short fiber index (%), fiber uniformity. (%) and fiber elongation (%) properties were examined. The properties examined in the study were analyzed with the help of the statistical package program JMP 5.01 (Copyright © 1989-2002 SAS Institute Inc.).

3. Findings and Discussion

In terms of fiber length, it was determined that the general average of the lines used in the standards and the experiment was 28.99 mm, and the fiber lengths varied between 26.79



mm and 31.54 mm. In the study, it was determined that 3 lines (44A (31.54 mm), 31A (31.43 mm) and 22E (31.30 mm) cotton genotypes had longer fibers than the highest standard variety. (Table 1).

The length of the cotton fibers is one of the most important quality characteristics because it affects the durability of the yarn as well as its ability to be spinning consistency index. Fiber length is an inherited trait and varies considerably according to cultivars and species. However, it is also affected by cultural processes and environmental factors applied during the cultivation of cotton (Van der Sluijs et al., 2004).

In terms of fiber fineness (mic), the overall average of the experiment is 4.62 microners. Fiber fineness 3.80-5.64 mic. and our 2 lines numbered 22 (3.80 mic.) and 9 (4.33 mic.) were determined as the thinnest fiber in terms of fiber fineness. Among the standard varieties, Gloria was determined as the thinnest fiber variety (Table 1). Another most sought-after feature in cotton fiber quality properties is the fineness of the fiber. In general, long-fiber cottons are finer than short-fiber cottons. Very coarse fibers are a problem in the spinning process, and very fine fibers in the dyeing process. Fiber fineness is highly affected by ecological conditions (plant nutrients in the soil, temperature, etc.) and cultural practices (irrigation, fertilization, disease and pest control, etc.).

In terms of fiber strength (g/tex), 3 genotypes 22E (36.00 g/tex), 9 (35.16 g/tex) and 31A (34.87 g/tex) have the highest fiber strength (34.39 g/tex), respectively. tex) was found to be higher than the standard variety. In addition, the fiber strength varied between 26.81-36.00 g/tex, and the general average of the experiment was determined as 30.83 g/tex (Table 1). Fiber strength is a very important feature that shows the strength of the fiber and is highly affected by environmental conditions.

Spinning consistency index has been developed by means of some regression equations that reflect the value of some cotton fiber quality characteristics and spinning consistency quality. The higher this value, the higher quality spinning consistency will be produced. In terms of spinning consistency index (SCI), it was determined that the indices of the genotypes in the experiment varied between 107.33-166.99, and the overall mean of the trial had an index of 133.34. Among the lines, the spinning consistency index (SCI) of lines 9 (166.99), 22E (160.53) and 31A (157.30) were found to be higher than the GW-Teks (153.42) standard variety, which had the highest spinning consistency index among the control varieties (Table 1).



The short fiber index causes frequent breakage of the yarn during the yarn making process and a decrease in spinning consistency quality. In terms of short fiber index (%), the general average of the experiment was determined as 7.59% and the short fiber index of the experiment varied between 5.32-10.01%. Among the standard varieties, the variety with the lowest short fiber index was Carmen, but in our experiment, 31A (5.32%), 12 (5.50%), 9 (5.81%), 3B (5.93%), 22E (6.04%) and 27 (6.26%) It was determined that 6 genotypes numbered) contained less short fiber index than the Carmen variety (Table 1).

Fiber uniformity (%) indicates the homogeneity or uniformity of the obtained fibers. In this context, it was determined that the general average of our experiment in terms of fiber uniformity (%) was 84.17%, and the fiber uniformity of the trial varied between 80.87%-87.42%. GW-Teks variety ranks first among standard cotton varieties with 85.60%, 9 (87.42%), 31A (86.93%), 18B (86.25%), 3B (86.09%), 27 (86.0%), 22E (85.91%).), 15 (85.81%) and 44A (85.67%) 8 lines passed the GW-Teks variety and it was revealed that they had a more uniform fiber structure compared to the GW-Teks standard variety (Table 1).

Fiber elongation is generally the elongation value of the fiber during tensile strength. This value is required to be 7% and above. This shows excellence in spinning quality and operation of the weaving machine. Considering all the characteristics, it was observed that the overall average of the experiment in terms of fiber elongation was 6.95% and the fiber elongation of all genotypes in the experiment varied between 5.62-8.43%. Among the control varieties, BA-119 (7.67%) reached the highest value in terms of fiber elongation, while among our lines 22E (8.43%), 9 (8.02%), 39C (7.92%), 18F (7.83%) and 51B (7.77%) It has been determined that 5 of our lines numbered 5 have a higher value than the BA-119 standard variety (Table 1).



Table 1. Data on the examined fiber quality characteristics

Genotypes	Fiber length (mm)	Micronaire (mic.)	Fiber strength (g/tex)	SCI	Short fiber index (%)	Fiber uniformity (%)	Fiber elongation (%)
BA-119	28.67	4.90	30.26	132.89	7.78	84.74	7.67
Carmen	31.09	4.45	31.52	146.90	6.31	85.23	6.97
STV-468	28.05	4.69	30.19	129.08	8.37	83.68	7.52
Gloria	29.35	4.34	31.26	140.42	8.25	84.35	6.31
GW-Teks	30.43	4.70	34.39	153.42	6.79	85.60	6.68
Average Standards	29.52	4.62	31.53	140.54	7.50	84.72	7.03
Standard deviation	1.25	0.10	1.70	9.95	0.91	0.75	0.57
Line Min.	26.79	3.80	26.81	107.33	5.32	80.87	5.62
Line Max.	31.54	5.64	36.00	166.99	10.01	87.42	8.43
Line avrg.	28.92	4.92	30.74	132.34	7.60	84.09	6.94
overall avrg.	28.99	4.88	30.83	133.34	7.59	84.17	6.95
Line Numbers Equal to Standards, Greater, Less than and Greater than Maximum Control							
Equal	8	5	9	4	11	3	10
Lower	21	4	19	24	10	21	17
Higher	7	27	8	8	15	12	9
higher than standard number of lines	3	2*	3	3	6*	8	5

*En düşük standarttan daha düşük hat sayısı

4. Conclusion

In the population created in the study, it is seen that there is a significant genetic variation in terms of the fiber quality characteristics examined. Cotton lines 44A, 31A and 22E in terms of fiber length; in terms of fiber fineness, cotton lines no. 22 and 9; cotton lines no. 22E, 9 and 31A in terms of fiber strength, cotton lines no. 9, 22E and 31A in terms of spinning consistency index, cotton lines no. 31A, 12, 9, 3B, 22E and 27 in terms of short fiber index, cotton lines no. It has been determined that cotton lines 9, 31A, 18B, 3B, 27, 22E, 15 and 44A are promising in terms of their properties, and cotton lines 22E, 9, 39C, 18F and 51B are promising in terms of fiber elongation. As a result, 9, 22, 25B, 22E, 18B, 21C, 44A and 51B coded cotton lines were selected and transferred to the next F7 generation to set up preliminary yield trials, taking into account the yield parameters, especially the fiber quality characteristics of these cotton lines.



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YEMEKLİK TANE BAKLAGİLLERDE HAPLOİD BİTKİ ÜRETİMİ

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ÖZET

Yemelik tane baklagiller, özellikle gelişmekte olan ülkelerde günlük protein ihtiyacının giderilmesinde ve sürdürülebilir tarım sistemlerinin devamında önemli rol oynamaktadır. FAO'ya göre 2050 yılında dünya nüfusunun 9,7 milyara ulaşacağı tahmin edilmektedir. Tarım alanlarını etkileyen iklim değişiklikleri, küresel ısınma ve ekonomik krizler yeni çeşitlerin geliştirilmesini zorunlu kılmaktadır. Tarımı kısıtlayan biyotik ve abiyotik faktörlere karşı dayanıklı ve yüksek verimli baklagil bitkilerin geliştirilmesi klasik ıslah programlarında uzun zaman almaktadır. Ayrıca istenilen özellik seçiminin başlaması için genotiplerin yüksek homozigot seviyelerine ulaşması gerekmektedir. Bitkilerde kendileme ile istenilen homozigotiye ulaşmak için klasik melezleme çalışmaları yüksek maliyet ve iş gücüne sahiptir. Ayrıca gençlik kısırlığı ve kendileme depresyonu klasik yöntemler ile homozigot bireylere ulaşmayı zorlaştırmaktadır. Özellikle baklagil bitkilerinin çiçek yapısı nedeniyle melezlemeler oldukça zor ve uzun süreli olmaktadır. Günümüzde geliştirilen doku kültürü tekniklerinden yararlanılarak ıslah çalışmaları daha kısa sürede yapılmaktadır. Biyoteknolojik ıslah yöntemlerinden biri olan ve uzun yıllardır aktif olarak kullanılan haploidi tekniğinin temelini, haploid bitkilerin kromozom setlerinin katlanması ve % 100 homozigot safhatların bir nesilde elde edilmesi oluşturmaktadır. Özellikle tek bir nesilde tam homozigotluk elde edilen dihaploidizasyon tekniği, bitkilerin ıslah süresini kısaltmakta ve istenilen özellikte yeni çeşitlerin oluşmasını hızlandırmaktadır. Haploid bitki çalışmaları incelendiğinde genotipin, donör bitkilerin yetiştirilme koşullarının, alınan dokuların gelişim döneminin, uygulanan ön işlemlerin, besin ortamı bileşenlerinin ve kültür ortamları gibi faktörlerin haploid bitki oluşturma başarısını etkilediği bilinmektedir. Bu tekniklerin daha çok belirli bitki türlerinde aktif olarak kullanıldığı, yemelik tane baklagillerde ise haploid bitki geliştirme çalışmalarının yetersiz kaldığı görülmektedir. Bu bildiride yemelik tane baklagil bitkilerinde yapılan haploid bitki geliştirme çalışmaları değerlendirilmiştir.

Anahtar Kelimeler: Yemelik tane baklagiller, haploid bitki, bitki ıslahı, doku kültürü



HAPLOID PLANT PRODUCTION IN EDIBLE GRAIN LEGUMES

ABSTRACT

Edible legumes play an important role in meeting daily protein needs and maintaining sustainable agriculture systems, especially in developing countries. According to FAO, the world population is estimated to reach 9.7 billion by 2050. Climate changes, global warming and economic crises affecting agricultural areas necessitate the development of new varieties. The development of high-yielding leguminous plants that are resistant to biotic and abiotic factors limiting agriculture takes a long time in classical breeding programs. In addition, genotypes must reach high homozygous levels in order to start the desired trait selection. Classical crossbreeding studies have a high cost and labor force to reach the desired homozygosity by inbreeding in plants. In addition, juvenile sterility and inbreeding depression make it difficult to reach homozygous individuals with classical methods. Especially due to the flower structure of legume plants, hybridizations are very difficult and long-term. Improvement studies are carried out in a shorter time by utilizing the tissue culture techniques developed today. The basis of the haploid technique, which is one of the biotechnological breeding methods and has been actively used for many years, is the folding of the chromosome sets of haploid plants and obtaining 100% homozygous stages in one generation. In particular, dihaploidization technique, which achieves full homozygosity in a single generation, shortens the breeding period of plants and accelerates the formation of new varieties with desired characteristics. When haploid plant studies are examined, it is known that factors such as the genotype, the growing conditions of the donor plants, the development period of the tissues taken, the pre-treatments applied, the components of the nutrient medium and the culture medium affect the success of forming haploid plants. It is seen that these techniques are mostly used actively in certain plant species, and haploid plant development studies are insufficient in edible grain legumes. In this paper, haploid plant development studies on legume crops were evaluated.

Keywords: Edible grain legumes, haploid plant, plant breeding, tissue culture



1. Giriş

1960'lı yıllarda ortaya çıkan yeşil devrimin gerçekleşmesiyle tarımda yüksek verimli çeşitlerin kullanılması, dünyada monokültür yetiştiriciliğine geçişi hızlandırmıştır (Çakmak ve ark., 2010). Mucize tohum olarak adlandırılan buğday ve pirinç çeşitlerinin yaygınlaşması besin kalitesi yüksek ve protein bakımından zengin olan yemeklik tane baklagil bitkilerinin üretim hızını azaltmıştır. Birleşmiş Milletler Gıda ve Tarım Örgütüne göre 2021 yılında Dünya'da 220,7 milyon ha alanda buğday yetiştiriciliği yapılırken, sadece 81,2 milyon ha alanda yemeklik tane baklagillerin tarımı yapılmıştır (FAO,2023). İnsanların sağlık problemlerini en aza indirmeleri için, dengeli ve sağlıklı beslenmesi gerekmektedir (Belluco ve ark.,2013). 2050 yılına kadar Dünya nüfusunun 9,7 milyar olacağı tahmin edilmekte ve pek çok ülkede yetersiz ve sağlıksız beslenen kişi sayısının artmasına neden olacağı öngörülmektedir (Kush ve ark., 2012). Yemeklik tane baklagiller insan beslenmesinde protein ihtiyacının %22'sini karşılamakta olup beslenmede hayati önem taşımaktadır (Gülümser, 2016). Protein ve mineral element (Fe ve Zn) kaynağı olarak önemli olan baklagil bitkileri ayrıca atmosferik nitrojeni sabitleyerek toprak verimliliğini iyileştirmedeki rolleri nedeniyle sürdürülebilir tarımsal araştırmaların ayrılmaz bir parçasını oluşturmaktadır (Ali and Kumar 2009; Pratap ve ark., 2010). Bu durum yemeklik tane baklagillerin stratejik önemini arttırmaktadır. Geleneksel ıslah yöntemleri, başlangıçta yemeklik tane baklagil bitki türlerinin geliştirilmesinde, verim özelliklerinin iyileştirilmesi ve hasat süresinin kısaltılmasına olumlu etki yapmıştır. Ancak çevresel faktörlerin yüksek etkisi ve genotip ile olan etkileşimleri (G×Ç etkileşimi) verimliliği sınırlandırmıştır (Pratap ve ark., 2010). Ayrıca geleneksel ıslah çalışmalarında bugüne kadar verim artışı üzerine yoğunlaşmış, besin değeri, aroma ve tat gibi kalite kriterleri göz ardı edilmiştir (Morris ve Sands, 2006). Günümüzde ıslah çalışmaları ile artık besin içeriği zenginleştirilmiş, verim ve kalitesi yüksek, hatta anti-besinsel maddelerin (fitik asit gibi) giderildiği yeni çeşitlerin geliştirilmesi oldukça önem taşımaktadır. Klasik ıslah programlarında istenilen özelliğe sahip yeni çeşitlerin geliştirilmesi uzun zaman almakta ve ıslah başlangıcında genotiplerin yüksek homozigot seviyelerine ulaşması gerekmektedir. Biyoteknolojik ıslah yöntemlerinden biri olan ve uzun yıllardır aktif olarak kullanılan haploidi tekniği ıslah süresinin kısaltılmasında umut vadedicidir (Tuncer ve Yanmaz, 2007).

2. Haploid bitki

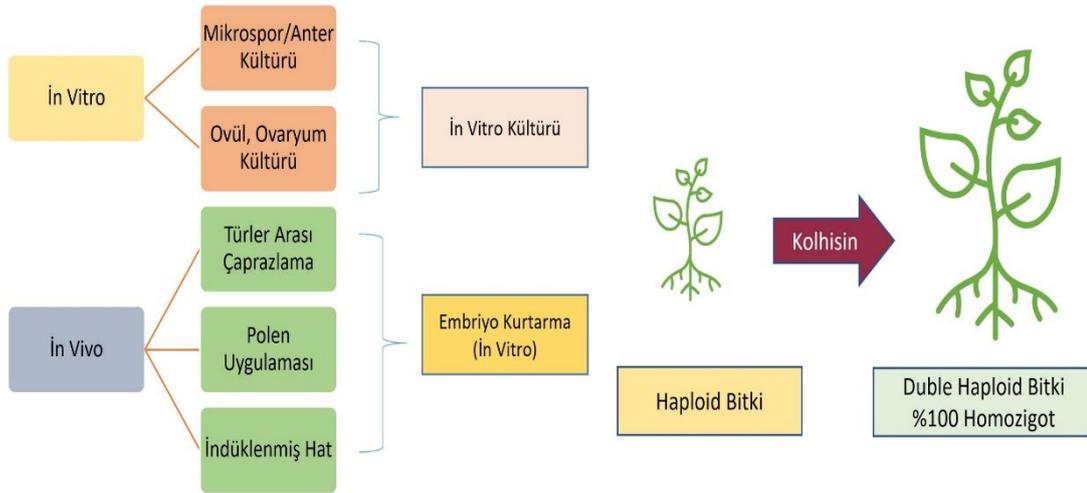
Haploid bitkilerin (n) somatik hücrelerindeki kromozom sayısı, ait oldukları türün gamet hücrelerinde bulunan kromozom sayısına eşittir (Lulsdorf ve ark., 2011). Diploid (2n) bitkilere kıyasla haploid bitkilerin boyları kısa, çiçekleri küçük, yaprakları dar, tohumları kısır



ve verimleri düşüktür (Yaralı ve Yanmaz, 2013). İlk olarak Datura bitkisinden 1964 yılında in vitro anter kültürü ile elde edilen haploidler, hızlı bir şekilde homozigot bireylere ulaşılabilmenin başlangıcı olmuştur (Palmer ve Keller, 2005). Daha sonra tütün, buğday gibi bitkilerde yapılan benzer çalışmalarda hızla artmıştır (Foster ve ark., 2007). Haploid teknikleri kullanılarak yeni çeşitlerin geliştirilmesi dihaploidizasyon uygulamalarının gelişmesiyle ortaya çıkmıştır (Jensen, 1974). Haploid bitkilerin, çeşit geliştirme çalışmalarında etkin bir şekilde kullanılmaları için mutlaka Kolhisin gibi kromozomları katlayan kimyasal maddeler ile muamele edilmesi ve kısırılığının ortadan kaldırılması gerekmektedir (Hansen ve Andersen, 1998). Haploid bitkinin kromozomlarını katlama yöntemine dihaploidizasyon yöntemi, elde edilen bitkilere de katlanmış haploid adı verilmektedir (Foster ve ark., 2007).

3. Haploid bitki elde etme yöntemleri

Haploid bitkilerin üretilmesi için kullanılan yöntemler in vivo ve in vitro haploid tekniği olmak üzere iki ana grupta değerlendirilmektedir (Şekil, 1).



Şekil 1. Haploid bitki elde etme yöntemleri ve katlanmış haploidlerin oluşumu

İn vitro koşullarda haploid bitkiler erkek veya dişi gametik hücrelerden elde edilebilir (Gilles ve ark., 2017). Bunlar mikrospor/anter kültürü veya ovül/ovaryum kültürü teknikleridir. Anter kültüründe polen çekirdekleri henüz tek çekirdekli dönemdeyken gametofitik gelişme somatik gelişime çevrilmekte ve androgenesis/ mikrospor androgenesis gerçekleşmektedir (Ellialtıoğlu ve ark., 2012). Erkek gametik hücrenin androjenez sporofitik büyümesinde, mikrospor indüklenmektedir. Mikrospor, başlangıçta vejetatif ve generatif iki çekirdek hücreden oluşan polen üretmek üzerine programlanmıştır. Olgunlaşmasını tamamlamamış anterlerden izole edilen mikrosporda sporofitik gelişimin başlatılması, özellikle gametik hücrenin totipotent görüldüğü erken gelişim aşamalarında mümkün olmaktadır (Touraev ve



ark., 2001). Mikrosporlar erkek gametik hücrelerin ilk neslidir ve bir haploid kromozom tamamlayıcısına sahiptir. Ayrıca belirli koşullarda ve birçok türde androjenik indüksiyona uygun olmaktadır. İn vitro koşullarda sıvı besi yerlerinde geliştirilen mikrosporlar, bitki anterlerinde çok sayıda üretilir, bu nedenle bunlara erişmek ve manipüle etmek nispeten kolaydır (Wedzony ve ark., 2009).

Androjenesis'in başarısız olduğu türlerde genellikle alternatif yöntem olarak ginogenesis kullanılmaktadır. Gynogenesis döllenmemiş yumurta hücresinde (dişi gamet) sporofitik gelişim indüklenmesiyle gerçekleşmektedir (Bohanec, 2009). Gynogenesis, bir dereceye kadar, apomiks sırasında doğada bulunan partenogeneze benzemektedir (Wedzony ve ark., 2009). Döllenmemiş yumurtalıkların kültürlenmesi yoluyla gynogenik haploid bitkilerin üretimi ilk olarak arpada bitkisinde uygulanmıştır (San Noeum, 1976). Bitkilerin polen tanelerinden çok daha az yumurta hücresi üretmesi nedeniyle gynogenesis tekniği genellikle çok verimli değildir, ancak androgenesis yönteminin etkili olmadığı türlerde kullanılmaktadır (Bohanec, 2009). Gynogenesis özellikle androjenesisin inatçı olduğu, albino rejener bitki seviyesinin yüksek olduğu (çoğu durumda %100'e ulaşan) ve erkek kısırlığı ya da doğası nedeniyle dioik olan bitki türlerinde yaygın olarak kullanılmaktadır (Thomas ve ark., 2000; Bhat ve Murthy, 2007).

İN vivo koşullarında haploidlerin indüksiyonu, klasik haploidi indükleyicilerin veya CENH3 içinde mutasyonlar taşıyan bitkilerin tipik olarak kullanıldığı aynı türün polenleri ile tozlaşma (intraspesifik hibridizasyon) ile başlatılabilir (Watts ve ark., 2018). Haploid indükleyici hatlar, yalnızca mısır için bitki ıslahında rutin olarak kullanılmaktadır (Rober ve ark., 2005). Yabancı akraba veya akraba olmayan bir türün poleni ile tozlaşma, türler arası veya geniş hibridizasyon olarak adlandırılır. Haploidi, radyasyonla, kimyasallarla veya yüksek sıcaklıkta işlenen (kusurlu) polenle tozlaşmadan sonra da ortaya çıkabilir (Karimi-Ashtiyani, 2021). Endosperm gelişiminin gerçekleşmediği bazı in situ yöntemlerde embriyonun kurtarılması gerekmektedir. Haploid embriyolar veya fideler, spontan genom duplikasyonuna tabi tutulur veya çift haploid bitkilerin oluşumunu indüklemek için kolhisin gibi bir kimyasal ajanlar kullanılmaktadır (Kalinowska ve ark., 2019).

4. Yemelik tane baklagillerde haploid çalışmaları

Yemelik tane baklagillerde haploid bitki üretiminde morfogenez genellikle çok yavaştır, ayrıca sıklıkla albinoların, camsı dokuların gelişimi ve farklılaşmamış kalluslarda yanıtızlık gibi problemler mevcuttur. Bu sorunlara rağmen, özellikle embriyo kurtarma, somatik embriyogenez ve genetik transformasyon protokollerinin geliştirilmesi yemelik tane



baklagillerde in vitro kültür teknolojisinde önemli ilerlemelerin ortaya çıkmasını sağlamıştır (Pratap ve ark., 2010). Baklagillerde doku kültürü teknolojisindeki ilerlemeyi tartışan birçok yayınlanmış makale mevcuttur (Parrot ve ark. 1992; Sagare ve ark. 1995; Laxmanan ve Taji 2000; Grewal ve ark., 2009; Anwar ve ark. 2010.). Ancak bunların çoğu ya belirli bitkide ve özel tekniklerle ilgili bilgi vermekte kapsamlı bilgi sağlamamaktadır. Diğer bitkilere göre doku kültüründe bitki rejenerasyon hızının zayıf kalması, hızlı ve kullanımı kolay protokollerin ortaya çıkmaması ıslahta bu tekniklerin kullanımını sınırlandırmaktadır (Croser ve ark., 2006). Ayrıca yemeklik tane baklagiller, in vitro yaklaşımların çoğuna karşı direnç göstermektedir (Croser ve ark, 2006; Germanà, 2006; Skrzypek ve ark., 2008; Ochatt ve ark., 2009). Bununla birlikte, son 5 yılda bezelye, nohut, ve baklagil yem bitkilerinden *Medicago truncatula* Gaertn. gibi bazı baklagil türlerinde androgenes yoluyla önemli ilerlemeler kaydedilmiştir (Grewal ve ark., 2009; Ochatt ve ark., 2009). Ancak ilerlemeler yeterli düzeyde değildir.

5. Sonuç

Geleneksel ıslah programlarında, ilgilenilen özelliklerin seçiminin başlaması için bireylerin %100'e yakın homozigotluğa ulaşması gerekmektedir. Buna karşılık, haploid katlama teknolojisi, bir nesilde tam homozigotluk üretmektedir. Yemeklik tane baklagillerinde geliştirilen çeşitlerin çoğu, temel olarak sınırlı ön ıslah çabaları ile bir avuç genetik kaynağın hibridizasyon programlarında tekrar tekrar kullanılması nedeniyle dar bir genetik temele sahiptir. Doku kültürü tabanlı yapılacak çalışmalar varyasyon oluşturarak genetik temeli genişletmeyi sağlayabilmektedir. Yemeklik tane baklagil ıslahında haploid tekniklerin kullanımında, genotipik bağımlılık, inatçılık, doku kültürü teknolojilerinin yavaş gelişimi ve altta yatan süreçler hakkında bilgi eksikliği yöntemlerin diğer türlere kıyasla etkin kullanılmasını engellemektedir. Yemeklik tane baklagil bitkilerine özel etkili doku kültürü protokollerinin geliştirilmesi, embriyogenezi kontrol eden genlerin tanımlanması yapılacak haploid çalışmaları için çok önemlidir. Şu ana kadar baklagil bitkilerinde haploid üretimi için yayınlanmış tek bir protokol yoktur ve bu konuda yalnızca sınırlı sayıda yayınlanmış bilgi mevcuttur.



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ÖZET

Klasik ıslah yöntemleri ile yeni çeşitlerin geliştirilmesi uzun yıllar gerektirmekte ve çok fazla zamana ve iş gücüne ihtiyaç duyulmaktadır. Günümüzde bu süreyi kısaltmak ve daha kalıcı sonuçlar elde etmek için doku kültürü tekniklerinden faydalanılmaktadır. Haploid bitki eldesi bitki ıslahının en önemli uygulama alanlarından biridir. Haploid bitkiler özellikle mutasyon çalışmaları ve %100 homozigot bitkilerin elde edilmesinde büyük önem taşımaktadır. Haploid bitkiler, moleküler biyoloji, genetik ve fizyoloji gibi temel bilimler için uygun bir araştırma materyalidir. Haploid bitki eldesinde kullanılan en önemli teknik *in vitro* teknik olan anter kültürüdür. Tekniğin başlıca hedefi homozigot hatların kısa sürede elde edilmesidir. F₁ hibrit üretimi yapılacak homozigot hatlar vejetatif olarak uniform şekilde çoğaltılarak hibrit tohum eldesi için avantaj sağlamaktadır. Yeterli haploid bitki üretimi sağlayacak olan anter kültürü ile istenilen mutant çeşitlerin seçimi ve yeni çeşitlerin geliştirilmesi mümkündür. Bu yöntem, polen oluşumu sırasında anterlerin çiçek tomurcuklarından çıkarılıp *in vitro* koşullarda besin ortamına alınmasıyla başlar. Anterler bu kültür ortamında mitoz bölünme geçirir ve gelişimlerini tamamladıkları zaman haploid bitkicikler elde edilmektedir. Özellikle dayanıklılık ıslahı çalışmalarında kısa sürede dayanıklılığı aktarma imkânı ve saf hat elde etme avantajı sağlamaktadır. Anter kültürü ile elde edilen haploid bitkilerin kök uçlarından hazırlanan preparatlar ile kromozom sayıları kesin olarak belirlenebilmektedir. Anter kültüründe, başarımın türlere bağlı olması ve yalnızca kültüre cevap verebilecek gen kaynaklarının kullanılması tekniğin uygulanabilirliğini sınırlandıran en önemli faktörlerdir. Sonuç olarak, anter kültüründe klasik yöntemlere göre homozigot hatların eldesi için uzun yıllar beklemeden tek generasyonda başarıya ulaşmak mümkündür. Bu bildiride, anter kültürünün tanımı, avantajları ve farklı bitkilerde uygulamaları üzerine yapılan çalışmalar değerlendirilecektir.

Anahtar Kelimeler: Anter kültürü, haploid bitki, bitki ıslahı



ANTHER CULTURE APPLICATIONS IN PLANT BREEDING

ABSTRACT

The development of new varieties with classical breeding methods requires many years and a lot of time and labor is needed. Today, tissue culture techniques are used to shorten this period and obtain more permanent results. Haploid plant production is one of the most important application areas of plant breeding. Haploid plants are especially important in mutation studies and obtaining 100% homozygous plants. Haploid plants are suitable research material for basic sciences such as molecular biology, genetics and physiology. The most important technique used in obtaining haploid plants is anther culture, which is an in vitro technique. The main goal of the technique is to obtain homozygous lines in a short time. Homozygous lines to be produced for F1 hybrid production can be propagated vegetatively in a uniform manner, providing an advantage for hybrid seed production. It is possible to select desired mutant varieties and develop new varieties with anther culture, which will provide sufficient haploid plant production. This method starts with removing the anthers from the flower buds during pollen formation and adding them to the nutrient medium in vitro. Anthers undergo mitosis in this culture medium and when they complete their development, haploid plantlets are obtained. Especially in resistance breeding studies, it provides the advantage of transferring resistance in a short time and obtaining pure lines. Chromosome numbers can be determined precisely with the preparations prepared from the root tips of haploid plants obtained by anther culture. In anther culture, the success depends on the species and the use of gene resources that can only respond to the culture are the most important factors limiting the applicability of the technique. As a result, it is possible to achieve success in a single generation without waiting for many years to obtain homozygous lines according to classical methods in anther culture. In this paper, studies on the definition, advantages and applications of anther culture in different plants will be evaluated.

Keywords: Anther culture, haploid plant, plant breeding



1. Giriş

Haploid bitkiler, gametik kromozom sayısını (n) taşıyan sporofitlerdir. Bir haploidin kendiliğinden veya indüklenmiş kromozom kopyalanması meydana geldiğinde, ortaya çıkan bitkiye double haploid (DH) adı verilir. Haploidler, düşük bir frekansta kendiliğinden meydana gelir veya in vivo olarak değiştirilmiş tozlaşma yöntemleri (geniş hibridizasyon, kromozom eliminasyonu, ışınlanmış polenle tozlaşma, vb.) ve olgunlaşmamış gametofitlerin in vitro kültürü gibi çeşitli yöntemlerle indüklenebilir. Gametik embriyogenez, bitkiler aleminde mevcut olan farklı embriyogenez yollarından biridir ve erkek (mikrospor veya olgunlaşmamış polen tanesi) veya dişi (ginogenesis) gametofitlerin, gametofitik gelişim yollarından sporofitik gelişim yollarına geri dönüşümsüz olarak geçiş yapma kapasitelerinden oluşur.

Mikrospor veya polen embriyogenezi (aynı zamanda androgenesis), hücrel totipotensin en çarpıcı örneklerinden biri olarak kabul edilir (Reynolds 1997), ama aynı zamanda bir atavizm biçimidir. Sadece belirli koşullar altında ve çevresel stresin bir sonucu olarak ifade edilen bitkiler aleminde önemli bir hayatta kalma adaptasyon mekanizmasıdır (Bonet ve ark. 1998).

Geleneksel ıslah yöntemleriyle karşılaştırıldığında, gametik embriyogenez, homozigot soyların üretimini mümkün kılar ve bu tür soyların üretilmesi için gereken süreyi kısaltarak, heterozigot ebeveynlerden tamamen homozigot dizilerin tek adımda geliştirilmesine olanak tanır. DH yöntemleri, bahçe bitkileri ve başlıca tahıllar dahil olmak üzere, ekonomik açıdan önemli olan çok çeşitli bitki türlerinde iyi geliştirilmiştir (Wedzony ve ark., 2009). Gynogenesis, düşük etkinliği nedeniyle şu anda en az tercih edilen tekniktir, ancak daha etkili yöntemlere yanıt vermeyen türlerde kullanılmıştır (Forster ve ark., 2007). Polen üretiminin ve işlevinin kontrol edilmesini ve yeniden programlanmasını içeren haploidleri ve DH'leri elde etme yeteneği, bitki ıslahı ve genetiğinde polen biyoteknolojisinin en önemli uygulamalarından biridir (Testillano ve ark., 2000). Solanaceae, Gramineae ve Cruciferae ailelerinden 200'den fazla türde erkek gametlerden rejenerasyon gözlemlenmiştir (Dunwell, 2009; Hu ve Yang, 1986). Anter kültürü veya izole edilmiş mikrospor kültürü, polen embriyogenezini indüklemenin en yaygın yollarıdır. Bu metodolojinin basitliği nedeniyle, büyük ölçekli anter kültürü oluşturulabilir ve çok çeşitli genotiplere uygulanabilir. Anter kültürü, çoğu mahsulde DH üretimi için sıklıkla tercih edilen yöntemdir.

2. Yapay haploid bitki üretimi

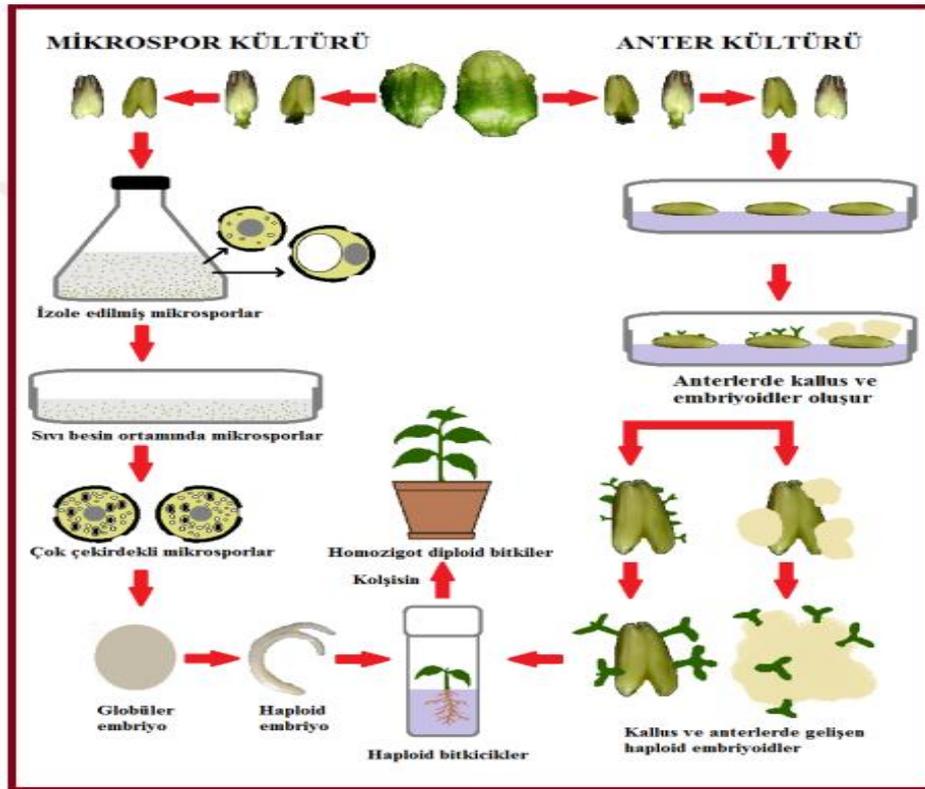
Haploid bitkilerin doğada kendiliğinden ortaya çıkmaları türlere ve tür içerisinde bulunan genotiplerle ilişkili olarak değişmektedir. İstenilen düzeyde olmayan çıkışları



nedeniyle doğal haploid oluşumunun ıslah programlarında kullanımı uygun görülmemektedir. Haploid bitkilerin üretilmesi için önerilen yöntemleri genel olarak *in situ* haploid uyartımı ve *in vitro* dişi veya erkek gamet kültürleri olmak üzere iki ana grupta toplamak mümkündür. Son zamanlarda, haploid bitkilerin üretilmesi için en etkin ve verimli yöntem; erkek veya dişi gametlerin başlangıç materyali olarak kullanıldığı *in vitro* tekniklerdir. Haploidizasyon, diploid kromozom (2n) yapısına sahip bir hücreden, kromozomlarını eksilterek haploid (n) yapıda bir hücre elde etme sürecidir. Anter kültürü ile haploid bitki üretimi günümüzde kullanılan en etkili yöntemdir (Arı,2006).

3. *In Vitro* Anter Kültürü

Anter kültürü ilk olarak bitki ıslahı amacıyla başarılı olan *in vitro* haploid induksiyon yöntemiyle keşfedilmiştir (Reed ve ark., 2005). Doğru gelişim aşamasında, diğer kültürlerde haploid bitkilerin uyarılması için açılmamış çiçek tomurcuklarından alınan anterler kullanılmıştır (Teixeria ve ark., 2015). Olgunlaşmamış anterler çoğunlukla tek çekirdekli mikrospor aşamasında başlangıç malzemesi olarak kullanılmaktadır (Dogru ark., 2016).



Şekil 1. Anter ve mikrospor kültürü basamakları (Erim,2019)

Anter kültürü tomurcukların ön uygulamasına, *in vitro* kültür koşullarına ve kültür bitkisinin genetik yatkınlığına bağlıdır. Haploidizasyon çalışmalarında en etkili ve en çok



kullanılan süreç olarak kabul edilmektedir. Anterler bu süreçte doğrudan kültüre alındığı gibi mikrospor izolasyonu sonrası da kültüre alınır. Bu yöntemin temel yönü, normal şartlarda iki çekirdekli bir yapıya sahip olan polen tanesini çekirdeksiz bir aşamada yakalayarak somatik yönde bu üretimin devam etmesini sağlamak ve haploid bitkiler elde etmektir (Murovec ve Bohanec, 2012). Gelişim evresi ilk polen mitozuna karşılık gelir ve polen tanelerinin asetokarmin ve DAPI gibi çeşitli yöntemlerle mikroskop altında incelenmesi ile boyanma sonrası evre belirlenebilir (Germana, 2011).

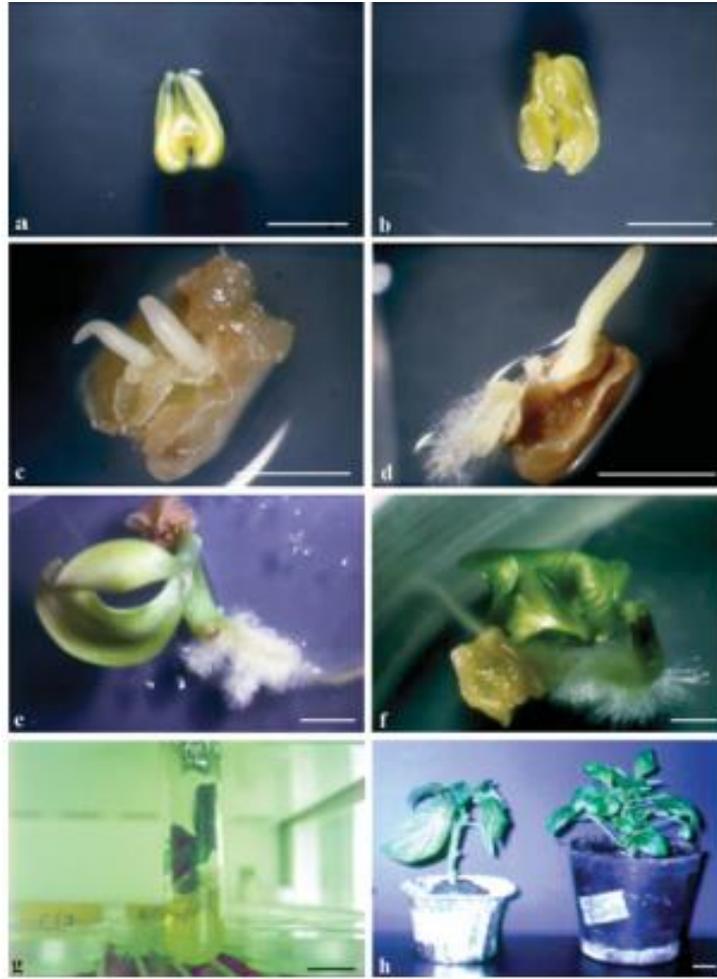
Haploidi indüksiyonunda *in vitro* anter kültürünün tepkisini arttırmak için çiçek tomurcuklarına spesifik fiziksel veya kimyasal ön işlemler uygulanabilmekte ve daha sonra çiçek tomurcuklarından izole edilen anterler farklı *in vitro* kültür ortamlarında aseptik koşullarda inkübe edilmektedir. Süs bitkilerinde mikrospor yetiştiriciliğinin kullanımı tarla bitkileri ve sebzelere göre nispeten düşüktür. Ancak süs bitkilerinde haploid bitki elde etme girişimlerinin arttığı görülmektedir. Farklı bir kültürde anter duvarından rejenerasyon meydana gelebilir. Haploid bitkicikler, yalnızca tek bir mikrospor hücresinin yeniden üretilmesiyle elde edilir. Bu nedenle mikrospor gelişim evresinin belirlenmesi ve anter izolasyonu başarılı mikrospor kültürü için kritik adımlardır (Olsen, 1992; Ferrie ve ark., 2011). Anter kültüründe başarıyı etkileyen faktörlerin başında bitki genotipi gelmektedir. Anter kullanılan verici bitkilerin fizyolojik durumu ve yaşı da kültürün başarısını yakından etkilemektedir. Çiçek gelişim sezonunun başında gen bitkilerden alınan çiçeklerdeki anterlerin, daha geç dönemde alınan çiçek anterlerinden daha iyi gelişim gösterdiği gözlenmiştir. Birçok bitki türünde doğal büyüme sezonunda tarla koşullarında yetiştirilen bitkilerden alınan anterlerden, kontrollü koşullarda (sera, bitki büyütme kabini) yetiştirilen bitkilerden alınan anterlerden daha iyi sonuç elde edilmektedir.

Anter kültürü çalışmalarında sıvı veya katı besi ortamı kullanılabilir. Kültür sıcaklığı bitki türüne bağlı olarak 25-30 °C arasında olmasına rağmen, yüksek sıcaklığın buğday ve kolza gibi bitki polenlerinde kallus oluşumunu hızlandırdığı da gözlenmiştir. İzole edilen anterlerdeki mikrospordan haploid bitki oluşumunu iki farklı yol ile gerçekleştirmektedir: (a) Direkt olarak; polen tanesinden gelişen embriyo çimlenerek haploid bitkiyi oluşturur. (b) İndirekt olarak; polen tanesinden oluşan kaluus, embriyogenez veya organogenez yolu ile haploid bitkiyi oluşturur.

Anter kültüründe, mikrosporların uygun gelişim aşaması benzer şekilde belirlenir ve tek çekirdekli erken çift çekirdekli aşamaya kadar mikrospora sahip anterler için daha ileri adımlar tercih edilir. Mikrosporlar, havan ve tokmak veya blender kullanılarak yüzey steril



anterden mekanik olarak izole edilir veya tomurcuklardan anterler toplanır, sıvı bir ortama yerleştirilir ve mikrosporların çözülmesine izin verilir (Olsen, 1992; Ferrie ve ark., 2011). Daha önce başka bir toplulukta belirtilen spesifik prosedürler, haploid embriyolar elde etmek için, spesifik fiziksel ve kimyasal ön işlemler, aşılardan önce mikrospor kültürünün etkinliğini artırır. Mikrospor kültürünün diğer kültürlerle göre çeşitli faydaları vardır, ancak teknik açıdan uygulanması daha zordur (Obert ve ark., 2009). Ayrıca anter kültürü, erken resesif gen ekspresyonunu mümkün kıldığından, değişkenlik oluşturmak için önemli bir araç olabilir (Chen ve ark., 2001).



Şekil 2. Anter kültürü ve haploid bitki rejenerasyonu. (a) Kültür başlangıcında anter. (b) Kültürde 6 gün sonra anter. (c, d) Kültürde 30 gün sonra anterlerden çıkan, kökleri ve sürgünleri gösteren embriyolar. (e-g) Büyüme ortamında alt kültürlenmiş kotiledonlu (e) ve yapraklı (f, g) bitkicikler. (h) Anter kültüründen ve aynı yaştaki bir diploid kontrolünden 80 günlük rejener haploid bitki (Barany ve ark. 2005)

Arpa, kolza tohumu, tütün ve buğday gibi model türlerde bir mikrospor embriyogenezi etkili olurken, doku yetiştirme, baklagiller ve odunsu bitkiler gibi daha geniş kültürel veya bilimsel nitelikteki diğer birçok türün anter kültürüne daha az yanıt verdiği belirlenmiştir.



Tekniğin ıslah programlarında kullanılabilmesi için anter veya mikrospor kültürünün hemen her türden veya genotipten çok sayıda haploid üretebilmesi gerekmektedir (Shahnewaz ve Bari, 2004).

Anter kültürüyle haploid geliştirmenin kendi kendine indüklenen akraba çiftleşme depresyonunu önlemesi ve tozlayıcı genomunun kontaminasyonunu gerektirmemesi gibi birkaç avantajı vardır. Haploid bitkiler üretmek için anter kültür protokolünün maksimize edilmesinde çeşitli faktörler rol oynar. Bu nedenle anter ön işlemi, genotip, polen büyüme aşaması, kültür ve embriyo indüksiyon koşulları ve bitki rejenerasyonu dikkate alınmalıdır. Anter veya mikrospor kültürlerinin çok sayıda haploid bitki üretmek için en etkili yöntemler olduğu kanıtlanmıştır (De Buyser ve Henry, 1980).

Mikrospor kültürünün anter kültürüne göre daha karmaşık bir teknik olmasına rağmen birçok türde daha başarılı sonuçlar elde edildiği gözlemlenmiştir. Bu yöntemde bitkiler doğrudan mikrospordan (olgunlaşmamış polen taneleri) üretilir. Anter veya mikrospor kültürü yoluyla, melez ebeveynlerin katkıda bulunduğu genetik materyalin rekombinasyonunu temsil eden benzersiz ve nadir gen kombinasyonlarına anında erişim sağlanır. Anter kültürü ve ardından kromozom ikiye katlama yoluyla, bu tür gen kombinasyonları, tek bir adımda kendilenmiş olarak homozigot durumlarında sabitlenebilir. Son yirmi yılda, anter kültürü, çeşitlendirmede bir araç olarak geniş çapta kabul görmüştür. Bu teknik, mantar hastalıklarını yönetmek, yeni direnç genleri kombinasyonlarına sahip bitkiler üretmek için özellikle yararlı olabilir.

4. Sonuç

İslahta haploidi, double haploidi ve gametik embriyogenez kullanmanın büyük potansiyeli açıkça ortadadır. Haploidler, genellikle zaman alıcı, zahmetli ve bazen oldukça verimsiz geleneksel yetiştirme yöntemlerinin etkinliğini ve hızını artırabilir. Polen embriyogenezinin uygulanması yaygın olmasına ve birçok türün anter kültürüne çok iyi yanıt vermesine rağmen, mikrospordan polen embriyotlerine dönüşümü için hücresel, biyokimyasal ve moleküler temeller hala tam olarak anlaşılabilir. Bu nedenlerden dolayı, mevcut protokollerin incelenmesi ve iyileştirilmesi yoluyla ve anter kültür sürecinin, özellikle iki ana gelişimsel anahtarın daha derin bir şekilde anlaşılmasını ve kontrolünü elde ederek genotipten bağımsız yeni yöntemler geliştirmek gerekmektedir.



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EVALUATION OF BIOETHANOL PRODUCTION FROM CORN COBS

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ABSTRACT

Converting organic matter from biomass into biofuels such as bioethanol will be more advantageous than the processing of fossil fuels. At the same time, it is also important that it is compatible with nature and sustainable. Corn cobs can be utilized in many areas as an agricultural product, but it is also possible to offer alternative opportunities. When bioethanol yield values are analyzed, it is a very valuable biomass. Ethanol production from biomass is one of the main strategies to develop alternative fuels and reduce oil dependency. In this context, among plant materials, corn cob can be considered as an important material for biofuel production due to its high cellulose content and seed percentage, low hemicellulose and lignin content, good availability, and low cost. The higher the proportion of fermentable sugars there is in plants, the higher the amount of bioethanol can be seen. Each plant completes ethanol production by being subjected to different processes due to the raw materials it contains (starch, sugar, cellulose, etc.). Corn cobs have been identified as a potential source of cellulose for bioethanol production due to their high dry matter content. Clean ethanol yields from corn cobs alone have been shown to be significantly lower than those from a blend of corn kernels and cobs. Therefore, in line with advancing technology, it is necessary to optimize conditions for both fermentations and extractions to determine its full potential. This study is aimed to evaluate bioethanol production from corn cobs.

Keywords: Bioethanol, corn, corncob, renewable energy resources



Introduction

It shows that global policies are gradually evolving into sustainable resources due to the rapidly increasing human population in the world. In addition, changing environmental conditions due to the damage caused by fossil fuels to the universe has become one of the only issues that need to be emphasized in the social sense. Declining fossil fuels, rising oil import prices and changing global policies are forcing nations to seek sustainable alternative measures. Since 2005, many countries have legalized certain standards for incorporating biofuels into automobile use. Approximately 98% of the fuel needs in the road transport sector are currently met by fossil fuels and the remaining 2% by biofuels (Kojima & Johnson, 2005).

Biomass is considered a renewable energy source due to its short life cycle, and biofuels derived from biomass have the potential to replace fossil fuels (Chen et al., 2018). Biofuels are safe for the environment. The use of organic materials obtained from plants and animals as biofuels is more advantageous than the formation of fossil fuels over hundreds of years. One of the other reasons for the need to obtain energy from alternative sources is the depletion of fossil fuels. Corn is the second most cultivated grain crop in the world. Additional use of plant residues, such as corn cobs or cobs, could potentially increase ethanol yields per unit area and utilize existing conversion and distribution infrastructure. Corn cobs have been found to give higher glucose concentrations than other corn residues, such as stems or leaves, and are extracted from fields during traditional harvesting (Hoskinson et al., 2007). Based on the information given, in this study, bioethanol production from corn cob and bioethanol yield values and quality characteristics obtained from corn cobs are discussed within the framework of the relevant literature.

Production of Bioethanol From Corn COB

The higher the rate of fermentable sugar in plants, the higher the amount of bioethanol will increase accordingly. Each plant is exposed to different processes due to the raw materials it contains (such as starch, sugar, cellulose). Accordingly, the critical points affecting the bioethanol yield were determined at different stages in each process. Production of bioethanol from corn cob is a process with the potential to address many of the issues facing traditional corn-based ethanol production. Corn cobs are highly abundant, relatively easy to obtain and have little processing cost compared to grinding corn kernels. The yield of clean ethanol from corn cobs alone has been shown to be significantly lower than that obtained from a mixture of corn kernels and cobs; thus, it is necessary to optimize conditions for both the fermentations



and extractions in order to realize the full potential of this new technology (Mohanty & Swain, 2019).

The production of bioethanol is an alternative method to produce clean fuel. Corn cob is a valuable raw material which is used as food additive, instead of disposing it in landfills, this can be used as raw material for ethanol production. It is possible to produce ethanol from corn cob. With the trend of bioethanol production, corn cob can be used as a raw material instead of grains, because it is cheaper and less demanding than grains. The process for obtaining ethanol from corn cob is conducted at room temperature, so the risks are not large (Das et al., 2007).

Bioethanol (C_2H_5OH) is colorless, flammable and oxidized hydrocarbons. It is fermented from sugar, starch and cellulosic biomass and used in many fields today. Ethanol (also called ethyl alcohol, grain alcohol, or drinking alcohols) is a biofuel that can be produced from various types of organic matter, such as corn and sugarcane. Ethanol is used in a variety of applications that include automobile gasoline replacement, agricultural crop production and refinement into biodiesel (Klass, 2004).

Corn cob has been identified as a potential cellulose source for bioethanol production due to its high dry matter content. Also it contains higher amount of lignin than other unprocessed lignocellulosic biomass (Hernández et al., 2019). Corn cobs are a vital part of the corn kernel. The biomass of corn cob is typically used as animal feed and is scarce, so using it as bioenergy source has received much attention. Corn cobs consist of cellulose, hemicellulose, and lignin in various proportions (Santolini et al., 2021).

Today, it is observed that some studies are carried out to obtain energy from agricultural wastes such as corn cob and these are increasing rapidly (Ayeni & Daramola, 2017). Recent developments in bioethanol production in the world are generally on the increasing amount of ethanol in biomass. In addition, the focus is on technical development to minimize ethanol loss. These technical developments; It covers raw material modification with genetic methods, advancement of cellulose enzyme techniques and various studies on a cellular basis. With a more comprehensive and detailed explanation, the following topics are examined in the continuation of this article; Bioethanol production from cereals, factors affecting bioethanol yield and technological developments and finally the study is concluded.

The production of ethanol from biomass represents one of the main strategies for developing alternative fuels and reducing the dependence on oil. Among plant materials, the corn cob is one of the most promising materials for biofuel production because it possesses high



cellulose content and germ percentage, low hemicellulose and lignin contents, good availability and low cost (Ibeto et al., 2011).

Research by the Du vd. (2020) analyzes the potential of corn cob bioethanol production, as well as its cost and production strategies. First, the comparison of corn cob ethanol with other types of bioethanol made. Then there an analysis about the availability and sustainability of corn cobs for fuel production. Studies have shown that thermochemical processes using straws from agricultural crops as well as other biomass materials are efficient methods to produce biofuel from biomass feedstocks. The thermochemical process known as gasification produces syngas that can be used directly in internal combustion engines or converted into bioethanol by fermentation (Du et al., 2020).

Before bioethanol production, microorganisms cannot directly affect starch. Therefore, starch must be pre-treated. In addition to the standard procedures, new studies are still ongoing in this regard. The aim here is to increase the amount of fermentable sugars and to provide high ethanol yield. For this, starch polymers are pretreated with enzymes or acids for hydrolysis.

Bioethanol Yield Values And Quality Characteristics From Corn Cobs

The remaining cob part of the corn plant, which is of great importance in the world, is a nutrient that can be evaluated in any case. Therefore, ethanol production from corncob is both practically possible and offers significant advantages over other biomass sources. Because it is inexpensive and easily available waste material from local sources, the by-products can also be used as roughage in feed to supplement animal protein needs (Van et al., 2016).

The energy value of corn cobs has been found to be very low and is generally considered a waste product. One way to increase their utility is to convert their cellulose-rich material into bioethanol, which can then be used as a renewable transportation fuel or as animal feedstock (Genovese et al., 2015).

Zhang et al. (2021), it was aimed to evaluate the ethanol yield from corncob and quality characteristics such as pure alcohol, reducing sugar and acidity. The data show that the percentage of reducing sugar was 44.54%; there is a negative correlation between reducing sugar and lactic acidity; also found a positive correlation between lactic acidity and purity alcohol (Zhang et al., 2021). This indicates that corncob is a potential source of bioethanol that needs to be developed.

Prepared by the Getachew and Woldesenbet (2016) research was carried out to determine the yield, glucose and fructose contents of various forms of corn cobs and also assigned their quality characteristics. The results showed that corn cob consists of 87-90%



water, 1% ash and 11-13% crude fiber. Crude protein was found to be only 0.12 % which is in agreement with the findings of other workers who reported a value between 0-0.4% (Getachew & Woldeesenbet, 2016). In the study prepared by David vd. (2020) it is observed that the bioethanol yield values and quality characteristics obtained from corn cobs of different sizes have been evaluated. The results obtained in the study determined that the size of the cob is directly related to the yield capacity, which is characterized by maximum ethanol yield (David et al., 2020). In the research prepared by El vd. (2011) to investigate the effect of biomass material (i.e. corn cob) on ethanol production through enzymatic hydrolysis, as well as to optimize parameters such as reaction temperature and duration required for efficient conversion from starch to glucose, the data obtained are used to evaluate the sugar content and enzyme activity of corn cobs that are found to be affected by some factors affecting bioethanol yield and quality characteristics has been expressed (El et al., 2011). In another study, it is observed that it is aimed to evaluate the concept of producing ethanol from a raw material derived from corn cobs as an alternative source for bioethanol. In this context, the results obtained in the research; showed that dry weight yields were 40.4% for starch and 45.4% for cellulose. The research also found that drying did not have a significant effect on ethanol production from corn cobs (Genisheva et al., 2011). In the Luque vd. (2016) study, it is observed that the ethanol yield characteristics and quality of liquid bioethanol obtained from corn cobs (mainly cob silage) were evaluated using a pilot plant. In this context, it was determined that ethanol yield values gradually increased with increases in acetone concentration and water content, but decreased when ethanol concentration was high. In another study, it is observed that the amounts of bioethanol, cellulose and hemicellulose extracted from corn cobs are determined. In this context, it is observed that the bioethanol yield values obtained from corn cobs are approximately 3 times higher than those obtained from sugarcane meal and corn kernels (Luque et al., 2016). Bioethanol is a renewable energy source that can be produced from cellulosic biomass through enzymatic hydrolysis and fermentation; this process is known as saccharification-fermentation. The corncob forms an alternative feed stock to other lignocellulosic materials, but the low yield of ethanol is mostly due to the high water content of the corn cob, which limits the amount of sugar released by enzymatic hydrolysis. To increase bioethanol production from corn cobs, it will be important to optimize consolidation using an appropriate enzyme mixture according to endoglukanase activity and concentration, soluble xylanase activity, and cost-effective dissolution process of hemicellulose molecules such as xyloglukan hydrolase (Vasić et al., 2021).



Conclusions

Today, innovative studies are carried out on the determination of genes that affect ethanol production and new gene expressions, transfer of these characteristics to new progeny, plant breeding, enzyme and microorganism activity used in fermentation.

In this study, bioethanal production from corn cob and bioethanol yield values and quality characteristics obtained from corn cobs were examined. The points reached in this context are given below:

It has been established that corn cobs are an important component of agricultural and domestic waste in many parts of the world and consist mainly of cellulose, which can be converted into energy in the form of bioethanol as an efficient and effective waste management tool.

It has been established that corn cobs account for about 30% of corn agricultural waste, and its applications in the biofuel industry are the focus of many studies aimed at achieving an effective and efficient waste management scheme.

It has been determined that corn cobs are used to evaluate sugar content and enzyme activity, which have been found to be affected by some factors affecting bioethanol yield and quality characteristics.

It has been found that the production of ethanol from corn cobs offers significant advantages over other biomass sources, is inexpensive and provides several advantages due to the fact that it is a waste material that can be easily obtained from local sources.

Based on the results given, it can be said that corn cobs are a potential source of bioethanol, but more research is needed to determine its values as an ethanol raw material.



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NUTRITIONAL CONTENT AND UTILIZATION AREAS OF BREAD WHEAT

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ABSTRACT

Wheat is one of the most produced grains in the world. It ranks third after corn and rice. It also has a wide range of uses. In addition to being consumed as food, it is also used as a raw material in livestock feed and in the manufacture of many products. Bread wheat germ is a concentrated source of bran, endosperm and germ from dried whole wheat grains. The nutrient content of bread wheat germ varies depending on the processing method. Because nutrients are found in different parts of the wheat grain, the more the wheat grain is milled toward the hull and the higher the flour yield, the more nutritious the products obtained. The nutritional composition of bread wheat germ is known to be rich in protein, fat and vitamins. In addition, it is a mildly flavored, soft yellow powder extracted from wheat after bran and flour have been removed. It contains vitamins B1, B2 and folic acid, as well as minerals such as iron, manganese and chromium. Compared to whole grain products such as whole wheat pasta and whole wheat bread, products containing only wheat germ have a slightly higher nutritional value. The largest single user of bread wheat is Europe. In addition, North America, Central Asia, North Africa and Southeast Asia constitute important additional markets with strong export potential. It is grown in almost every country, with China and India being the two largest producers. Based on the explanations given, this research will examine the uses of bread wheat and the basic nutritional content of bread wheat seed.

Keywords: Wheat, nutritional content, evaluation area



Introduction

Bread wheat is used as a major food source in many parts of the world. The use of bread wheat has been adapted to various cultures around the globe and is considered a staple in these areas. Bread wheat is widely used in the food industry due to high digestibility, good forage quality, short growing period and high crop yield. Bread wheat can be used for making bread and other kinds of food products (Peña, 2002).

Bread wheat usage areas are Europe, which is the largest single user of bread wheat. In addition, North America, Central Asia, North Africa and South-East Asia constitute significant additional markets with strong export potential. Bread wheat is the most widely cultivated cereal crop in the world (Erenstein et al., 2022). It is grown in almost every country, with China and India being the two largest producers (Shiferaw et al., 2013).

Based on the explanations given, in this research, the usage areas of bread wheat, the explanation of bread wheat germ and the examination of its basic nutritional content will be made.

Bread Wheat Usage Areas

Bread wheat is used for bread and other baked products, cereal-based foods and snacks, breakfast cereals and side dishes. Bread wheat is used for all types of breads, most of the biscuits and cookies. The Bread Wheat Usage Area is based on where the grain was delivered and consumed (Awika, 2011).

The largest region with the most significant use of wheat is Asia. It accounts for approximately 37 percent of total global usage. Wheat consumption in eastern Europe, northern Africa and the Middle East represent major bread wheat producing and consuming regions of the world (Pinstrip et al., 1999).

Bread wheat is the third most widely grown cereal crop after rice and maize. Today, it is the most important source of calories for people around the world. Bread wheat provides about 15% of the protein consumed by humans worldwide. The high gluten content in bread wheat flour provides the necessary flexibility for the dough to expand during leavening (rising) (Aboaba & Obakpolor, 2010).

Bread wheat is the most important crop in the world after maize. It was found that bread wheat was grown on an area of nearly 300,000 km², and its production accounted for more than 1/3 of total wheat output in the world. Bread wheat uses are found in all countries of the world and can be used as food product, biofuels, animal feed and fillers for paper production (Dhiman & Mukherjee, 2021).



Bread wheat is a variety of wheat used to make flour suitable for making bread. Bread wheat is grown in higher density plantings than are used for the production of other cereals, resulting in shorter spikes and weaker stems. These characteristics make it more difficult for farmers to harvest by conventional methods (Guerrini et al., 2020).

Wheat is the third most produced cereal behind maize and rice. The main uses for wheat are: food (breads, cakes, noodles), alcoholic beverages (beer), animal feed and industrial applications such as adhesives, textiles and paper manufacture (Khairuddin & Lasekan, 2021).

Wheat is planted in areas where the climate is suitable for growing wheat. There are many factors that determine the suitability of a specific climate for growing wheat. For example, when comparing two different regions that have similar average temperatures, those regions may have vastly different climates because of large differences in rainfall or other climatic factors like humidity, wind speed and direction, etc (Yue et al., 2019).

Bread wheat is used in all major wheat-consuming areas covering all the continents and over 90 countries, with China and India being major importers. In 2020, the world produced 649 million tonnes of bread wheat, with a slight decrease in production compared to 2018. Its production was also lower than expected thanks to bad weather conditions and agricultural infrastructures in certain parts of the world (Beres et al., 2020).

The world's major wheat consumers are Western Europe, Eastern Europe and North America. Western Europe and Eastern Europe together account for over 60% of world bread wheat imports. The main markets for wheat in this region are France, Germany and the United Kingdom. Major importers in North America include Canada, Mexico and United States (Schils et al., 2018).

Bread wheat is the most important food crop in the world. It is used for pastry products, as an ingredient in biscuits, pasta and many other foods. Bread wheat is grown in regions across the world. It is a highly versatile crop, and is used for making flour for all types of food products. Bread wheat can be ground into multiple types of flour, some of which retain a sweet, nutty taste, while others are more mellow with little to no aftertaste. Many fine flours can be enriched and fortified with vitamins, minerals and other nutrients for additional health benefits (Noorfarahzilah et al., 2014).

One of the most important food crops grown in the world, wheat is also used to feed livestock and as a raw material for production of a range of other products, including alcoholic beverages and vegetable oils (Shiferaw et al., 2011).



Bread wheat is used for bread and pastry, although millers may use it for oatmeal, vegetable broth and animal feed. The kernel consists of three parts: the seed coat or glume, which is a structure that protects the endosperm wrapped by aleurone layer, embryo and with pericarp covering outside. In the following parts of the study, the basic nutritional content of bread wheat germ is mentioned (Newman & Newman, 2006).

Bread wheat is a staple grain in a number of countries and bread wheat production has traditionally been one of the principal uses for this crop. There are four major regions where bread wheat is grown: the United States, Canada, Russia and Turkey (Okur, 2017).

Bread wheat uses include wheat flour and other wheat-based products. As of 2020, 45% of the world's wheat production was used as human food, 20% for animal feed, and 30% for baking. The main area of application is bakery products, which accounts for 95% of all bread wheat usage. Other important applications are flours for pastries and biscuits, pasta, sausages and other meat products, sauces and soups (Ang et al., 2020).

The use of bread wheat in most countries is limited to making bread and other leavened foods. It is less suited than some other varieties for non-leavened cereal products like porridge or gruel, or for products like pasta, noodles, or “refined” white breads (Peña et al., 2002).

Bread wheat is for human consumption, with about 90% of the world's supply being used for this purpose. The remaining 10% is used for livestock feed, distillation into alcohol or biodiesel, and industrial uses such as making plastics and cosmetics (Shiferaw et al., 2013).

Basic Nutrient Content And Nutrient Consumption Rates Of Bread Wheat Grain

Wheat grain is rich in carbohydrates, protein, mineral substances, trace elements, vitamins, fatty acids and color substances and phenols called secondary plant metabolites. Since the nutrients are found in different parts of the wheat grain, the more the wheat grain is ground towards the shell and the flour yield is increased, the more the products obtained are enriched in terms of nutritional physiology (Ereku et al., 2016).

Bread wheat germ is a concentrated source of the bran, endosperm and germ of dried whole wheat grain. Nutritional content of bread wheat germ varies with the method of processing. The nutritional composition of bread wheat germ is rich in protein, fat and vitamins. Wheat germ is a soft yellow powder with a faint aroma, which is extracted from the wheat after the removal of bran and flour. It contains vitamins B1, B2 and folic acid and minerals such as iron, manganese and chromium. In comparison with whole-grain wheat products, such as whole wheat pasta and whole wheat bread, products containing wheat germ only have slightly higher nutritional value. Wheat germ is a whole-grain product, which is obtained by grinding the wheat



kernel. The most common type of wheat flour storage, which has been milled without removing the outer layers and bran. Moreover, the germ of wheat flour is also referred to as “wheat bran,” which is used in preparing breakfast cereals that are rich in dietary fiber (Onipe et al., 2015).

Bread wheat germ has a high content of protein, fat, fiber and carbohydrates. Protein accounts for about 19.4%, carbohydrate accounts for about 61%, fat accounts for about 4% in the bread wheat germ. The content of vitamin E (alpha-tocopherol), vitamin B1 (thiamine), vitamin B2 (riboflavin) are 1.3%-0.13%, 0.42%-0.045%, 0.12%-0.040% respectively, other nutrients include Ca, P and Fe (Šramková et al., 2009).

The nutritional content of wheat germ includes: carbohydrates, protein and choline. There are a few vitamins and minerals contained within it such as vitamin E, vitamin B, riboflavin, calcium, magnesium and zinc. These vitamins are needed by the body to build cells in your body (Welch, 2011).

Bread Wheat germ is a seed of wheat, which is rich in nutrients. It is a rich source of dietary fiber and helps in lowering total cholesterol levels. It also contains antioxidant molecules like phenolic acids that help protect against cancers.

Conclusions

The results of this research, in which the usage areas of bread wheat and bread wheat germ are explained and the basic nutrient content is examined, are shared below:

Bread wheat usage area is a global industry. Bread wheat is mainly used for making bread, pastry, cake and cookies.

It has been determined that bread wheat is grown in many regions of the world and it has been revealed that it grows in temperate climates with good rainfall and fertile soils.

Bread wheat is a major commercial crop in China, Russia and India, with production and consumption levels among the highest in the world.

Bread wheat germ has a high content of protein, fat, fiber and carbohydrates. Protein accounts for about 19.4%, carbohydrate accounts for about 61%, fat accounts for about 4% in the bread wheat germ. The content of vitamin E (alpha-tocopherol), vitamin B1 (thiamine), vitamin B2 (riboflavin) are 1.3%-0.13%, 0.42%-0.045%, 0.12%-0.040% respectively, other nutrients include Ca, P and Fe.



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SEROPREVALENCE OF BOVINE RESPIROVIRUS 3 IN CATTLE IN AFYONKARAHISAR PROVINCE OF TÜRKİYE

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ABSTRACT

Bovine respirovirus 3 (BRV-3, formerly Bovine parainfluenza virus type 3) is one of the important viral respiratory pathogen of young and adult cattle. Clinical signs associated with BRV-3 infection are pyrexia, coughing, nasal and ocular discharges, anorexia, dyspnoea and sometimes diarrhoea. BRV-3 infection is widespread among cattle around the world, and three genotypes (BRV-3a, BRV-3b and BRV-3c) have been described. Previous serological studies conducted in Turkey indicate that disease is common in cattle in Turkey. However, there is limited information about BRV-3 situation in cattle in the Afyonkarahisar Province. Therefore, aim of this study was to investigate the seroprevalence of BRV-3 infection in non-vaccinated cattle in Afyonkarahisar Province. A total of 97 cattle sera were randomly collected from 14 herds. A commercial enzyme-linked immunosorbent assay (ELISA) kit was used to determine the presence of antibodies to BRV-3 in cattle sera. Antibodies to BRV-3 were detected in 36 cattle out of the 97 cattle (37.1%, 95% CI: 27.5 - 46.7). BRV-3 seropositivity was significantly higher in animals older than 3 years old than animals younger than 3 years old ($p < 0.05$). Furthermore, female animals had significantly higher BRV-3 seropositivity than male animals ($p < 0.05$). Results of this study indicate that BRV-3 circulates in cattle population in the investigated area, but results obtained in this study are insufficient to determine the BRV-3 epidemiological situation in Türkiye. Future studies are needed to investigate the prevalence of BRV-3 infection in cattle and small ruminants. Cattle can be protected by vaccination against the BRV-3 infection. Therefore, increasing farmer awareness about vaccine benefits and implementing biosecurity measures are recommended.

Keywords: Bovine respirovirus 3, Bovine parainfluenza virus type 3, Cattle, Seroprevalence, Risk factors, Türkiye



TÜRKİYE’NİN AFYONKARAHISAR İLİN’DE SIĞIRLARDA BOVINE RESPIROVIRUS 3 SEROPREVALANSI

ÖZET

Bovine respirovirus 3 (BRV-3, eski adı ile Bovine parainfluenza virus tip 3), genç ve yetişkin sığırların önemli viral solunum patojenlerinden birisidir. BRV-3 enfeksiyonunun klinik belirtileri ateş, öksürük, nazal ve oküler akıntı, iştahsızlık, nefes darlığı ve bazen ishaldir. Dünyada sığırlar arasında yaygın olan BRV-3 enfeksiyonunun, üç farklı genotipinin (BRV-3a, BRV-3b ve BRV-3c) mevcut olduğu bildirilmektedir. Hastalığın, Türkiye’de sığırlar arasında yaygın olduğu daha önce yapılan serolojik çalışmalarda ortaya konulmuştur. Ancak Afyonkarahisar ilindeki sığırlarda BRV-3 durumu hakkında sınırlı bilgi bulunmaktadır. Bu nedenle bu çalışmanın amacı, Afyonkarahisar ilinde aşılanmamış sığırlarda BRV-3 enfeksiyonu seroprevalansının araştırılması idi. On dört sürüden rastgele örnekleme ile toplam 97 sığır serumu toplandı. Sığır serumlarında BRV-3’e karşı antikorların varlığını belirlemek için ticari bir enzime bağlı immünosorbent analiz (ELISA) kiti kullanıldı. Doksan yedi sığırdan 36’sında BRV-3’e karşı antikor tespit edildi (%37,1, %95 CI: 27,5 – 46,7). BRV-3 seropozitivitesi, 3 yaşından büyük hayvanlarda, 3 yaşından küçük hayvanlara göre anlamlı derecede yüksekti ($p < 0.05$). Ayrıca dişi hayvanlar, erkek hayvanlara göre önemli ölçüde daha yüksek BRV-3 seropozitifliğine sahipti ($p < 0.05$). Bu çalışmanın sonuçları, BRV-3’ün araştırma alanındaki sığır popülasyonunda sirküle olduğunu göstermektedir, ancak bu çalışmada elde edilen sonuçlar, Türkiye’deki BRV-3 epidemiyolojik durumunu belirlemek için yeterli değildir. Sığır ve küçükbaş hayvanlarda BRV-3 enfeksiyonunun prevalansını araştırmak için gelecekteki çalışmalara ihtiyaç vardır. Sığırlar, BRV-3 enfeksiyonuna karşı aşılama ile korunabilir. Bu nedenle, aşının yararları konusunda çiftçi farkındalığının artırılması ve biyogüvenlik önlemlerinin uygulanması tavsiye edilmektedir.

Anahtar Kelimeler: Bovine respirovirus 3, bovine parainfluenza virus tip 3, sığır, seroprevalans, risk faktörleri, Türkiye



1. Introduction

Bovine respirovirus 3 (BRV-3) is one of the etiological agents of the bovine respiratory disease complex (BRDC) (Edwards, 2010). BRDC, commonly referred as “Shipping fever”, is an important health problem of the cattle around the world, and causes substantial losses due to decreased carcass quality, reduced performance and treatment costs (Griffin, 1997; Smith, 1998; Snowden et al., 2006). It has been reported that death loss caused by BRDC can reach 14.2 deaths per 1000 cattle (Loneragan et al., 2001).

BRV-3, formerly Bovine parainfluenza virus type 3, is a member of the *Respirovirus* genus within the *Paramyxoviridae* family, and it has non-segmented, negative and single-stranded RNA genome (ICTV, 2019). BRV-3 virions (150 -200 nm) have a spherical to pleomorphic shape, and they have lipid envelope which is derived from the cell membrane. Its genome encodes six structural proteins, fusion protein (F), hemagglutinin-neuraminidase protein (HN), large polymerase protein (L), matrix protein (M), nucleocapsid protein (N), phosphoprotein (P), and three non-structural proteins (C, D, and V) (Suzu et al., 1987; Pelet et al., 1991; Bailly et al., 2000). Genetic characterization of BRV-3 depend on the M and HN proteins of the virus revealed that it has three genotypes (Horwood et al., 2008; Zhu et al., 2011). Genotype A has been reported from Argentina, China, Japan, Türkiye, and the United States (Zhu et al., 2011; Maidana et al., 2012; Ohkura et al., 2013; Muftuoglu et al., 2021); Genotype B from Argentina and Australia (Maidana et al., 2012; Ohkura et al., 2013) and genotype C has been detected in China, Japan, Türkiye, and the United States (Neill et al., 2015; Leal et al., 2019; Muftuoglu et al., 2021).

BRV-3 infection is mostly seen in young and adult cattle. However, BRV-3 infection has also been reported in sheep, goats, pigs and camels (Qiao et al., 2009; Saeed et al., 2016; Baghezza et al., 2021; Teng et al., 2021). The clinical manifestations of BRV-3 infection can vary from mild to severe; fever, serous nasal discharge, dyspnoea, lacrimation, coughing, and bronchointerstitial pneumonia are the main clinical signs of the infection (Kapil and Basaraba, 1997; Maclachlan et al., 2017).

BRV-3 is widespread among cattle around the world. The primary routes of transmission are by aerosol and contaminated surfaces and objects resulting from nasal discharges (Maclachlan et al., 2017). Morbidity and mortality rates of infection usually low, but they can be higher in cases of secondary infections (Fulton, 2009). The presence of BRV-3 infection in cattle and small ruminants has been reported in different regions of Türkiye (Yeşilbağ and Güngör, 2008; Gür, 2019; Muftuoglu et al. 2021). However, there is limited



information available about the seroprevalence of BRV-3 in non-vaccinated cattle in the Afyonkarahisar Province. Therefore, aim of the study was to determine BRV-3 seropositivity in non-vaccinated cattle population.

2. Materials and Methods

2.1. Study area and sample collection

The present study was conducted between June 2022 and October 2022 in the Afyonkarahisar Province in the Aegean region of Türkiye. Sampled cattle were from different herds (n = 14). The sample size was calculated with an expected disease prevalence of 50%, confidence level of 95%, and standard error rate of 10%. A total of 97 cattle sera, six to seven cattle per herd, were randomly collected from sampled herds. Cattle of different ages and sex with no vaccination history against BRV-3 were included in the study.

The collected blood samples were centrifuged at 2000×g at 4 °C for 10 min., and obtained sera samples were stored at -20°C until analysis.

2.2. Serological analysis

A commercial enzyme-linked immunosorbent assay (ELISA) kit (BioX Diagnostics, Belgium) was used to determine BRV-3 specific antibodies in bovine sera samples. All sera were run in duplicate. The analysis was carried out taking into account manufacturer's instructions. The ELISA analysis was performed using an ELISA reader (Epoch, BIO-TEK, USA), and results were evaluated taking into account manufacturer's instructions.

2.3. Statistical analyses

The obtained data were analysed using SPSS (version18, SPSS Inc., Chicago, USA). The association between seropositivity and sex and age were estimated by Chi-square test. A p-value of ≤ 0.05 was considered statistically significant. The BRV-3 seroprevalence and 95% confidence intervals were calculated by using Bayesian approach of the beta distribution.

3. Results

Results obtained by ELISA are presented in Table 1. The overall BRV-3 seroprevalence was 37.1% (36/97, 95% CI: 27.5-46.7). Results showed that BRV-3 seropositivity was significantly higher in animals older than 3 years old (49.1%, 95% CI: 35.9-62.3) than animals younger than 3 years old (21.4%, 95% CI: 9.0-33.9) ($p < 0.05$). Furthermore, female animals (47.1%, 95% CI: 33.4-60.8) had significantly higher BRV-3 seropositivity than male animals (26.1%, 95% CI: 13.4-38.8) ($p < 0.05$).

An infected herd was defined at least one of the samples was seropositive within flock. In this study, 11 of the 14 herds (78.6%, 95% CI: 57.1-100.0) had at least one seropositive animals.



Table 1. Seroprevalence of BRV-3 in non-vaccinated cattle in the Afyonkarahisar Province

Categories	No. of samples	BRV-3 seropositivity, (%)	P- value
Age	< 3 years	42	9 (21.4%)
	> 3 years	55	27 (49.1%)
Sex	Male	46	12 (26.1%)
	Female	51	24 (47.1%)

4. Discussion

BRDC is one of the major diseases of cattle, which causes severe economic losses in cattle industry worldwide (Miles, 2009). Several viral and bacterial pathogens can contribute to the occurrence of BRDC, among which BRV-3 is one of the important pathogens (Ellis, 2010); however, there is insufficient information on BRV-3 infection in non-vaccinated cattle in the Afyonkarahisar Province. In this study, BRV-3 seropositivity in non-vaccinated cattle population was investigated. Sampled herds had no vaccination history against to BRV-3 infection. Therefore, the detection of seropositive animals in this study suggests these animals were naturally infected with BRV-3.

In the current study, antibodies to BRV-3 were detected in 36 cattle out of the 97 cattle (37.1%, 95% CI: 27.5 - 46.7). This rate is higher than previous reported rates from Eastern and Southeastern Anatolia regions of Türkiye (Çabalar and Can-Şahna, 2000). However, detected BRV-3 seropositivity in this study was lower than results of previous studies which were conducted in different regions of Türkiye (Alkan et al., 1997; Gür, 2019). Alkan et al. (1997) reported 52.7% BRV-3 seropositivity in different provinces of Türkiye. Yeşilbağ and Güngör found that BRV-3 seropositivity was 43.0% in North-Western Turkey. Furthermore, different BRV-3 seropositivity in cattle has been reported from different countries, such as 13.4% in Grenada (Tiwari et al., 2016), 65.9% in India (Narang et al., 2020), 72.8% in Lithuania (Kęstaitienė et al., 2009), 73.6% in Colombia (Pastrana et al., 2022), and 95% in Iran (Hatami et al., 2013). The differences in the seropositivity of BRV-3 between various regions and countries may be due to the sampling strategy, the number of sampled animals, the number of sampled herds, the age of animals and the difference in the herd management.

In the current study, age of the animals was significantly associated with BRV-3 seropositivity. BRV-3 seropositivity was significantly higher in animals older than 3 years old. Similar results were also obtained in previous studies. Pastrana et al. (2022) reported that animals older than 2 years old had two fold higher odds of seropositivity to BRV-3 than young animals. A different study from Colombia also reported that BRV-3 seroprevalence was higher



in the age group of >24 months of age (León et al., 2019). The higher BRV-3 seropositivity in older animals maybe related with the presence of some stress factor in these animals, and the concomitant infections with other bacteria and viruses.

In this study, an association was found between BRV-3 seropositivity and sex. Sex found as a risk factor for BRV-3 infection, and it has been reported that female animals had about four fold higher odds of seropositivity to BRV-3 than male animals (León et al., 2019). However, Betancurt et al. (2010) found no statistical association between BRV-3 infection and sex. Possible explanations for the differences in BRV-3 seropositivity in different studies are the number of sampled animals, the age of the sampled animals, the sampling method, the detection method and management conditions.

In conclusion, results of the current study showed that BRV-3 infection is common in non-vaccinated cattle population in the Afyonkarahisar Province. Therefore, prevention and control measures including vaccination, sanitation and hygiene practices should be applied to control the disease and to reduce the seroprevalence of BRV-3 infection.



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PROTECTIVE EFFECTS OF VARIETY CONCENTRATIONS OF TREHALOSE AND CARBOXYMETHYL CELLULOSE AS CRYOPROTECTANT DURING CRYOPRESERVATION OF RAM SEMEN

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ABSTRACT

Carboxymethyl cellulose is a non-toxic anionic polysaccharide having more water solubility and low viscosity and hence may act as a novel non-penetrating cryoprotectant. Adding Carboxymethyl cellulose as supplement can increase viscosity of extender and may also preserve sperm energy by arresting motility during cooling and equilibration steps prior to freezing. Trehalose is an oligosaccharide, unlike glucose or fructose, cannot pass through plasma membrane and act as an extracellular cryoprotectant. This study was designed to evaluate the protective effects of both CMC and trehalose as cryoprotectant on ram semen extender during freeze-thawing process. Carboxymethyl cellulose in single concentration of 0.25% (w/v) and trehalose in different concentration (50, 75, 100 mM) added in tris-citric acid-glycerol extender before freezing. After semen collected from four qezel rams, samples were randomly divided in to four groups. Group 1, was the control without adding any supplements. In group 2, semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 50 mM trehalose. In group 3, semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose. Finally, in last group semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose. Sperm parameters (sperm motility and vitality), DNA fragmentation, plasma membrane integrity (PMI) and intracellular reactive oxygen species (ROS) were examined in all groups. The results showed that the addition of 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose improved sperm motility and vitality and plasma membrane integrity. Furthermore, sperm DNA fragmentation in group containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose was significantly lower in comparison to other experimental groups. Moreover, adding of 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose had a tendency to decrease ROS generation compared to the other groups. In conclusion, adding exact concentrations of CMC and trehalose improved sperm parameters and plasma membrane integrity and decreased ROS generation after freeze-thawing process in ram spermatozoa. Therefore, both of them recommended as cryoprotectant.

Keywords: Carboxymethyl cellulose, trehalose, cryoprotectant, extender, ram spermatozoa



1. Introduction

Cryopreservation of mammalian sperm is a complicated technique that requires a proper balance of many factors to achieve optimal outcomes. Ram sperm is extremely vulnerable to temperature changes during freeze-thawing procedure. This has been attributed to the high amount of polyunsaturated fatty acids in their plasma membrane and insufficient level of cytoplasmic antioxidants that render sperm cells sensitive to lipid peroxidation (LPO) in presence of reactive oxygen species (ROS) (Allai et al., 2018). Cryopreservation leads to ice formation, cold shock, chemical effects induced by cryoprotectants, osmotic injury, oxidative injury, and apoptosis, finally damaging the structure and physiological function of spermatozoa (Lv et al., 2019). Furthermore, excessive production of ROS by inducing biochemical and structural alterations including ATP depletion and DNA fragmentation impairs motility, viability, and fertilizing capacity of spermatozoa (Topraggaleh et al., 2014). Various compounds have been added to extenders to enhance freezability of ram semen (Moce et al., 2010). Various monosaccharides and disaccharides have improved quality of frozen-thawed semen (Quan et al. 2012; Panyaboriban et al. 2015). Cryoprotectants are substances that reduce both the size and quantum of ice crystals formed during cryopreservation of sperm and thus reduces ice crystal-mediated damage to plasma membrane. Permeating cryoprotectants such as glycerol, polyethylene glycol and DMSO act, in part, by entering the sperm and displacing intracellular water and thus cause cellular dehydration. They also bind to intracellular water and prevent intracellular ice formation, which can damage the sperm (Amann and Pickett, 1987; Sieme et al., 2016). On the other hand, the non-permeating cryoprotectants such as disaccharides (sucrose, trehalose), polysaccharides (Ficol, dextran, methyl cellulose) and polyaminoacids (Poly-L-lysine) etc. act extracellularly as solutes and reduce freezing temperature of extender and thus reduces extracellular ice formation (Aisen et al., 2002; Ntemka et al., 2018). Carboxymethyl cellulose is a non-toxic anionic polysaccharide having more water solubility and low viscosity and hence may act as a novel non-penetrating cryoprotectant. In addition, by increasing viscosity of extender it may also assist in preserving sperm energy by arresting motility during cooling and equilibration steps prior to freezing. Moreover, in this study trehalose administered to the extender as an extracellular cryoprotectant because it cannot pass through plasma membrane (Quan et al., 2012). the glass transition temperature of trehalose (-30 °C) is much higher than that of other traditional cryoprotectants, such as ethylene glycol (-85 °C) and glycerol (-65 °C) (Pereira and Marques, 2008). Therefore, trehalose may contribute to extracellular vitrification formation and reduce ice crystal



production. In addition, the cryoprotective roles of trehalose may be associated with its antioxidant activity. In Nili-Ravi buffaloes, trehalose was found to improve the activities of antioxidant enzymes in post-thaw semen (Iqbal et al., 2016). Recent studies demonstrated that adding antioxidants to extenders before freeze-thawing process can protect spermatozoa from the deleterious effects of cryopreservation. The oxidative chain reaction is broken by antioxidants. Also, these agents reduce the oxidative stress. Supplementation of antioxidants in extenders have been shown to have a positive effect in cryopreservation of bull, goat, ram, canine, boar, and human semen quality. After thawing antioxidants improved the quality of semen parameters, integrity of plasma membrane and motility of sperm (Kumar and Mahmood, 2001).

2. Materials and Methods

The present study was conducted in Animal Sciences Department facilities of the Faculty of Agriculture at Urmia University, Urmia, Iran. The housing area for the sheep was near the Department facilities and the male and female Qezel sheep (five rams and two ewes) were housed at this location.

2.1. Study design

Ethical considerations for animal usage and experiments were based on regulations of the urmia university animal ethics committee. Samples were randomly divided in to 4 groups each as follow:

- 1- Control group: Without adding any supplements during freeze-thawing process.
- 2- CMC 0.25% (w/v), Trehalose 50 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 50 mM trehalose.
- 3- CMC 0.25% (w/v), Trehalose 75 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 75 mM trehalose.
- 4- CMC 0.25% (w/v), Trehalose 100 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 100 mM trehalose.

2.2. Extender preparation

Experimental extenders were prepared by using buffer of Tris-citric acid (pH 7.0, osmotic pressure 320 mOsmol Kg⁻¹. Glycerol 5%, fructose 0.2% weight/volume and egg yolk 20% volume/volume were added to the extender. Streptomycin-penicillin combination (1000 µg/ml, 1000 unit/ml) was used as antibiotics in extender. CMC at the single dose of 0.25% (w/v) and Trehalose at the rate of 50, 75,100 mM simultaneously were used to make



experimental extenders. The extender without CMC and Trehalose supplementation was kept as control.

2.3. Chemicals and reagents

The carboxymethyl cellulose (CMC, Sigma-Aldrich, USA; Cat. No. C5678) and trehalose (Trehalose, Sigma-Aldrich, USA, Cat. No. 1673715) were purchased from Sigma Company. Furthermore, other materials used in this study was from Merck or Sigma-Aldrich Companies.

2.4. Collection of semen

With use of an artificial vagina (IMV, France), semen samples were obtained from the rams in the presence of an estrous ewe, two times in a week during autumn and winter seasons. After collection, ejaculates were immersed in a water bath (37 °C) until evaluation. An equal volume of semen sample from the different rams was pooled, if the sperm of the sample had a mass motility estimate of greater than 3, progressive motility greater than 70% and concentrations greater than 3×10^9 per mL. The prepared pooled sample from each day when semen collections occurred was used in the present study.

2.5. Semen cryopreservation

Samples of each experimental group were placed in 0.25 mL French straws (Minitube, Germany), sealed with polyvinyl alcohol and there was a cooling of samples from 37 to 4 °C within 3.5 to 4 hours (slow cooling). The straws were subsequently maintained at a refrigerated temperature (4 °C) for an additional 2 hours. Straws were placed horizontally on a cold rack and floated 4 cm above the surface of the liquid nitrogen in a styrofoam container for 15 min, and were subsequently plunged into the liquid nitrogen for storage. The depth of the liquid nitrogen was about 25 cm at beginning of the freezing period. The size of the freezing vessel was 55 (length) \times 32 (width) \times 45 (height). To evaluate the variables, there was thawing of straws individually in a water bath at 37 °C for 2 min (Evans and Maxwell, 1987), 1 week after freezing.

2.6. Sperm membrane integrity

Sperm plasma membrane integrity (PMI) was measured by hypoosmotic swelling test (Lu et al., 2018). Briefly, 10 μ L of semen sample was diluted with 100 μ L hypo-osmotic solution (100 mOsm/L; 4.9 g/L sodium citrate and 9.0 g/L fructose) and then incubated at 37 °C for 30 min. After the incubation period, at least 200 sperm per simple was counted and classified under 400X magnification with contrast field microscopy. Percentage of sperm with characteristic swollen-coiled tail (having intact plasma membrane) was recorded.



2.7. DNA fragmentation

DNA fragmentation was assessed by TdT-mediated dUTP Nick-end labeling (TUNEL) assay kit (Beyotime, China), following the manufacturer's instruction. Briefly, sperm samples were centrifuged and washed twice with PBS, and then spread onto poly-lysine coated glass slides. After treatment with Triton X-100, the slides were immediately incubated with the TUNEL mixture at 37 °C for 60 min and fragmented DNA was fluorescently labeled. Subsequently, slides were mounted using antifade mountant with DAPI (Beyotime, China). A total of 500 randomly selected sperm per sample was counted and analyzed using fluorescent microscopy, the percentages of sperm exhibiting green fluorescence were considered as DNA fragmentation index (DFI).

2.8. Sperm motility and vitality

Assessments of sperm motility were performed via the CASAs for all samples. Semen (a drop) was put on a warm glass slide (37 °C) and then put cover slip on it. Visual motility percentage was evaluated microscopically at 400X.

2.9. Intracellular reactive oxygen species (ROS)

Dichlorofluorescein diacetate (DCFH-DA, Beyotime, China) was used to determine intracellular ROS generation according to its characteristic of being oxidized by ROS to produce fluorescent compound dichlorofluorescein. Specifically, a total of 10×10^6 cells/mL semen sample suspension was treated with 10 μ M DCFH-DA and incubated in darkness (30 min, 37 °C). Following centrifugation and resuspension procedures, the fluorescence intensity of analyzed sample was immediately measured using the fluorescence spectrometer at excitation wavelength (488 nm) and emission wavelength (525 nm).

2.10. Statistical analyses

Data were expressed as mean \pm SD and analyzed for statistical significance by one-way ANOVA and Bonferroni's multiple comparison test using SPSS 15.0. $P < 0.05$ was considered statistically significant.

3. Results

The aim of this study was evaluate the effect of single dose of CMC with varying concentrations of trehalose supplements adding simultaneously on extender as cryoprotectant before freeze-thawing process in ram spermatozoa. Both CMC and trehalose act as extracellular cryoprotectant. In our study, attempts were made by replacing some part of glycerol with other non-permeating cryoprotectant to minimize the toxic effects of glycerol and improve post-thaw recovery of ram sperm. The effects of carboxymethyl cellulose and trehalose addition on the



frozen–thawed sperm motility and vitality were analyzed and the results were listed in Table 1. The motility and vitality of sperm after freeze–thaw was significantly reduced compared with the fresh samples. Supplementation with 0.25% CMC and 75 mM trehalose significantly improved the motility and vitality, in comparison to the control group without CMC and trehalose addition ($P < 0.05$). In addition, 0.25% CMC with 50 mM trehalose and 0.25% CMC with 100 mM trehalose also had a certain improvement in sperm vitality (significant difference was found in 0.25% CMC with 100 mM trehalose group, $P < 0.05$), but did not show significant effects on motility.

Effect of carboxymethyl cellulose and trehalose addition concentration on sperm parameters after cryopreservation.

Groups (CMC + trehalose addition)	Sperm vitality	Sperm motility	
		Progressive motility	Total motility
Pre-freeze-thawing process			
analysis	81.7 ± 3.9	39.9 ± 3.1	67.9 ± 4.4
Control	59.4 ± 3.8b	27.9± 2.5bc	42.7 ±3.1bc
CMC+ trehalose 50mM	62.2 ± 3.8 ab	28.9 ± 2.5ac	44.5 ±2.7ac
CMC+ trehalose 75mM	64.9 ± 4.1a	30.6 ± 2.6a	46.4 ± 2.7a
CMC+ trehalose 100mM	63.7 ± 3.1a	28.9 ± 2.1ab	44.3 ±2.4ab

The average values for a series of experiments are given, a-c means in the same column with no common superscript differ significantly ($p < 0.05$). The values are expressed as mean ± SD.

The effect of adding CMC and trehalose on percentage plasma membrane integrity (PMI) of cryopreserved qezel ram semen is presented in figure 1. Our investigation demonstrated that sperm PMI was improved by supplementation of CMC simultaneously with trehalose in comparison to control group. In the group that supplementations are in dosage of 0.25% CMC with 75 mM trehalose, sperm PMI was significantly higher compared to other concentrations of these supplements.

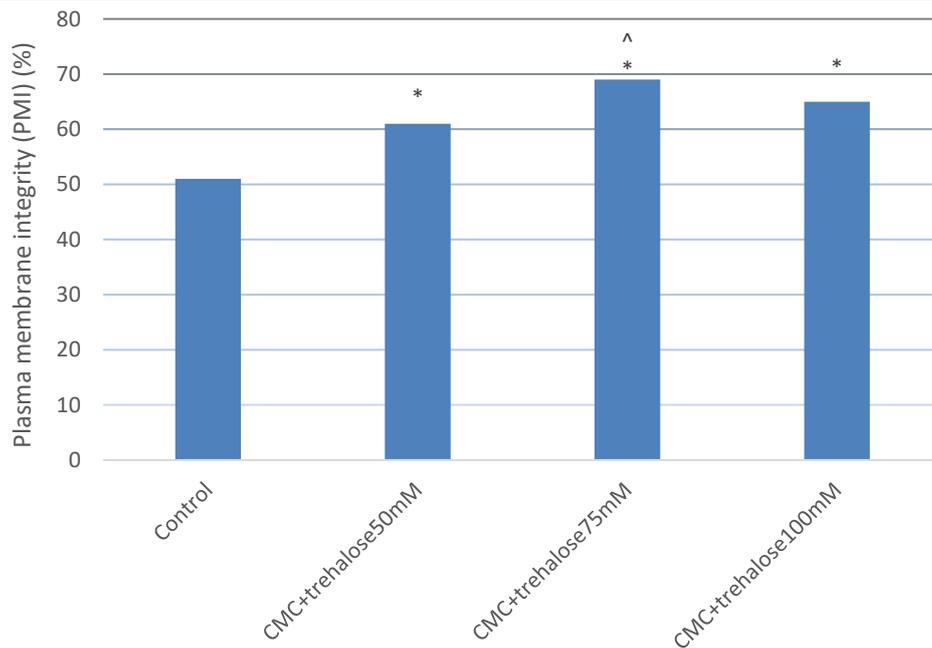


Figure 1. Effect of CMC and trehalose addition concentration on plasma membrane integrity (PMI) after cryopreservation.

Role of CMC and trehalose addition to extender on plasma membrane integrity (Mean \pm SE) of qezel ram semen after cryopreservation. * shows improvement in PMI percentage regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant improvement in PMI percentage on exact concentration of 0.25% CMC with 75 mM trehalose in comparison to other experimental groups.

The effect of adding CMC and trehalose on DNA fragmentation index (DFI) of cryopreserved qezel ram semen is presented in figure 2. Adding CMC with trehalose to ram extender before freeze-thawing process can reduce DNA fragmentation index in comparison to control group. Sperm DNA fragmentation in group containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose was significantly lower in comparison to other experimental groups. In addition, figure 3 shows that addition of CMC and trehalose had a tendency to decrease ROS generation compared to control group. There was significant reduction in ROS generation when added 0.25% CMC with 75 mM trehalose in comparison to other groups.

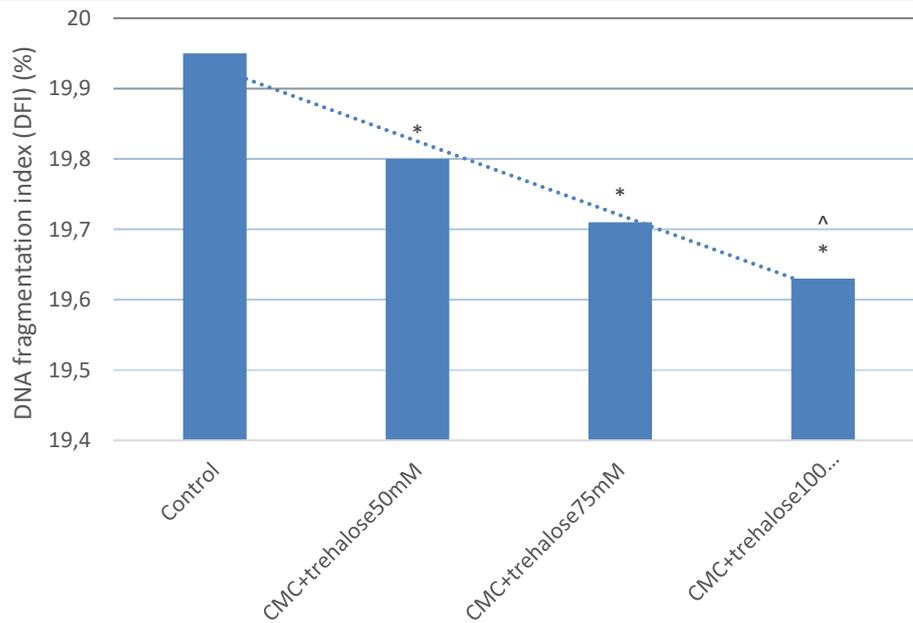


Figure 2. Effect of CMC and trehalose addition concentration on DNA fragmentation index (DFI) after cryopreservation.

Role of CMC and trehalose addition to extender on DNA fragmentation index (DFI) (Mean±SE) of qezel ram semen after cryopreservation. * shows reduction in DNA fragmentation index percentage regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant reduction in DFI percentage on exact concentration of 0.25% CMC with 100 mM trehalose in comparison to other experimental groups.

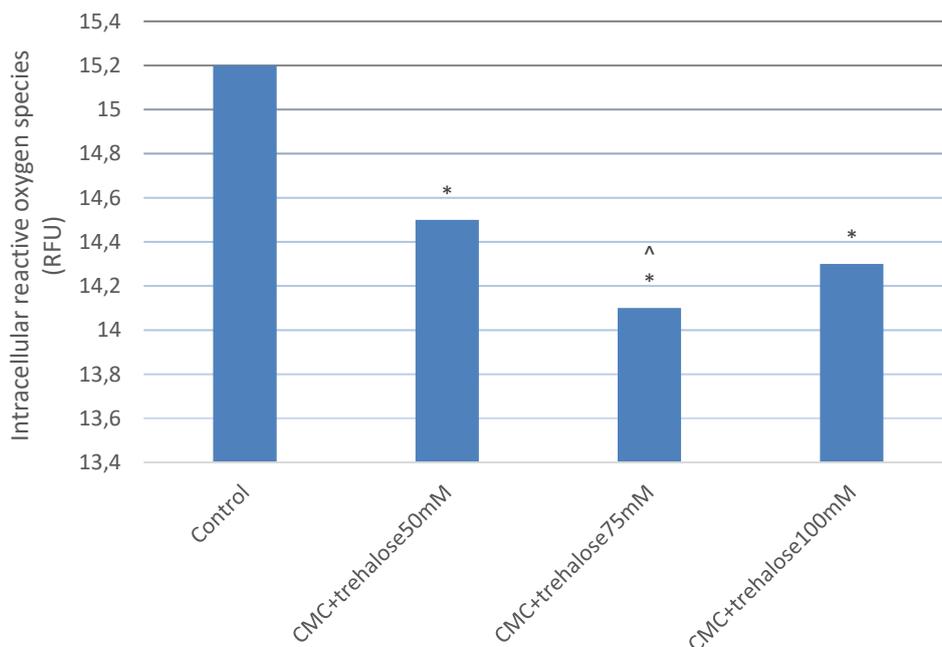


Figure 3. Effect of CMC and trehalose addition concentration on intracellular reactive oxygen species (ROS) after cryopreservation.



Role of CMC and trehalose addition to extender on intracellular reactive oxygen species (ROS) (Mean \pm SE) of qezel ram semen after cryopreservation. * shows reduction in ROS generation regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant decrease in ROS generation on exact concentration of 0.25% CMC with 75 mM trehalose in comparison to other experimental groups.

4. Conclusion

Mammalian spermatozoa are extremely sensitive to cryoinjuries induced by the freezing and thawing processes. As an efficient cryoprotectant, trehalose has been extensively studied in cryopreservation of stock semen. Most of investigations have confirmed the positive effects of trehalose on spermatozoa during cryopreservation (Aboagla and Terada, 2003; Bucak et al., 2021). The combination of glycerol with other non-permeating and non-toxic cryoprotectants such as disaccharides, polysaccharides, polyamino acids (carboxylated ϵ -poly-L-lysine) etc was reported to result in higher post-thaw sperm recovery than glycerol alone (Aisen et al., 2002; Ntemka et al., 2018; Tariq et al., 2020). Presence of polysaccharides increases the glass transition temperature of extender (Oldenhof et al., 2013) and thus protects sperm membrane during freezing. Carboxymethyl cellulose (CMC), a derivative of cellulose, is a low viscous and non-toxic anionic polysaccharide containing carboxymethyl groups that render enhanced water solubility. In conclusion, adding exact concentrations of CMC and trehalose to tris-citric acid-glycerol extender improved sperm parameters and plasma membrane integrity and decreased DNA fragmentation and ROS generation after freeze-thawing process in ram spermatozoa. Therefore, both of them recommended as cryoprotectant. In future investigations, by adding non-permeating cryoprotectants we can evaluate the protective effect of these cryoprptectants against reducing glycerol concentration from 5% to 4% regarding to control and decrease the adverce effect of glycerol on ram semen during freeze-thawing process.

Declaration of competing interest

There is no competing interest.



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IMPACT OF AGRICULTURAL FINANCE ON AGRICULTURAL GROWTH IN NIGERIA

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ABSTRACT

The federal government of Nigeria over the years has poured huge resources into the agricultural sector through a number of formal lending institutions, schemes, policies and programmes. However, the sector's performance is still below average. This study therefore, aim to investigate the impact of agricultural finance on agricultural growth in Nigeria. The study adopted a time-series research design using Autoregressive Distributed Lag model (ARDL) technique with an elaborated econometric methods. The data were sourced from 2022 Central Bank of Nigeria (CBN) statistical bulletin covering the period 1981 to 2021. The estimated model revealed that the CBN/ACGSF programme with coefficients values of (0.169, 0.132) and federal government direct funding to agriculture with coefficients values of (0.179, 0.174) have positive and significant effects on agricultural growth in Nigeria in both the short and long run at (5%, 1%) and (5%, 1%) respectively. However, in the short-run the relationship between commercial bank credit and agricultural growth in Nigeria is not statistically significant but became significant at 1% only in the long run with a coefficients value of (0.065). Lastly, one of the control variables, inflation rate with coefficients values of (-0.089, -0.174) was also significant both in the short and long run at (1%, 1%) respectively. The research came to the conclusion that agricultural finance is a key factor in determining agricultural growth in Nigeria. The study therefore, recommend among others, that CBN should strengthened and expanded its Agricultural Credit Guarantee Scheme (ACGSF) to provide more credit to farmers as this can help to improve their access to credit and provide the necessary resources for them to invest in their farms.

Keywords: Agricultural Growth, Commercial Banks Credit, Government Direct Funding and CBN/ACGSF Programme, ARDL



1.0 Introduction

Agriculture was Nigeria's main source of foreign exchange earnings until the mid-1970s, when the oil sector overtook agriculture as the country's main source of income. However, the importance of agriculture in transforming Nigeria's economic cannot be overstated as it has contributed significantly to the Nigerian economy in several different ways (Eze et al 2010). One significant challenge facing agriculture in Nigeria is inadequate finance. The agricultural sector requires substantial investment in inputs, infrastructure, research and development to achieve its potential. In fact, public expenditure on agriculture has been insufficient to meet the government's policy objectives over the years. This shortfall has resulted in low agricultural productivity, inadequate food supply and high food prices, among other issues (IFPRI 2008; Oni & Ojo 2014).

The importance of agricultural finance is comparable to the importance of other factors of production such as labour and land, as agricultural activities will be meaningless without adequate credit to support them. The agricultural credit sector comprises of many different types of institutions, including the banks, non-bank financial institutions and other specialized institutions and schemes. However, lending to agriculture by most of these financial institutions has been perceived to be very risky, unprofitable and unpredictable compared to lending to other sectors (Nwokoro, 2017). Thus, various studies such as Elegham (1983), Ogar, Nkamare and Effiong (2014) as well as Ademola (2019) have shown that the provision of credit to local farmers is a major challenge due to the risk of non-payment of credit facilities and their inability to present the required collateral. In response to this, the federal government through the Central Bank of Nigeria (CBN) issued directives to commercial banks to disburse a certain percentage of their loans portfolio to agriculture at lower than normal interest rates. This measure was taken in response to declining food production in the country. Nevertheless, most commercial banks were willing to pay penalties rather than lend to the agricultural sector (Igyo, Simon, & Jane 2016). This was part of the reasons for the establishment of government owned financial institutions such as the Nigeria Agriculture and Cooperative bank in 1972 which was later renamed Bank of Agriculture (BOA) in 2001 (Okumadewa, 1997 & Winters, 1998).

Thereafter, the Agricultural Credit Guarantee Scheme, better known as ACGS, was set up by the Federal Government of Nigeria to address the financing problems faced by peasant farmers in Nigeria. The scheme through the CBN was created to provide guarantee cover for agricultural loans granted by commercial banks to farmers in Nigeria. The ACGS is aimed at



reducing the risk associated with agricultural lending and increasing the amount of credit available to farmers and other stakeholders in the agricultural sector (Florence & Nathan, 2020).

In addition to the Agricultural Credit Guarantee Fund (ACGSF) programmes, other Institutions and policies such as NIRSAL in 2011 and Anchor Borrower in 2015 among others were introduced by the government through CBN intervention programmes to address the problem of inadequate financing of agricultural production. However, the sector's performance is still below average. This is because the sector is unable to meet domestic food needs, supply raw materials to agro-industries and generate sufficient foreign exchange through exports (Izuchukwu, 2011; Awe, 2013; Olomola & Yaro, 2015). Specifically, most farmers are unable to raise the equity capital needed to expand their operations and modernize their businesses, and banks' phobia of lending to the sector still persists despite policy initiatives taken to address the situation (Olomola & Yaro, 2015).

Therefore, the main objective of this study is to assess the impact of agricultural finance on agricultural growth in Nigeria. The specific objectives of this study are: to examine the impact of the ACGSF on agricultural productivity growth in Nigeria; to examine the extent to which the allocation of direct public funds from government has contributed to agricultural productivity growth; and to assess the impact of lending to the agricultural sector by commercial banks.

Overall, this study is important to a wide range of stakeholders. For instance it can help the government to identify policy interventions that can improve access to finance for farmers, such as the creation of specialized agricultural finance institutions or the provision of incentives to commercial banks to lend to the sector. Also, this study can help Development Partners such as international organizations, NGOs and donor agencies that have interest in promoting agricultural development in Nigeria to identify areas where they can provide support, such as capacity building for financial institutions or funding for specific agricultural projects. Lastly, the findings of this study will contribute to existing knowledge about agricultural finance in Nigeria and to identify areas for further research

2.0 Literature review

This section presents the review of the extant literature, majorly in the areas of conceptual, theoretical and empirical studies.

2.1 Conceptual Review

This section reviews the extant literature in terms of the defined concepts allied to concept of agricultural financing and sources of credit to agriculture in Nigeria.



2.1.1 Concept of Agricultural Financing

According to Lee (2008), as stated in Nnodim (2019), agricultural finance is defined as the acquisition and use of money in agricultural endeavors. Agricultural finance is comprised primarily of two aspects: the availability of finances in agriculture and the demand for those funds. Agricultural finance refers to the management and provision of financial resources for agricultural activities, such as crop production, livestock farming, and agribusiness. It involves the acquisition, management, and allocation of financial resources to support agricultural production, marketing, and processing. The availability of finances in agriculture refers to the availability of credit and other financial resources to farmers and agribusinesses. This includes loans, grants, subsidies, insurance, and other forms of financial support that can be used to fund agricultural activities. On the other hand, the demand for funds in agriculture refers to the need for financial resources to support agricultural activities. This includes the financing needs of farmers, such as working capital, equipment, and infrastructure, as well as the financing needs of agribusinesses, such as marketing and distribution channels. Idris, Adisa & Kura, (2019).

2.1.2 Sources of Credit to Agriculture in Nigeria

i. **Commercial Banks:** Commercial banks are financial institutions that provide credit facilities to individuals, businesses, and organizations. In Nigeria, commercial banks are one of the primary sources of credit to agriculture. They provide loans to farmers and agribusinesses for agricultural purposes such as the purchase of equipment, seeds, fertilizers, and other agricultural inputs. The loans are typically secured by collateral and have an interest rate that is dependent on various factors such as the loan amount, the duration of the loan, and the creditworthiness of the borrower. Commercial banks that provide credit to agriculture in Nigeria include First Bank, Zenith Bank, and Access Bank, among others (Okon & Isong, 2015).

ii. **Microfinance Institutions:** Microfinance institutions are financial institutions that provide small loans to individuals and small businesses. In Nigeria, microfinance institutions provide small loans to farmers and agribusinesses who do not qualify for loans from commercial banks. They focus on small-scale agriculture and rural development. The loans are typically unsecured, and they have shorter repayment periods than those of commercial banks. Examples of microfinance institutions that provide credit to agriculture in Nigeria include LAPO Microfinance Bank and Accion Microfinance Bank (Ojo, Adewumi, & Adeyemi, 2017).



iii. **Governmental Agencies:** The government of Nigeria has several agencies that provide credit to agriculture. These agencies include the Central Bank of Nigeria (CBN), Bank of Agriculture (BOA), and the Nigerian Agricultural Insurance Corporation (NAIC). The CBN provides credit to agriculture through its various intervention programs such as the Commercial Agriculture Credit Scheme (CACCS) and the Anchor Borrowers Program (ABP). The BOA is a government-owned development bank that provides credit to agriculture at subsidized interest rates. The NAIC provides insurance services to farmers and agribusinesses, enabling them to access credit from commercial banks and other financial institutions (CBN, 2021).

iv. **Cooperatives:** Cooperatives are associations of farmers who pool their resources to provide credit to their members. They provide loans for agricultural production, processing, and marketing. Cooperatives are a source of credit to agriculture in Nigeria, particularly for small-scale farmers who do not have collateral to secure loans from commercial banks. The loans are typically low-interest, and they have longer repayment periods than those of commercial banks. Examples of cooperatives that provide credit to agriculture in Nigeria include the Nigeria Farmers' Cooperative Society and the Nigerian Women in Agriculture Cooperative Society (IFAD, 2017).

v. **Non-Governmental Organizations:** Non-governmental organizations (NGOs) also provide credit to agriculture in Nigeria. These organizations provide loans and other forms of support to farmers and agribusinesses to improve their livelihoods. They typically focus on small-scale agriculture and rural development, and their loans are unsecured. Examples of NGOs that provide credit to agriculture in Nigeria include the International Fund for Agricultural Development (IFAD) (IFAD, 2017).

2.2 Theoretical Underpinning

The theoretical underpinning to this study is based on the Supply-leading and Demand-following hypothesis. The Supply-leading and Demand-following hypothesis was developed by Burns, Arthur in 1958. The notion that demand will follow supply is that progress in the financial sector drives overall economic growth. According to this theory, the acts of financial institutions serve as a beneficial technique for expanding the productive capacity of the economy. The hypothesis implies that supply-side policies, such as tax cuts and deregulation, can be more effective than demand-side policies, such as fiscal and monetary stimulus, in boosting economic growth. This is because supply-side policies aim to increase production and investment, which can lead to sustained economic growth, while demand-side policies tend to focus on short-term stimulus that may not have lasting effects (Demetriades & Hussein 1996).



2.3 Empirical Studies

The transformation of traditional farming into the large-scale commercial agriculture that is distinctive of modern times and that contributes to the growth of agriculture is facilitated in great part by credit, which is an important component of this evolution. Therefore, Akram, Alam, and Iqbal (2018) looked at the connection that exists between agricultural funding and agricultural productivity in the country of Pakistan. They concentrated their efforts, to be more particular, on Pakistan's agriculture sector. The authors investigated the effect that agricultural finance has on productivity, paying particular attention to the rural population's function as a moderating influence. Using descriptive statistics, correlation analysis, and analytical methods that employ the ordinary least square, as well as farm finance and agricultural output as variables, research is being done on time series data. Even though the rural population is present in the position of a mediator, the results of the study indicate that financial aid for agriculture has a positive and observable effect on agricultural production. This is the case even when the rural population is present.

In addition to this, Ajayi, Nageri, and Akolo (2017) used linear regression with time series data to study the impact of agricultural financing policy and deposit money bank loan on agricultural sector productivity in Nigeria. More specifically, they evaluated the impact of agricultural financing policy and deposit money bank loan to agricultural sector on agricultural productivity. This was done by studying the impact of agricultural financing policy and deposit money bank loan to agricultural sector in Nigeria. This was accomplished by conducting research on the effects that agricultural finance policy and deposit money bank loan had on the productivity of the agricultural sector in Nigeria. According to the results of the study, the lending rate (LR) has a significant adverse effect on agricultural productivity in Nigeria. On the other hand, deposit money bank loans (CBF) and agricultural financing policy proxy by Agricultural Credit Guarantee Scheme Fund (ACGSF) both have significant favorable effects on agricultural productivity.

Similarly, Ademola (2019) investigated the impact that agricultural financing has on the economy of Nigeria by carrying out an empirical investigation on the connection between agricultural finance and the growth of the Nigerian economy. This investigation looked at the relationship between agricultural finance and the expansion of the Nigerian economy. Examining data obtained from cross-sections using the ordinary least square method, with credit size, agricultural output, commercial bank credit, and real interest rate serving as the variables under investigation (OLS). The results of the model that was used suggest that the



increase in productivity of investments will be better financed with resources administered by commercial and specialized financial institutions, and that there is an urgent and sincere need to expand the credit size that is available to the agricultural sector in order to enhance the increase in productivity of the agricultural sector.

However, Adeshina, Tomiwa, and Eniola (2020) investigated agricultural finance and economic performance in Nigeria by conducting a study that particularly aimed to evaluate the influence that agricultural financing has on economic performance in Nigeria. This research applied some preliminary test of time series data such as unit root test, the bound cointegration test before applying an error correction technic to estimate the specified model. The study came to the conclusion and firmly maintained that agricultural financing contributed negatively to the economic performance of Nigeria during the sampling period primarily due to insufficient funding to the sector.

Furthermore, Anetor, Ogbechie, Kelikume, and Ikpesu (2016) examined the influence that the commercial banks loans and many different loan programs offered in Nigeria had on the productivity in the agricultural sector. The outcomes of the study indicated that the ACGSF performed a poor job of explaining the performance of the agricultural sector, but that commercial loans to the agricultural sector had a significant effect on the amount of agricultural output that was produced.

Olowofeso, Adeboye, Adejo, Bassey, and Abraham (2017) investigated the relationship between credit to agriculture and agricultural output in Nigeria by using time series data and a nonlinear autoregressive distributed lag (NARDL) model. This was done in order to better understand the nature of this relationship. The findings did not point to any asymmetry in the influence of credit on production growth in the agricultural sector (both positive and negative changes), but in the long run, there are a variety of equilibrium connections at play. In the short term, the findings did not point to any asymmetry in the influence of credit on production growth in the agricultural sector (both positive and negative changes).

Adegboyega (2020) examined time series data by using Johansen's co-integration, the Error Correction Method (ECM), and Granger causality analytical tools in order to investigate the influence that agricultural finance has on the unemployment rate in Nigeria. In order to investigate the connection between agricultural funding and the unemployment rate in Nigeria, a co-integration methodology was used to carry out this research. According to the findings, all the independent variables exhibited a connection with unemployment over a prolonged period of time in addition to having a statistically significant association with it.



Igyo, Simon, and Jane (2016) investigated the influence of deposit money banks' credit on agricultural production in Nigeria from 1981 to 2014 using the ordinary least square approach. An effect study of deposit money banks' credit exploring time series data was carried out, and this was done so that they could assess the financial intermediation and agricultural production in Nigeria. This was done so that they could conduct an investigation into the nature of the connection between the two. The results of the study indicated that a loan from a deposit money bank is a viable choice for providing funding for the continuance of sustainable growth in the agricultural sector.

In addition, Okorie, Nwonye, Anowor, and Ojiogu (2019) constructed an econometric model with dynamic error correction and assessed the health outcomes and agricultural output in Nigeria. They did this by using dynamic error correction in the model. The data were evaluated with the help of this model. The data showed that HIV/AIDS has severe effects on the outcomes of health as well as the collective productivity. [Citation needed] [Citation needed] It was discovered that the results of health care have a significant impact on the potentials of agricultural production, and that there is a connection of causation between the outcomes of health care and agricultural output in Nigeria. Nigeria was the location where this connection was discovered.

Ewubare and Ologhadien (2019) used an error correction mechanism and explored time series data to determine the impact of agricultural financing on cassava production in Nigeria. This was done in order to have a better understanding of the impact that agricultural finance has had on cassava output in Nigeria. Utilizing cassava production as a dependent variable, along with public capital spending on agriculture, public recurrent expenditure on agriculture, loans and advances to agriculture from deposit money institutions, and the Agricultural Credit Guarantee and Stabilization Fund (AGSCF) as independent variables. From the findings, agricultural credit guarantees program fund has a significant positive impact on cassava production at lag 3, however it has a negative effect on cassava production at its second lag. Again, the contemporaneous value of bank loans showed a positive link with cassava output, but the lagged values had a significant negative influence on the crop's productivity. This was the case despite the fact that the contemporaneous value of bank loans was higher.

Orji, Ogbuabor, Anthony-Orji, and Alisigwe (2020) investigated whether or not there is a causal linkage between agricultural financing and agricultural output growth in developing economies. They did this by employing pair wise granger causality tests with time series to study the causal linkage between agricultural financing and agricultural output growth in Nigeria. Their findings



indicated that there is a causal linkage between agricultural financing and agricultural output growth in developing economies. In particular, they were interested in determining whether or not there was a connection in Nigeria. The research showed that there was no causal link between the growth of agricultural financing and the growth of agricultural output within the time period that was taken into account.

Orok and Ayim (2017) conducted an analysis to determine the effect that the agricultural loan guarantee program fund has on the growth of the agricultural industry in Nigeria. They were able to accomplish this by modifying the analytical tools of multiple linear regression and ordinary least square (OLS) to work with time series data. Their goal was to demonstrate how the Agricultural Credit Guarantee scheme fund (ACGSF) has contributed to the development of the agricultural sector in Nigeria. The investigation resulted in the discovery of a beneficial and statistically significant connection between ACGSF and the expansion of the agricultural industry. This connection was determined by the persistent growth of the agricultural sector's contribution to GDP. The results also indicated that the plan had supplied more funding to the crop sector than it did to the livestock and fisheries sector, and that it had also had a higher effect on the crop sector. This was proven to be the case since the crop sector had been the primary beneficiary of the scheme.

3.0 Research methodology

This section focuses on the methodology adopted in the study. It contained the specification of model, research design, sources of data and collection, data analysis techniques and model specification.

3.1 Data Collection Method and Sources

Documentary sources are used in the process of data collecting for this particular research. In particular, the data were acquired from the Central Bank of Nigeria 2022 Statistical Bulletin. The study adopted an ex post facto research design. The gathered data covered the period between 1981 and 2021. The selection of this time period is for the aim of conducting an empirical test to determine the relevance of agricultural finance's influence on the level to which agricultural growth in Nigeria.

3.2 Model Specification

In line with the original model, as specified by Anetor, Ogbechie, Kelikume, and Ikpesu (2016) and two additional control variables of inflation and exchange rate were included in the model. This is analysed by specifying the model below:

$$AGG_t = F(ACGSF, CDCB, GDFA, INF, EXR)$$



$$AGG_t = \beta_0 + \beta_1 ACGSF_t + \beta_2 CDCB_t + \beta_3 GDFA_t + \beta_4 INF + \beta_5 EXR + \mu_t$$

AGG = Agricultural growth measured by Change in the Percentage of Agricultural contribution to GDP (Agriculture % of GDP in current year - Agriculture % of GDP in previous year / Agriculture % of GDP in previous year)

ACGSF = Agricultural Credit Guarantee Scheme Fund

CDCB = Credit Disbursed by Commercial Banks to the agricultural sector

GDFA = Government Direct Fund Allocation to agriculture

INF = Inflation Rate

EXR = Exchange Rate

β_0 = Intercept of the model

$\beta_1, \beta_2,$ and β_3 = slope of the coefficient.

μ = Error term

3.3 Model Estimation Techniques

The Autoregressive Distributed Lag (ARDL) model is a statistical model used for analyzing the relationship between two or more variables in a time series context. It is often used to estimate the long-run relationship between variables, even if they are non-stationary or have different orders of integration. The ARDL model combines the autoregressive and distributed lag models to capture the short-term and long-term effects of changes in the independent variables on the dependent variable. It allows for the inclusion of lagged values of the dependent variable, lagged values of the independent variables, and any other relevant covariates. The ARDL model is particularly useful when dealing with time series data that exhibit non-stationarity or have breaks in their trends, as it can account for these characteristics in its estimation. Additionally, the ARDL model can be used to test for the existence of a cointegrating relationship between the variables, which implies a long-run equilibrium relationship (Pesaran and Shin 1998; Pesaran et al. 2001).

4.0 Result and discussion

In this part, the data obtained from the research will be presented, and a discussion of the results' implications will follow. This session is divided into two parts. The first part, presents the preliminary analyses such as the descriptive analysis, the correlation analysis, test of unit roots and bound test while the estimation of the model using regression analysis based on ARDL model formed the second parts of this session.



4.1 Descriptive Analysis

This research makes use of descriptive statistics as shown on Table 4.1 because, in addition to being valuable when carrying out empirical and analytical analysis, it is also based on what other studies that are comparable to this one utilized. The descriptive analysis allows us to characterize the important characteristics of the phenomenon that is being looked at and provides specific information on the variables that are important (Trochim, 2006).

Table 4.1: Summary Statistics of Variables

	AGG	ACGFS	CDCB	G DFA	INF	EXR
Mean	22.88138	3183081.	192.6138	20.69444	18.90806	108.8737
Median	22.23471	808820.1	48.56150	7.537355	12.87658	111.2313
Maximum	36.96508	12997004	1457.822	76.60099	72.83550	412.9900
Minimum	12.24041	25154.90	0.590600	0.012770	5.388008	0.610025
Std. Dev.	4.589772	3869825.	317.8070	24.38010	15.96264	111.9584
Skewness	0.440302	0.968179	2.293070	0.916470	1.810433	1.039132
Kurtosis	3.732787	2.682852	2.304850	2.523509	3.554744	3.383478
Jarque-Bera	6.454107	6.577190	84.00576	6.127299	33.54720	7.629819
Probability	0.139674	0.137306	0.513000	0.146717	0.343000	0.122040
Sum	938.1364	1.31E+08	7897.167	848.4720	775.2306	4463.823
Sum Sq. Dev.	842.6402	5.99E+14	4040051.	23775.57	10192.24	501387.5
Observations	41	41	41	41	41	41

Source: Author's Computation, (2023)

Table 4.1 presents the summary statistics of variables in form of mean, standard deviation, minimum, maximum and the normality of each variable.

According to the data presented in the table that is located above, agricultural growth which is measure by Percentage of Agricultural contribution to GDP had a mean value of 22.9 percentage with a standard deviation of 4.6 percent. This indicates that agricultural growth had a significant amount of variation over the course of the years that were taken into consideration. The lowest value of agricultural growth is estimated to be 12.2 percent, while the highest value of agricultural growth is estimated to be 37 percent. This suggests that at some point in time, Nigeria has recorded a healthy value for agricultural contribution to the economy.

The Agricultural Credit Guarantee Scheme Fund (ACGSF) has a value of 3.18 billion Nigerian naira on average, with a standard deviation of 3.87 billion Nigerian naira, which indicates that the variable has been changing over the course of the years. The agricultural loan guarantee program fund has a minimum value of N25.15 million and a maximum value of N12.9 billion. This shows the total amount of funding that has been allotted to various projects for the agricultural industry throughout the course of time.

The standard deviation of the value of credit disbursed by commercial banks to the agricultural sector is 317 billion, which indicates that credit disbursed by commercial banks has varied



significantly over the years. The average value of credit disbursed by commercial banks to the agricultural sector is 192 billion. It can be seen from the fact that the least value of credit extended by commercial banks to the agricultural sector is N0.5 billion, while the highest value is N1457 billion, that commercial banks have extended a significant amount of credit to the agricultural industry during the course of the years.

The standard deviation of the values of government direct fund allocation to agriculture over the years is N24.4 billion, which indicates that there is a large difference in the values of government direct fund allocation to agriculture over the years. The average value of government direct fund allocation to agriculture is N20.7 billion. The direct funding that the government provides to agriculture may have a minimum value of 12.8 million Nigerian naira and a maximum value of 76.6 billion Nigerian naira.

Inflation rate (INF) has a mean value of 18.9 percent and a standard deviation of 16.0 percent, this indicates that inflation rate in Nigeria had a significant amount of variation over the course of the years that were taken into consideration in the study. Inflation rate also has a minimum value of 5.4 percent and a maximum value of 72.8.

The standard deviation of the values of exchange rate over the years is 112.0 naira, which indicates that there is a large difference in the rate of the exchange rate over the years while the average value is 108.9 naira. The exchange rate also have a maximum rate 412.9 naira of and a minimum rate of 0.6 naira.

The Jarque-Bera statistics for the variables that were investigated revealed that all of the variables (AGG, ACGFS, CDCB, GDFA, INF and EXR) had a normal distribution. This was shown by the fact that the Jarque-Bera probability was greater than the threshold of significance of 5%. In a similar vein, the values of the variables' skewness and kurtosis are within the range defined by the cutoff point of +3 and -3, which indicates that the variables are skewed and kurtic (Asika, 2005).

Pairwise Correlation Matrix

This section presents inferential statistics such as correlation analysis to show relationships among variables, unit root test to examine if variables are stationary, co-integration test to examine the long run relationship among variables, and regression analysis to examine the effect of agricultural credit guarantee scheme fund on the growth in agricultural productivity in Nigeria.



4.2 Correlation Analysis

The results of the pairwise correlation analysis, which was performed to evaluate the connections that exist between all of the variables, are summarized in Table 4.2. The results of the pairwise correlation show the correlation coefficient between all of the explanatory variables (i.e. agricultural credit guaranteed scheme fund, credit disbursed by commercial banks to agricultural sector, government direct fund allocation to agricultural sector, inflation rate and exchange rate) is less than 0.8. This indicates that the inclusion of these variables in a model would not result in multicollinearity issues (Kennedy, 2008). According to Kennedy (2008) multicollinearity is a problem when the correlation is above 0.80, which was not the case here.

Table 4.2: Pairwise Correlation Matrix

	AGG	ACGFS	CDCB	G DFA	INF	EXR
AGG	1.000000					
ACGFS	-0.246156	1.000000				
CDCB	-0.071161	0.522375	1.000000			
G DFA	-0.158245	0.644017	0.708871	1.000000		
INF	0.193576	-0.356760	-0.184357	-0.339015	1.000000	
EXR	-0.130956	0.624597	0.605716	0.774136	-0.298639	1.000000

Source: Author's Computation, (2023)

4.2.2 Augmented Dickey Fuller Unit Root Test

Table 4.3: Unit Root Test

S/N	Variable	Level		First Difference		Order of Integration
		ADF	p-value	ADF	p-value	
1	AGG	-1.6709	0.7446	-5.6596	0.0002	I(1)
2	ACGFS	-1.5230	0.5113	-6.8788	0.0000	I(1)
3	CDCB	2.0797	1.000	-7.1338	0.0000	I(1)
4	G DFA	-1.9241	0.3181	-6.8920	0.0000	I(1)
5	INF	-1.6240	0.2271	-5.6521	0.0000	I(1)
6	EXR	-1.7351	0.3283	-6.2224	0.0000	I(1)

Source: Author's Computation, (2023).

The results of the Augmented Dickey-Fuller test that were performed on each of the study's variables are shown in Table 4.3. The investigation indicated that none of these variables are stationary at their respective levels; nevertheless, they are all stationary at their respective initial differences (i.e. when each of them was differenced once). This indicates that the null hypothesis that there is a unit root in their differenced series should be rejected in favor of the



alternative hypothesis that there is no unit root. This suggests that the variables are stationary at first difference, and as a result, they are considered to be an I(1) series.

4.4 Optimal lag Length Selection

Vector Autoregressive, VAR, was used to determine the optimal lag length for the ARDL co integration test which was based on the AIC criterion as shown in table 4.4. From the result, the optimal lag length is 1 according to AIC and which is consistent with most of the other criteria. Using this optimal lag length, the likelihood ratio test which depends on the Maximum Eigen values of the stochastic matrix of the Johansen (1991) procedure for exploring the number of co integrating vectors was employed as shown in table 4.4.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1.717671	NA*	0.131864	0.641314	1.348700	0.934548
1	2.463180	0.810966	0.124520*	0.751613*	1.414505*	0.960801*
2	3.385035	0.711764	0.130160	0.762481	1.463188	0.986717
3	3.306862	0.401027	0.142370	0.838457	1.575783	1.087437

Source: Author's Computation, (2023).

4.5 Bound Test

After determining the lag length requirement of the ARDL analysis the study thus, conducted Bound Test to establish the existence of a long run relationship between the dependent variable and the explanatory variables (Belloumi, 2010). Based on the results of the Bounds test, we can conclude that there is evidence of cointegration between the variables in the model. The table below summarizes the results of the bounds test. The result of the bound test was shown in table 4.5 below:

Test	Statistic	Critical Value 5%	Critical Value 1%
F-Test	6.631	4.08	5.01
Bounds Test (Level)	9.63	4.07	5.04
Bounds Test (First Diff)	4.24	3.63	4.20

Source: Author's Computation, (2023)

The F-test statistic of 6.631 is greater than both the 5% and 1% critical values, which provides evidence of cointegration at the 5% significance level. The bounds test (level) statistic of 9.63 is greater than the 5% critical value of 4.07 and the 1% critical value of 5.04, which provides further evidence of cointegration. The bounds test (first diff) statistic of 4.24 is also greater than the 5% and 1% critical values, indicating evidence of cointegration in first differences. Overall, these results support the use of an ARDL model to estimate the long-run relationship between the variables in the model.



4.2.4 Model Estimation using ARDL Regression Analysis

The regression analysis conducted in this study employed the short run error correction model and long run co-integrating form following the autoregressive distributive lag (ARDL) methodology. The results ARDL regression model is presented in Table 4.6 below.

Table 4.6: Short and Long run Regression Coefficients model

Short Run Error Correction Model				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(ACGFS(-1))	0.169	0.077	2.198	0.032
D(CDCD(-1))	0.058	0.046	1.277	0.205
D(GDFA(-1))	0.179	0.081	2.210	0.031
D(INF(-1))	-0.089	0.022	-4.122	0.000
D(EXR(-1))	0.238	0.198	1.204	0.233
CointEq(-1)	-0.733	0.145	-5.058	0.000
C	0.295	0.076	3.872	0.000
Long Run Coefficients				
Variable	Coefficient	Std. Error	T-Statistic	Prob.
ACGFS(-1)	0.132	0.032	4.190	0.000
CDCD(-1)	0.065	0.021	3.056	0.004
GDFA(-1)	0.176	0.043	4.082	0.000
INF(-1)	-0.174	0.054	-3.214	0.002
EXR(-1)	0.068	0.046	1.467	0.148
C	0.109	0.026	4.168	0.000
R-squared	0.994614			
F-statistic (p-value)	738.64 (0.000)			
Durbin-Watson	1.926351			

Source: Author's Computations, (2023)

The table shows the coefficients, standard errors, t-statistics, and p-values for both the short run and long run ARDL model, including the error correction term (ECT). The error correction term (ECT) is included in the short run model to capture the extent to which the model adjusts to deviations from the long run equilibrium relationship. In this case, we can see that the coefficient on ECT (-1) is -0.733, which is statistically significant with a p-value of 0.000. This indicates that the model adjusts relatively quickly to deviations from the long run equilibrium relationship. Specifically, the short run model includes only the lagged values of the variables, while the long run model includes both the lagged values and the estimated equilibrium relationship.

The short-run ARDL model indicates that agricultural credit guarantee scheme (ACGFS, 0.169) significant at 1%, government direct funding to agriculture (GDFA, 0.179) significant at 5% and control variable of inflation rate (INF, -0.089) significant at 1% are all significant predictors of agricultural output growth in Nigeria in the short run, except the credit from commercial banks and the control variable of exchange rate (EXR) which are not significant in the short



run. In the long run model, all the coefficients remain statistically significant, with the exception of Exchange Rate EXR (-1) which is not significant at the 5% level. The signs of the coefficients are all consistent with our expectations based on economic theory. The coefficient of ACGFS in the long-run model is 0.33, indicating that a 1% increase in ACGFS will lead to a 0.33% increase in agricultural output growth in Nigeria in the long run.

According to the statistically significant positive coefficient of agricultural credit guaranteed scheme fund, an increase in agricultural credit guaranteed scheme fund of one percentage point would result in an increase in agricultural growth of about 0.169 percent in the short run and 0.132 percent in the long run vice versa. The results of Orok and Ayim (2017), Ewubare and Ologbadien (2019) as well as Nageri, and Akolo (2017) are consistent with the positive and substantial coefficient of agricultural credit guaranteed scheme fund in both the short and long run.

In the same direction, the statistically significant positive coefficient of government direct fund allocation to agricultural sector indicates that an increase of one percentage point in government direct fund allocation to agricultural sector will result in an increase of 0.179 percent in the short run and 0.174 percent in the long run in agricultural productivity and vice versa. The statement suggests that an increase in government direct fund allocation to the agricultural sector will result in a corresponding increase in agricultural productivity. This relationship has been examined in various studies in Nigeria. Some empirical sources that supported this statement are Abubakar et al. (2020) and Oni et al. (2017) who investigated the relationship between agricultural financing and agricultural productivity in Nigeria. The authors suggested that increased government direct fund allocation to agriculture would improve access to credit and other forms of support for farmers, leading to increased agricultural productivity.

However, the study revealed a statistically insignificant positive coefficient of (0.065) in the short run but a significant coefficient of (0.065) in the long run of credit dispensed by commercial banks on agricultural growth in Nigeria. Specifically, the relationship between credit dispensed by commercial banks and agricultural growth is mixed. While some studies have found a positive relationship between the two variables, others have found no statistically significant relationship or even a negative relationship. For instance, the studies of Olagunju et al. (2015) and Ajiboye and Olumide (2016) found that while access to credit from commercial banks had a positive effect on agricultural productivity, the effect was not statistically significant. Furthermore, a study conducted by Omotosho et al. (2017) also found that access to credit from commercial banks had a positive effect on agricultural production, but the effect



was not statistically significant. However, in contrary to the findings of Igyo, Simon, and Jane (2016), Adeola and Ikpesu reported a significant effects of commercial bank credit to agricultural growth in Nigeria.

From the two control variables of inflation rate and exchange rate introduced into the model only inflation with significant coefficient of (-0.089) in the short run and (-0.174) in the long run have a significant effects on agricultural growth in Nigeria at 1% respectively. The results suggest that inflation has a significant negative impact on agricultural growth in Nigeria both in the short run and long run. This means that an increase in inflation rate will lead to a decrease in agricultural growth in the country. The coefficient values (-0.089) in the short run and (-0.174) in the long run, indicate that the negative effect of inflation is more pronounced in the long run. The implication of this findings is that inflation has negative effects on agriculture growth in Nigeria. Firstly, inflation can lead to an increase in the cost of production, which can reduce the profitability of agriculture. This is because farmers will have to spend more on inputs such as fertilizers, seeds, and pesticides, which will lead to a decrease in their net income. Secondly, inflation can reduce the purchasing power of consumers, which can lead to a decrease in demand for agricultural products. This will lead to a decrease in the price of agricultural products, which will in turn lead to a decrease in the income of farmers. This outcome is in line with the studies of Ogunyomi and Ekunwe, (2018), Adebayo et al. (2018) and Ogunniyi et al. (2021)

Overall, the ARDL model suggests that increasing access to credit through ACGFS and commercial banks, as well as increasing government direct funding to agriculture, can contribute to the growth of the agricultural sector in Nigeria. Additionally, efforts to control inflation may also contribute to sustainable growth in the sector.

4.6.1 Model Diagnostic and Post Estimation Test

The diagnostic aspect of the result reveals that Durbin-Watson was 1.926351 which is close to 2; implies the absence of first order autocorrelation in the regression model (Field, 2005). Therefore, we were able to make valid prediction(s) with the equation. Moreover, the coefficient of multiple determinations - R-squared is 0.854614 which shows that 85.46% of the variation in the Agricultural growth (% GDP) in Nigerian is caused by the variations in the explanatory variables as explained by the model. This shows that about 14.54 % change in the dependent variable is caused by other variables not found in the equation but measured by the error term.



The F-statistics of the entire model is 738.64 and significant at 1 percent level of significance; hence the model is of good fit. To authenticate the reliability of the result, table 4.8 further reveals that the correlation result which is 1.765781 is not significant at 5 per cent indicating that the variables used in the model are not serially correlated while the normality test conducted reveals the Jarque-Bera test value of 0.354432 which is not significant at 5% level of significance implies that the variables in the model are normally distributed (Jacques and Bera, 1987). Furthermore, the heteroskedacity test shows that there is no heteroskedasticity in the research model as the Prob. Chi-Square (2) is also not significant at 5%. Also, residual test of the model is conducted using serial correlation and normality test to authenticate the reliability of the result (see table 4.7).

Table 4.7 Post Estimation Test

Table 4.8: Residual Test Result Breusch-Godfrey Serial Correlation Test		Normality Test		Breusch-Pagan-Godfrey Heteroskedasticity Test	
Obs*R-squared	2.65731	JarqueBera	0.354432	Obs*R-squared	0.2601
Prob.Chi-Square(2)	0.53221	Probability	0.681427	Prob.Chi-Square(17)	0.2212

Source: Author's Computations, (2023)

5.0

6.0 Conclusion and Recommendations

This study was concluded based on the results obtained from the analysis presented in the preceding session. The results suggested that the CBN ACGSF and government direct funding to agriculture have a positive and significant impact on agricultural growth in Nigeria in the both the short and long run. However, the short-run relationship between commercial bank credit and agricultural growth is not statistically significant but became significant in the long run. Inflation rate has a negative effect on agricultural output growth both in the short run and long run. The research came to the conclusion that agricultural finance is a key factor in determining agricultural growth in Nigeria. It was discovered that the agricultural credit guaranteed scheme fund, government direct funding to agriculture and credit that was distributed by commercial banks contributed favorably to agricultural growth in Nigeria. Therefore, in line with the supply-lead and demand follow hypothesis, any government intervention policies through any of these sources of agricultural finance will be more effective in boosting economic growth According to this theory, the acts of financial institutions serve as a beneficial technique for expanding the productive capacity of the economy. In the light of the above, the following recommendations were made in line with the results generated from the study:



- 1) The Federal Government of Nigeria should increase the allocation of its direct funding to agriculture to boost agricultural output growth in the short and long run. This will help to enhance agricultural productivity and provide the necessary support for farmers.
- 2) The CBN should encourage more commercial banks to provide credit to the agricultural sector as it has a positive effect on agricultural output growth in the long-run. This can be achieved through targeted policies and incentives for banks to invest in agriculture.
- 3) The CBN should strengthened and expanded its Agricultural Credit Guarantee Scheme (ACGSF) to provide more credit to farmers, particularly smallholder farmers. This can help to improve access to credit for farmers and provide the necessary resources for them to invest in their farms.
- 4) The Nigerian government should maintain low inflation rates to enhance the short and long run agricultural output growth. This can be achieved through sound monetary policies and a stable macroeconomic environment. This will help to provide a stable and predictable business environment for farmers and other stakeholders in the agricultural sector.



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ANTIMICROBIAL ACTIVITY OF BUFFALO CHEESES

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ABSTRACT

Bioactive peptides are specific protein fragments that positively affect and promote health. They contain 3-20 amino acids and their function depends on the amino acid sequence. Bioactive peptides are inactive within the parent protein molecule and released through enzymatic hydrolysis during gastrointestinal digestion or food processing. The use of preservatives which increase the shelf life of foods is limited due to their negative effects on health. In recent years, the addition of natural antimicrobial components and/or the formation of them through fermentation is preferred in order to eliminate these problems. Antimicrobial peptides are important supporters for immune system when the organism is subjected to pathogens, helping to reduce the risk of chronic diseases. Recently, milk proteins and dairy products were proved to have large number of bioactive peptides showing antimicrobial, antioxidant, antihypertensive, antidiabetic, hypolipidemic, anti-inflammatory, antiproliferative, anticarcinogenic, antimutagenic, hepatoprotective, cardioprotective, immunomodulatory, antithrombotic, mineral binding and opioid activities. Among dairy products, milk protein hydrolysates, fermented dairy products like yogurt and kefir, and cheese are the most defined sources of these peptides. Cheese can be consumed fresh or ripened after the cheesemaking process. Several bioactive peptides are derived by the endogenous milk enzymes, the enzymes used as coagulants like rennet, and the enzymes of lactic acid bacteria used as starter culture. Especially different kinds of cheese contain a wide variety of bioactive peptides based on the milk type, starter culture, and cheesemaking and ripening processes. Buffalo, which is widely cultivated in about 40 countries around the world, is a farm animal with high economic value. It is a valuable raw material for meat and dairy products, with resistance to animal diseases and ease of care conditions, especially making good use of roughage and quality feed and benefiting from pasture conditions. Since buffalo milk and cheese gain attention with their bioactive peptide content nowadays, this presentation focuses on the antimicrobial activity of buffalo cheeses.

Keywords: Bioactivity, Antimicrobial, Buffalo, Cheese



1. Introduction

Bioactive peptides are specific protein fragments that positively affect and promote health, by binding to specific receptors on target cells to modulate physiological functions (FitzGerald and Murray, 2006). They are encrypted within the amino acid sequences of proteins (Clare and Swaisgood, 2000). They contain 3-20 amino acid residues and their function depends on the amino acid sequence and composition. Most of these peptides have more than one function (Clare and Swaisgood, 2000; FitzGerald and Murray, 2006; Korhonen, 2009). Bioactive peptides are inactive within the parent protein molecule and released through enzymatic hydrolysis during gastrointestinal digestion by enzymes like pepsin or trypsin, and during food processing by the proteolytic enzymes of microorganisms or the enzymes taking part in production (Gobbetti et al., 2002; Silva and Malcata, 2005; FitzGerald and Murray, 2006;).

Over the past two decades, bioactive peptides of milk and dairy products gained serious attention. Milk proteins are the main sources of bioactive peptides with antimicrobial, antioxidant, antihypertensive, antidiabetic, antiproliferative, immunomodulatory, antithrombotic, mineral binding and opioid activities (Clare and Swaisgood, 2000; Silva and Malcata, 2005; Korhonen and Pihlanto, 2006; Korhonen, 2009; Brandelli et al., 2015). Among dairy products, milk protein hydrolysates, fermented dairy products like yogurt and kefir, and cheese are the most defined sources of these peptides. Cheese can be consumed fresh or ripened after the cheesemaking process. Several bioactive peptides are derived by the endogenous milk enzymes like plasmin, the enzymes used as coagulants like rennet (chymosin and pepsin), and the enzymes of lactic acid bacteria used as starter culture (Gobbetti et al., 2002; Barac et al., 2016; Fialho et al., 2018). Also, non-starter lactic acid bacteria take an important part especially in the production of traditional cheeses (Sahingil et al., 2014). Especially different kinds of cheeses contain a wide variety of bioactive peptides based on the milk type, starter culture, cheesemaking (heat treatment, homogenization) and ripening processes (time, temperature, relative humidity and packaging) (Korhonen and Pihlanto, 2006; Gomez-Ruiz et al., 2007; Sahingil et al., 2014). The amount of bioactive peptides increases with proteolysis during cheese ripening (Ryhänen et al., 2001; Mushtaq et al., 2016), however in the later stages of ripening, the activity may decrease due to the breakdown of bioactive peptides because of the advanced proteolysis (Pritchard et al., 2010).

Buffalo, which is widely cultivated in about 40 countries around the world, is a farm animal with high economic value. It is a valuable raw material for meat and dairy products, resistant to animal diseases and care conditions are easy. It uses roughage and quality feed very well and



benefits from pasture conditions. Buffalo milk constitutes the 15% of the total worldwide milk production (FAO, 2022), being a potential substitute for cow milk. The cheese yield is high according to the high protein and fat content. Coagulation time with rennet is shorter and less chymosin is needed for the cheesemaking process (Islam et al., 2014).

In recent years, the addition of natural antimicrobial components and/or the formation of them through fermentation and food production is preferred in order to eliminate the problems caused by the use of synthetic preservatives. Antimicrobial peptides are found to be important supporters for immune system when the organism is subjected to pathogens, helping to reduce the risk of chronic diseases. Demand for more natural foods are increasing, so researches are focused on the use of milk protein peptides as preservatives and functional ingredients. Since buffalo milk and cheese gain attention with their bioactive peptide content, this presentation focuses on the antimicrobial activity of buffalo cheeses.

2. Antimicrobial Activity Of Milk Proteins And Peptides

The antimicrobial peptides exhibit activities towards microorganisms by neutralizing the pathogenic effect of lipopolysaccharides, enhancing phagocytosis, gathering immune cells at inflammatory sites (Elsbach, 2003), damaging the microbial membrane (Nissen-Meyer and Nes, 1997) and enhancing the progress of monocytes, dendritic cells and T-cells (Davidson et al., 2004). Milk contains antimicrobial immunoglobulins such as lactoperoxidase, lysozyme and lactoferrin, as well as peptides and proteins that act like antibiotics (Joerger, 2003). Milk proteins consist of caseins (80%) and whey proteins (20%). Whey proteins are α -lactalbumin, β -lactoglobulin, proteose peptone, immunoglobulins, and serum albumin, whereas caseins are α_{s1} -casein (α_{s1} -CN), α_{s2} -casein (α_{s2} -CN), β -casein, and κ -casein.

Lactenin is the first antimicrobial peptide isolated from milk, which was obtained by treating milk with rennet (Jones and Simms, 1930) and it shows antimicrobial activity against pathogenic streptococci. After that, casecidins were identified by hydrolysis with chymosin (Lahov and Regelson, 1996) and found to have antimicrobial activities against *Staphylococcus aureus* (*S. aureus*), *Escherichia coli* (*E. coli*) and *Salmonella typhimurium* (Tidona et al., 2009). Isracidin was obtained by treating α_{s1} -CN with chymosin, and is effective in the treatment of *S. aureus*, *Candida albicans* and *Listeria monocytogenes* (*L. monocytogenes*) based infections (Lahov and Regelson, 1996). Also, it protects dairy animals from mastitis, which is a serious mammary gland infection lowering the milk quality. It has been determined that peptides released from α_{s1} -CN and α_{s2} -CN have antimicrobial activity against bacteria such as *Escherichia*, *Helicobacter*, *Listeria*, *Salmonella* and *Staphylococcus* (Korhonen and Pihlanto,



2006), and fragments of κ -casein against *E. coli*, *Serratia marcescens*, *Staphylococcus carnosus*, and *Listeria innocua* (*L. innocua*) (Lopez-Exposito et al., 2006).

Whey protein hydrolysis with trypsin and chymotrypsin increased the antimicrobial activity against *E. coli* and *L. monocytogenes* (Salami et al., 2010). The hydrolysates of whey proteins of camel colostrum inhibited the growth of *E. coli* XL1 and *L. innocua* LRGIA0 (Jrad et al., 2014). Moreover, the hydrolysis of goat milk whey protein concentrate with human gastric juice significantly inhibited *L. monocytogenes* (Almaas et al., 2008) and *E. coli* K12 growth (Almaas et al., 2011).

3. Antimicrobial Activity Of Buffalo Cheeses

There are sufficient number of studies verifying the antimicrobial activity of different kinds of cheeses showing extensive inhibition against Gram-positive and Gram-negative bacteria, molds and yeasts (Sultan et al., 2018). Bactericidal activity was determined against *E. coli* in Minas cheeses (Fialho et al., 2018). The water soluble extracts (WSEs) of Emmental de Savoie and Asiago d'Allevo inhibit the growth of the *L. innocua* LRGIA01 (Nguyen Thi et al., 2014), and also inhibition of *L. innocua* LRGIA01 and *L. monocytogenes* 162 in Asiago d'Allevo cheese was achieved (Lignitto et al., 2012). Cachoeirinha and PEVenturosa cheeses show high antimicrobial activity against *E. coli*, *Enterococcus faecalis*, *Pseudomonas aeruginosa* and *Bacillus subtilis* (Silva et al., 2012). Significant antimicrobial peptide activities were observed in Cheddar cheeses (Pritchard et al., 2010).

Despite the large number of cheese studies, there are limited number of studies done on the antimicrobial activity of buffalo cheeses. In a study where peptides from different Italian cheeses' WSEs were evaluated for their antimicrobial activity, inhibition zones of 3 to 6 mm were obtained with Mozzarella WSE towards the indicator strain *Latilactobacillus sakei* A15 (Rizello et al., 2005). The water soluble peptide fraction from the fresh buffalo cheeses showed antimicrobial activity against *Enterococcus faecalis* (*E. faecalis*) and *Bacillus subtilis* (da Silva et al., 2019). Mozzarella cheese fortified with oregano showed antimicrobial activity against *E. coli*, *L. monocytogenes* and *E. faecalis* during 30 days of storage (Yerlikaya et al., 2021). When rosemary and peppermint were added during cheesemaking process, *S. aureus* growth was inhibited in early storage, and rosemary and oregano added Mozzarella samples showed antimicrobial activity against *Bacillus cereus* on the 10th day. However, there was no adverse activity on the growth of yeasts and moulds. The WSEs of Mozzarella inhibited *L. monocytogenes*, *Listeria ivanovii* and *E. coli* MC4100 growth significantly (Theolier et al.,



2014). Moreover, WSEs delayed the spore germination of *Fusarium* spp., *Aspergillus versicolor* and *Mucor racemosus*, showing antifungal activities.

4. Conclusion

The buffalo cheese offers a great potential of health benefits and a different aromatic and tasty cheese alternative. Its antimicrobial activity on different types of bacteria, yeasts and moulds are supported by more than one study. Since the amount of bioactive peptides increases with proteolysis during cheese ripening, the antimicrobial activity of ripened buffalo cheeses should be studied. However, the activity may decrease in the later stages due to the advanced proteolysis, therefore it is important and advised to determine the stage of ripening when the antimicrobial activity of buffalo cheeses are at the most beneficial point and offer a true alternative for food preservation.



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GIDA SEKTÖRÜNDE E-TİCARET VE COVID-19 PANDEMİSİNİN ETKİSİ

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ÖZET

Ticari faaliyetler yaşadığımız dönemde teknolojinin de desteği ile farklı bir boyut kazanarak gelişmeye devam etmektedir. Temelde elektronik ticaret siteleri bu gelişime oluşumunda etkilidir. Kısaltılmış haliyle e-ticaret sitesi adıyla bilinen bu siteler 2000'li yılların başından itibaren hızla gelişen bir ticaret türü haline gelmiştir. Geleneksel ticarete göre birçok farkı bulunan e-ticaret, günümüzde çalışma hayatı, kentleşme, ulaşım sorunlarının olması gibi genel nedenler sebebiyle tüketicilerin ilgisini kazanmış ve tüketicilere büyük avantajlar sağlamaktadır. E-ticaretin pratik, kolay ve hızlı olması en önemli avantajlarından biri olarak gösterilebilmektedir. Bunun yanında işletmeler için e-ticaret alanı fiziksel olarak sınırlı kalmayarak geniş pazarlar sayesinde hedef kitlelerine ulaşabilirliği artırır. Bir çok işlemin elektronik olarak gerçekleştirilmesiyle pazarlama, satış ve dağıtım maliyetleri azalmaktadır. Sermaye masrafının düşük olmasıyla bir şirket daha kolay ve hızlı olarak dünya genelinde daha fazla müşteri ve tedarikçiye ulaşabilmektedir. Yeni bir satış kanalıdır. Gelişen dünyamızda e-ticaretin de her geçen gün gelişmesiyle birlikte gıda ürünlerinin e-ticaret üzerinden pazarlaması ve alışverişi imkanını da ortaya çıkarmıştır. E-gıda ticareti gıda pazarlamasında mühim bir yere sahiptir. İnternet kullanım oranlarının oldukça önemli bir oranda yaygınlaşması tüketicilerin ihtiyacı olan gıda ürünlerine daha hızlı ve ekonomik şekilde sahip olma isteğinin de artmasına sebep olmuştur. 2019 yılında Çin'in başkenti Wuhan'da ortaya çıkan virüs tüm dünyayı etkilemiş COVID-19 adı verilen bu virüsün yarattığı pandemi ile kişilerin yaşam tarzlarında değişiklikler yaratırken pek çok yeni alışkanlık edinmelerine de sebep olmuştur. Bu alışkanlık ve yaşam tarzlarındaki değişiklikler arasında gıda tüketimi ve satın alma davranışlarında da etkiler görülmektedir. Özellikle pandeminin ortaya çıktığı ilk dönemde stoklama, tüketicilerin temel ve zorunlu ürünlerin alımına yönelmiş olması, çevrimiçi kanalların tercihinin artması, yerel ve sağlıklı ürünlere talebin artması, değişen marka tercihleri, alışverişte geçirilen sürenin azalması, alışveriş miktarının artması, panik alımlar gibi davranışların sokağa çıkma kısıtlamalarının da etkisiyle kişilerin davranışlarında farklılıkların ortaya çıktığı görülmektedir. Pandeminin bir sonucu olarak 2019 yılı sonrasında günümüze değin e-ticaretin gıda alanında kullanımı açısından büyük gelişmeler-yenilikler kaydedilmektedir ve bu değişimler günümüzde de halen devam etmektedir.

Anahtar Kelimeler: Ticaret, E-Ticaret, Gıda, COVID-19, Pandemi



E-COMMERCE AND THE IMPACT OF THE COVID-19 PANDEMIC IN THE FOOD INDUSTRY

ABSTRACT

Commercial activities continue to develop by gaining a different dimension with the support of technology in the period we live in. Basically, electronic commerce sites are effective in the formation of this development. These sites, known as e-commerce sites in abbreviated form, have become a rapidly developing type of commerce since the beginning of the 2000s. E-commerce, which has many differences compared to traditional commerce, has gained the attention of consumers due to general reasons such as working life, urbanization, transportation problems and provides great advantages to consumers. One of the most important advantages of e-commerce is that it is practical, easy and fast. In addition, the e-commerce area for businesses is not limited physically, but increases the reach of their target audiences thanks to large markets. By performing many transactions electronically, marketing, sales and distribution costs are reduced. With low capital expenditure, a company can reach more customers and suppliers around the world more easily and quickly. It is a new sales channel. With the development of e-commerce in our developing world, the opportunity to market and exchange food products through e-commerce has emerged. E-food trade has an important place in food marketing. The widespread use of the Internet at a very significant rate has led to an increase in the desire of consumers to have the food products they need faster and more economically. The virus that emerged in Wuhan, the capital of China in 2019, affected the whole world. Among these changes in habits and lifestyles, there are also effects on food consumption and purchasing behaviors. Especially in the first period of the pandemic, the tendency of consumers to buy basic and compulsory products, the increase in the preference of online channels, the increase in the demand for local and healthy products, the changing brand preferences, the decrease in the time spent in shopping, the increase in the amount of shopping, the panic buying, etc. It is seen that there are differences in the behavior of individuals with the effect of As a result of the pandemic, great developments and innovations have been recorded in the use of e-commerce in the field of food since 2019, and these changes still continue today.

Keywords: Commerce, E-Commerce, Food, COVID-19, Pandemic



1. Giriş

Milenyum çağı itibariyle internet, hayatlarımızda önemli ve etkili bir araç olarak yer edinmeye başlamıştır. Son yıllarda sosyal medyanın da etkisiyle internet üzerinden alışveriş oldukça gelişerek kişiler arasında yaygınlaşmıştır. İletişim teknolojilerinin hızla gelişmesi ile dünyada yeni bir ekonomik düzen oluşmaya başlamıştır. Temelde elektronik ticaret siteleri bu gelişimine oluşumunda etkilidir. Kısaltılmış haliyle “e-ticaret sitesi” adıyla bilinen bu siteler 2000’li yılların başından itibaren hızla gelişen bir ticaret türü haline gelmiştir. Ülke sınırları internet sayesinde ortadan kalkmış satıcı ile alıcı elektronik ortamda ticari işlemler yapabilmeye başlamıştır. Geleneksel ticarete göre birçok farkı bulunan e-ticaret, günümüzde çalışma hayatı, kentleşme, ulaşım sorunlarının olması gibi genel nedenler sebebiyle tüketicilerin ilgisini kazanarak tüketicilere büyük avantajlar sağlamaktadır. E-ticaretin pratik, kolay ve hızlı olması en önemli avantajlarından biri olarak gösterilebilmektedir. Gelişen dünyamızda e-ticaretin her geçen gün gelişmesiyle birlikte gıda ürünlerinin e-ticaret üzerinden pazarlaması ve alışverişi imkanı da ortaya çıkmıştır.

E-gıda ticareti gıda pazarlamasında mühim bir yere sahiptir. İnternet kullanım oranlarının oldukça önemli bir oranda yaygınlaşması tüketicilerin ihtiyacı olan gıda ürünlerine daha hızlı ve ekonomik şekilde sahip olma isteğinin de artmasına sebep olmuştur. Teknolojik gelişmelerin ve yeniliklerin etkisi ile ürün paketleme alanında oluşan gelişmeler ve lojistik imkanlarının iyileşmesiyle ürünlerin tüketiciye ulaşması kolaylaşmış ve hızlanmıştır. Etkin lojistik kullanımı sayesinde ürünün tüketiciye ulaştırılma imkanları iyileşerek ürünlerin fiyatlarında yeni avantajların doğmasını sağlamıştır. Böylelikle tüketiciler gıda ürünlerine daha hızlı ve kolay olarak ulaşabilmektedir. Bunun sonucunda ürün saklama koşullarından kaynaklanan bozulma oranlarının azalmasını sağlamıştır. Gelişen imkanlar ve teknolojinin sağladıkları sayesinde e-ticaretin gıda alanında gelişimi son yıllarda hız kazanmış ve tüketicilerin satın alma tercihlerinde önemli bir yer edinmiştir.

01 Aralık 2019 tarihinde Çin’in Hubei Bölgesi’nin başkenti Wuhan’da ortaya çıkan virüs tüm dünyayı etkilemiş ve halen etkileri devam etmektedir. Dünya Sağlık Örgütü (DSÖ), 11 Şubat 2020 tarihinde bu virüse ‘COVID-19’ adını vermiştir. Bu yaşanan salgın, kişilerin yaşam tarzlarında değişiklikler yaratırken pek çok yeni alışkanlık edinmelerine de sebep olmuştur. Bu alışkanlık ve yaşam tarzlarındaki değişiklikler arasında gıda tüketimi ve satın alma davranışlarında da etkiler görülmektedir. Özellikle pandeminin ortaya çıktığı ilk dönemde stoklama, tüketicilerin temel ve zorunlu ürünlerin alımına yönelmiş olması, çevrimiçi kanalların tercihinin artması, yerel ve sağlıklı ürünlere talebin artması, değişen marka tercihleri,



alışverişte geçirilen sürenin azalması, alışveriş miktarının artması, panik alımlar gibi davranışların sokağa çıkma kısıtlamalarının da etkisiyle kişilerin davranışlarında farklılıkların ortaya çıktığı görülmektedir. Pandeminin bir sonucu olarak 2019 yılı sonrasında günümüze değin e-ticaretin gıda alanında kullanımını açısından büyük gelişmeler-yenilikler kaydedilmektedir ve bu değişimler günümüzde de halen devam etmektedir.

Çalışmada e-ticaret kavramına değinilerek gıda sektöründeki önemi vurgulanmaya çalışılmıştır. Ayrıca COVID-19 pandemisinin sektörün gelişimine etkisi tartışılmıştır.

2. E-Ticaret kavramı

Ticaret, eski çağlardan beri var olan ve günümüzde insanlar için oldukça önemli olan bir faaliyettir. Türk Dil Kurumu Sözlüğü (TDK) “Mal, ürün, vb. alım satımı; kazanç sağlamak amacıyla yürütülen alım satım etkinliği; alışveriş sonucu elde edilen ve yararlanılan fiyat farkı ve kâr.” olarak ticareti tanımlamaktadır (Zeyrek 2015).

Kavramsal açıdan mal veya hizmetin alınması-satılması olarak açıklanmakta olan ticaret kavramı elektronik ortamda "elektronik ticaret" olarak adlandırılmaktadır. Elektronik ticaret internet aracılığı ile ürünlerin tanıtımı, satışı, ödemesi ve dağıtımını işlemlerinin yapılmasını sağlayan bir sistemdir (Küçükylmazlar 2006).

Ticari faaliyetler yaşadığımız dönemde teknolojinin de desteği ile farklı bir boyut kazanarak gelişmeye devam etmektedir. İletişim teknolojilerinin hızla gelişmesi ile dünyada yeni bir ekonomik düzen oluşmaya başlamıştır. Temelde elektronik ticaret siteleri bu gelişimin oluşumunda etkilidir. Kısaltılmış haliyle e-ticaret sitesi adıyla bilinen bu siteler 2000’li yılların başından itibaren hızla gelişen bir ticaret türü haline gelmiştir. Geleneksel ticarete göre birçok farkı bulunan e-ticaret, günümüzde çalışma hayatı, kentleşme, ulaşım sorunlarının olması gibi genel nedenler sebebiyle tüketicilerin ilgisini kazanmış ve tüketicilere büyük avantajlar sağlamaktadır.

E-ticaretin pratik, kolay ve hızlı olması en önemli avantajlarından biri olarak gösterilebilmektedir. Bunun yanında işletmeler için e-ticaret alanı fiziksel olarak sınırlı kalmayarak geniş pazarlar sayesinde hedef kitlelerine ulaşabilirliği artırmaktadır.

Bir çok işlemin elektronik olarak gerçekleştirilmesiyle pazarlama, satış ve dağıtım maliyetleri azalmaktadır. Böylece talep değişiklikleri sonucu pazarda da değişiklikler yapmak kolaylaşmaktadır. Sermaye masrafının düşük olmasıyla bir şirket daha kolay ve hızlı olarak dünya genelinde daha fazla müşteri ve tedarikçiye ulaşabilmektedir. E-ticaret sayesinde kullanıcılar özel hizmet imkanı bulabilmekte, etkili iletişim kurabilmektedir. E-ticaret, yeni bir alışveriş şekli ve yeni bir kültür oluşturmanın yanında farklı kültürlerdeki tüketicilere de hitap



edebilmektedir. İnternetin yaygınlaşması ile bu kültür kapsamı genişlemektedir. Elektronik ticaret, ürün, bilgi, ve hizmetlere dünyanın her yerinde kolay erişim imkanı sağlamaktadır.

Elektronik ticaretin 7/24 yapılabilme imkanı, zaman problemini ortadan kaldırmaktadır. E-ticaretin sağladığı istatistiklerle birlikte tüketici alışkanlıkları, tercihleri ve demografik özellikleri saptanabilmektedir ve bu bilgiler sayesinde “kişiye özel” ticari ilişki imkanı oluşabilmektedir. Bu özellikler sayesinde e-ticaretin hem tüketiciler hem de işletmeler bakımından oldukça önemli bir ticaret şekli olduğu görülmektedir.

2.1. E-Ticaret türleri

Ticaret türleri, elektronik ticaretin yapıldığı tarafları belirtmektedir ve kendi içinde beş farklı türe ayrılmaktadır. Bunlar Çizelge 1’de özetlenmiştir.

Çizelge 1. E-Ticaret Türleri (Öztaş 2009)

B2B (İşletmeden İşletmeye) E-ticaret	İşletmelerden işletmelere satış yapılan e-ticaret türüdür. Elektronik ödemelerde elektronik veri değişimini (EDI: (Electronic Data Interchange) sağlar. İşletmeler arasında e-ticaret ile şirket verimlilikleri artar, maliyetler düşer ve müşteri ile doğrudan bağlantı kurulabilir.
B2C (İşletmeden Tüketicie) E-ticaret	Çevrimiçi işletmeler ve tüketiciler arasında yapılan e-ticaret şeklidir. (Örneğin; www.alibaba.com, www.trendyol.com) Bu ticaret modelinde bilginin önemi devamlı bir yenilenme durumu söz konusudur.
C2C (Tüketiciden Tüketicie) E-ticaret:	Açık arttırma siteleri sayesinde, (Örneğin; E-bay, Gardrops, Dolap, Sahibinden ve Let-Go gibi) tüketicilerin birbirlerine satış yaptıkları e-ticaret türüdür. Tüketiciler ürüne teklif verme ya da satış için ürünü ekleyerek arama, reklam, takas işlemlerini sağlama gibi araçlardan faydalanırlar.
2G (Vatandaştan Devlete):	Vatandaş (Birey)-devlet arası uygulanan e-iletişim, e-işletmelerdir.
G2G (Devletten Devlete):	Devlet kurumlarıyla devletin birbiriyle olan e-iletişim şeklidir.

Tüm bu e-ticaret şekillerinde kaynak satıcı, hedef alıcı/tüketicidir. Bu e-ticaret şekillerinde satıcı bir işletme veya bir kişi olabilir. Tüketici ise bir devlet kurumu ya da bir işletme olabilmektedir.

Günümüzde en çok işletmeden işletmeye ve işletmeden tüketiciye e-ticaret uygulamaları yaygındır. İşletmeden tüketiciye e-ticaret dünyada ve ülkemizde git gide yaygınlaşan ve çeşitliliği çoğalan e-ticaret şekli olmaya devam etmektedir.

2.2. E-Ticaretin gelişimi

90’lı yıllarda dünyada internet kullanımının yaygınlaşmaya başlamasıyla birlikte 1992 yılı itibariyle internet sağlayıcıları tüketicilere internet üzerinden parekande olarak ürün satışı için



imkan sunmuştur. Böylece tüketici/kullanıcılar internet aracılığıyla ürün ve hizmet alabilmişlerdir. E-ticaretin tarihsel olarak gerçekleşen teknolojik gelişmeler neticesinde aşağıdaki gibi farklı dönemlerde değişiklikler göstermektedir (Çizelge 2) (Yıldırım 2022).

Çizelge 2. Elektronik Ticaretin Tarihsel Gelişimi (Demirdöğmez ve ark. 2018)

1995-2000 dönemi	2001-2006 dönemi	2007'den günümüze dönemi
Teknolojiye odaklanma Gelir artışı üzerinde durma Girişimciliğin finansmanı Girişimcilerin etkin olması Araçların ortadan kalkması Yeni ve iyi fiyatlar İşletmelerin çevrimiçi stratejileri İlk olan firmalarda avantajlar Daha az karmaşık olan perakende ürünler	İş odaklı olan gelişmeler Temel hedefin kâr ve kazanç olması Geleneksel olan finansman Güçlü bir yönetim ve düzenleme Büyük ölçekte geleneksel işletmeler/firmalar Araçların aktifleşmesi Marka, pazarlar ve ağların gelişimi Daha karmaşık ve yeni stratejilerin geliştirilmesi Takip edebilme gücü ve tamamlama Perakende mal ve hizmetler	Mobil uygulamalar ve teknolojinin ticaret odaklı olması Kullanıcı ve sosyal ağlara daha da önem verilmesi Devletin daha kapsamlı olarak denetlemelere başlaması Yeni pazarların yaygınlaşması Seçkin ve gelişmiş pazarlarda ticari ürün rekabetler Sektöre ilk girenlerin daha avantajlı olması Perakende hizmetler ve içerik zenginliği

İnternet kullanımının yaygınlaşması ile birlikte elektronik ticaret, ticari faaliyetlerin gerçekleştirilmesinde farklı ve etkin bir yöntem olarak gelişmeye devam etmektedir. Elektronik ticaret son yıllarda gerçekleşen ve bilgi paylaşımını kolaylaştıran teknolojik gelişmelerin bir sonucudur. Günümüzde internet kullanıcı kitlesindeki büyüme, internetin düşük maliyetli hizmet vermesi, kredi kartı kullanımının artması ve daha kolay hale gelmesi ile e-ticaretin kullanımı ve yaygınlaşmasında yükselmekte olan bir grafik çizmektedir. Bu sebeple teknolojide yaşanan gelişmeler elektronik ticaretin kullanımını yaygınlaştırmıştır ve bu süreç halen daha gelişerek yaygınlaşmaya devam etmektedir.

2.3. E-Ticaretin türkiye’de gelişimi

1992 yılında Merkez Bankası ve diğer bankaların arasında başlamış olan Elektronik Fon Transferi (EFT) işlemleri Türkiye’de elektronik ticaretin ilk uygulamasıdır. İkinci uygulama ise UNCTAD tarafından İGEME’nin 1995 yılında Ankara ticaret noktası seçilmesi adımıdır (Aydemir 2004).

1997 yılı içerisinde Bilim ve Teknoloji Yüksek Kurulu 25/08/1997 tarihli, 97/3 sayılı BTYK Kararı ile elektronik ticaret ağının kurulmasına karar vermiştir. Bu gelişme ile birlikte aynı yıl içerisinde TÜBİTAK TUENA’yı başlatmıştır. Bu proje Türkiye’nin enformasyon altyapısının görünüşünü ve kamunun konuya yaklaşımını ortaya koymaktadır. Ardından Bilim ve Teknoloji



Yüksek Kurulu kararı ile üniversite, özel sektör ve kamu katılımcıları ile ETKK oluşturulmuştur (Öztaş 2009).

1999 yılında ülkemizde ilk sanal ortamda bulunan alım-satım sitesi açılmıştır ve kurulduğu tarihten bugüne kadar internet sitelerinden yapılan alışverişlerde oldukça yüksek artış görülmektedir.

Günümüzde ülkemizdeki elektronik ticaret yapılması yüksek oranda işletmeden tüketiciye (B2C) e-ticaret şekliyle yapılmaktadır. Ancak dünya genelinde işletmeden işletmeye satış da e-ticaret uygulamalarında oldukça yaygın olarak kabul görmektedir. Türkiye’de öncelikle büyük ölçekli firmalar ve daha bir çok şirket tedarikçi ve bayileri ile gerçekleştirdiği işlemlerde internette faydalanmaktadır. İşletmeden işletmeye (B2B) satış modelinde ilk örnek Arçelik firması tarafından görülmüştür. Bankalar hizmetlerini internet ve uygulamalar üzerinde geliştirmesiyle bu konuda örnek olarak önden gitmektedir.

Bankalararası Kart Merkezi (BKM) üzerinden alınan veriler doğrultusunda Türkiye’de gerçekleşmiş olan elektronik ticaret hacminin 2018-2022 yılları arasında verileri Çizelge 3’de gösterilmektedir.

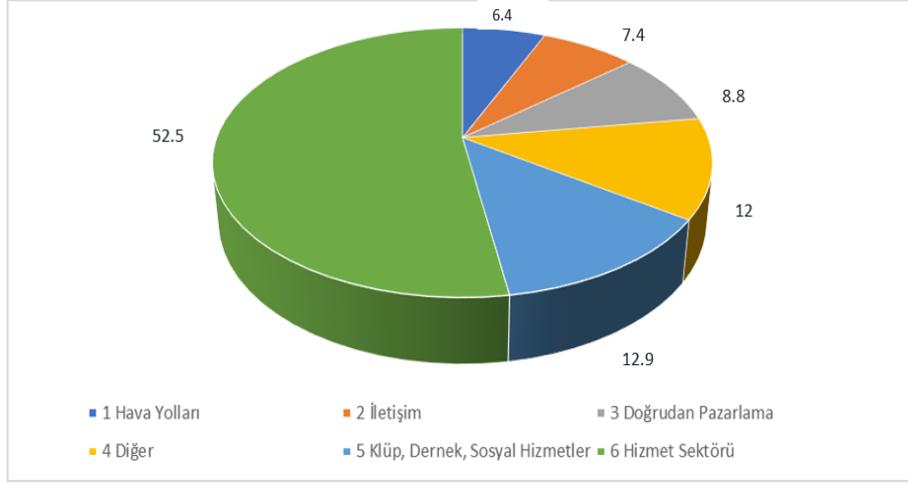
Çizelge 3. Bankalar Aracılığıyla Türkiye’de Yapılan E-Ticaret Hacmi (2018-2022)
(<https://bkm.com.tr/internette-yapilan-kartli-odeme-islemleri/> 30.12.2022)

Yıllara Göre Dağılımı	İşlem Adedi	İşlem Tutarı (Milyon TL)
	Yerli ve Yabancı Kartların	Yerli ve Yabancı Kartların
	Yurt İçi Kullanımı	Yurt İçi Kullanımı
2022	1.186.770.109	582.664,57
2021	1.351.877.076	454.507,77
2020	848.930.405	260.350,13
2019	607.072.794	190.110,48
2018	444.147.253	138.910,97

Ülkemizde yavaş adımlarla başlayan sanal alışveriş günümüzde sosyal medyanın da yaygınlaşmaya ve kullanılmasıyla birlikte oldukça yüksek oranlarda kullanılmaya başlanmıştır. 2018 ve 2022 yılları arasında görülen (Çizelge 3) Yerli ve Yabancı Kartların Yurt İçi Kullanımına dair işlem adedi ve işlem tutarı (milyon TL) her geçen yıl artmaktadır.



Grafik 1. 2008 Yılı E-Ticaret Hacminin Sektörel Dağılımı (Yeniova 2008)



2008’de Yeniova’nın yaptığı çalışmaya göre işlem hacmi içindeki sektörel dağılım Grafik 1’de gösterildiği gibidir. Grafığe göre e-ticaret ile gerçekleştirilen alışverişin yüzde 52,5 oranında hizmet sektörü, yüzde 12,9 oranında kulüp, dernek, sosyal hizmetler, yüzde 8,8 oranında doğrudan pazarlama, yüzde 7,4 oranında telekomünikasyon ve yüzde 6,4 oranında havayollarından oluştuğu görülmektedir.

Ülkemizde 1990’lı yılların ortasından sonra gelişmeye başlayan elektronik ticaret pazarında ilk faaliyet göstermeye başlayan firmalar hazır giyim sektöründeki firmaların internet sitelerini kurmalarıyla olmuştur. Daha sonraki dönemde diğer farklı sektörden firmalar da pazara dahil olarak internette alışverişin yaygınlaşmaya başlamasıyla birlikte e-ticaret sektöründe hızla büyüme kaydedilmeye başlamıştır. Bu dönemde yeni ve geliştirilmiş ödeme sistemlerinin yaygınlaşması ve gelişmesi de sektördeki bu gelişime katkıda bulunmuştur.

Ülkemizde elektronik ticarete yönelik kanun düzenlemelerinin olmamasından dolayı 2008 yılında, Dış Ticaret Müsteşarlığı ve tüm diğer ilgili kamu kurum ve kuruluşlarının katkılarıyla “Elektronik Ticaret Direktifi Çalışma Grubu” oluşturularak; 2015 yılında 6563 Sayılı “Elektronik Ticaretin Düzenlenmesi Hakkında Kanun” yürürlüğe girmiştir. Türkiye’de e-ticaret sektörünün gelişiminde genç nüfusun yoğunluğu ve internet, kredi kartı kullanımının artmasının etkili olduğu düşünülmektedir.

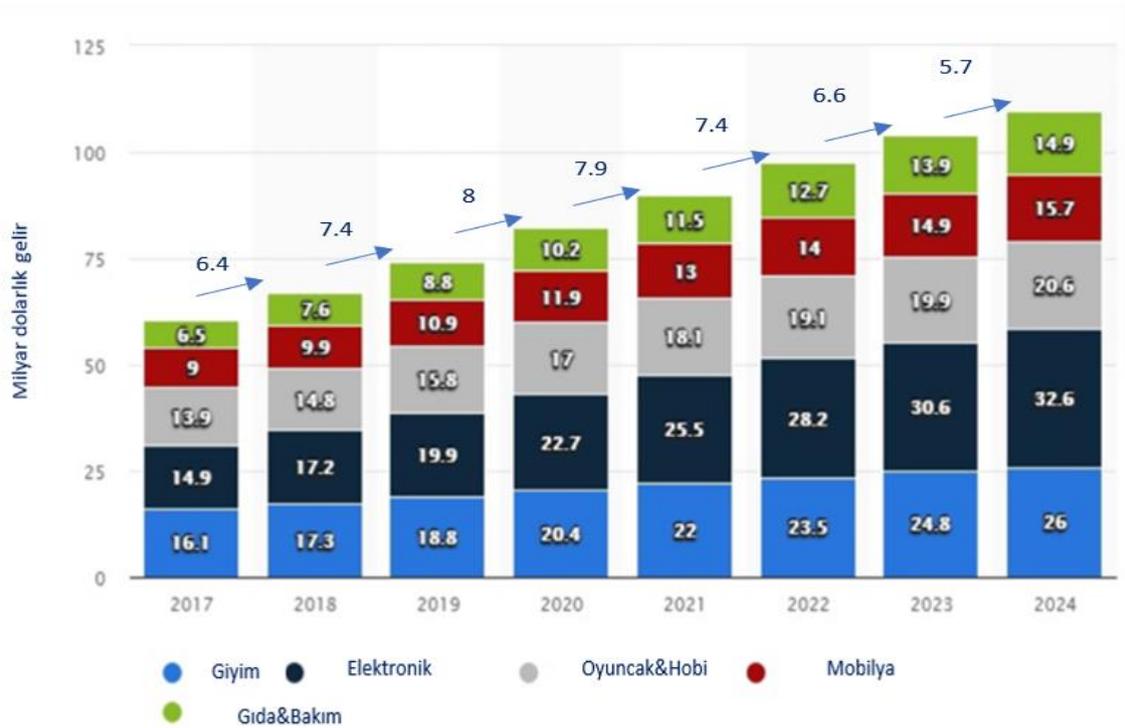


Grafik 2. Türkiye’de E-Ticaret Pazar Büyüklüğü (milyar TL) (Tuncalı 2020)



E-ticaretin sektöründe 2015-2019 yılları arası alınan verilere göre sektörler için ticaret oranları %38.1 oranında sadece online perakende, %36.6 oranında tatil ve seyahat, %30.9 oranında çok kanallı perakende ve %33.9 oranında yıllık ortalama büyüme olduğu görülmektedir (Grafik 2).

Grafik 3. Ürün Kategorilerine Göre E-Ticaret Gelirleri
(<https://www.eticaret.gov.tr/cevrimiciegitim/ulke-ve-sektor-raporlari-85> 06.03.2023)



E-ticaret Bilgi Platformu’nun gerçekleştirmiş olduğu araştırmaya göre, Almanya’da 2017-2024 yılları arasında ürün kategorilerine göre e-ticaret gelirleri tahminleri çerçevesinde 2024 yılında



giyim/moda segmentinde 26 milyar dolar; elektronik ve medyada 32.6 milyar dolar e-ticaret geliri beklenmektedir.

2020 yılının başında başlayan ve hala günümüzde devam etmekte olan koronavirüs salgını etkisi ile e-ticaret sektörü üzerinde büyük bir etki yarattığı düşünülmektedir. Salgın sebebiyle tüketici tercih ve alışkanlıklarında ciddi değişiklikler ve dönüşümlerde etkili olmuştur. Bu sebeple e-ticarete satış oranı ürünler özelinde değişiklikler göstermiştir. Sağlık, hijyen ve gıda ürünleri satış oranında yüksek bir artış görülerek ilk sırada iken, tatil ve seyahat harcamaları dünya genelinde son sıralarda olduğu kayıtlara geçmiştir.

3. E-Ticaretin gıda sektörüne yansımaları ve son dönemdeki gelişmeler

Gelişen dünyamızda e-ticaretin de her geçen gün gelişmesiyle birlikte gıda ürünlerinin e-ticaret üzerinden pazarlaması ve alışverişi imkanını da ortaya çıkarmıştır. E-ticaretin gelişmesi ile tüketicilerin e-ticaret kullanım oranları da aynı doğrultuda artmaya devam etmektedir.

Türkiye’de son dönemde elektronik ticaret büyük bir hız kazanıp gelişerek ekonomi içerisinde temel unsurlardan biri haline gelmiştir. Farklı alanlarda e-ticaret ile ilgili pek çok çalışma ve araştırma yapılmaktadır ancak gıda sektörü açısından yeterince bu konu hakkında veri sağlanamamaktadır. Gıda sektöründe e-ticarete verilerinin alınması ve toplanabilmesi ülke ekonomisine katkı sağlamak ve önünü açmak açısından da oldukça önemlidir. Ülkemizde gıda perakende sektörü Çizelge 4’de üç ana başlık altında toplanmıştır.

Çizelge 4. Gıda Perakende Sektörünün Sınıflaması (Öztaş 2009)

Gıda Perakende Sektörü		
İndirim Marketleri	Yerel Marketler	Ulusal Zincir Marketler
İndirim marketi satış felsefesi olarak devamlı düşük fiyat ilkesini benimseyerek perakende satış işlemleri.	Yerel-belirli bir bölgenin aynı adını altında faaliyet göstermekte olan aynı yönetim kadrosu tarafından yönetilmekte olan satış işlemleri.	Organize ve ulusal düzeyde yayılmış olan perakende satış işlemleri.

1997 yılında Migros tarafından Türkiye’de ilk sanal marketin açılışı yapılmıştır. 2000’li yılların başında ve sonrasında internet kullanıcılarının sayısı hızla yükselmiş ve bununla birlikte e-ticaret ile alım-satım işlemlerinin yapılması artmıştır (Öztürk 2020). Ülkemizde gıda ve gıdaya yönelik ürünlerin e-ticaret ile satın alınması, tüketici alışkanlık ve davranışlarının genellikle oturmuş olması, değişikliklerin az ve yavaş olması sebebiyle yeteri kadar yaygın değildir. Ancak günümüzün imkan ve şartlarında, bu sektörün git gide yaygınlaştığı ve tercih edildiği görülmektedir.



Gıda perakendesinde çevrimiçi iş modelleri dört ana başlık altında toplanabilir. Bunlardan ilkinde müşterilere hizmet depo üzerinden verilmektedir. Müşteriler araçlarından inmeden alım işlemlerini gerçekleştirebilirler. İkinci modelde tıklama sonucu mağazalardan müşteri ürünlerini işaretler aynı gün içerisinde kendisine teslimatı gerçekleşir. Üçüncü modelde merkez bir depo üzerinde müşterilere dağıtım gerçekleşir. Son olarak dördüncü modelde ise mağaza tabanlı ev teslimat modelidir ve çevrimiçi pazarlarda bulunmak istemekte olan klasik perakendecilerin ağırlıklı olarak tercih ettiği model türüdür.

Gıda perakende açısından e-ticaret önemli bir kanal olmasıyla birlikte buna karşın daha sınırlı olarak kaldığı görülmektedir. Gıda perakendesinde mağaza maliyeti haftalık ortalama %10 civarında teslimat maliyetleri sebebiyle artmaktadır. Bu da gıda ürünlerinin e-ticaretinin yaygınlaşmasında önemli bir engel oluşturmaktadır. Tüketiciler internet alışverişlerinde pek çok faktörden etkilenirler. Bu sebeple internetten gıda alışverişi yapmaları için tüketicileri etkileyecek olan bu faktörlere dikkat edilmelidir. Bu faktörlerden en önemlisi ise güven duygusudur (Özdemir 2016).

Çizelge 5. İnternette Yapılan Kartlı Ödeme İşlemlerinin Sektörel Dağılımı (Çeşitli Gıda)(<https://bkm.com.tr/internette-yapilan-kartli-odeme-islemlerinin-sektoreldagilimi/> 30.12.2022)

Dönem	İşlem Adedi	İşlem Tutarı (Milyon TL)
	Yerli ve Yabancı Kartların Yurt İçi Kullanımı	Yerli ve Yabancı Kartların Yurt İçi Kullanımı
	Toplam	Toplam
2022	46.067.585	8.546,39
2021	40.262.575	6.212,37
2020	7.739.195	2.781,56
2019	4.283.774	1.569,65
2018	1.429.367	787,17

Türkiye’de 2018-2022 yılları arasında internetten kredi kartı ile yapılmış olan gıda alışverişlerinin yurtiçi işlem hacmini gösteren Çizelge 5’de, internetten gıda alışverişinin yıllar geçtikçe arttığı görülmektedir. Ülkemizde günden güne artmakta olan internet üzerinden alışveriş, firmaları e-ticaret kullanmaları açısından teşvik etmekte ve dikkat çekmektedir. Duyusal olarak ise özellikle çevrimiçi ortamlar için dayanıklı olmayan gıdaların teslimatının çok daha hızlı ve teslimat taşıma süresince ürünün kalitesini ve özelliklerini bozmayacak şekilde yapılması pekçok ürünün özelliği gereğince sahip olduğu his, dokunma ve koku duyularını kullanarak seçilmeyi gerektirdiğinden pek de mümkün olmamakla birlikte öne çıkmaktadır.

Aralık 2019’da Çin’de başlayan COVID-19 pandemisi ile beraber dünyada çıkarılan raporlara göre en fazla etkilenen ve etkilenmesi muhtemel sektörlerin konaklama-yiyecek hizmetleri,



perakende-toptan ticaret, sanayi, gayrimenkul ve idari hizmetler olduğu belirlenmiştir. (Gezici ve ark. 2021). Sosyal mesafe, “Evde Kal” ve alınan birçok tedbir sonrası restoran, eğlence mekanları vb. Sektörlerinde görülen kısıtlama ve kapanmalara karşın sağlık sektörü ve gıda perakende talebin en yüksek olduğu sektörler olarak öne çıkmaktadır (Önemli 2020). Gönüllü ya da zorunlu karantina sürecinde sağlıklı beslenmenin önem kazanması, tüketici farkındalığının artması ve kısıtlama sürecinde alışveriş alışkanlıklarının değişmesi, tüketicilerin gıda alışveriş performanslarını da olumlu etkilemiştir. (Tepe ve ark. 2022). Gıda perakende sektörünün COVID-19 pandemisi döneminde çalışmaya devam ettiği hatta çalışmalarını hızlandırarak geliştirdiği görülmektedir. Nielsen Perakende Endeksi verilerine göre pandeminin ilk yarısında gıda dışı perakende %34 düşüş yaşarken, gıda perakendenin %33 büyüdüğü görülmektedir (Anonim 2020). Diğer yandan, gıda güvenliği ve sağlıklı gıdaya erişimin öneminin pandemi döneminde daha çok dikkat çekerek tüketici ve üreticiler tarafından öneminin farkedildiği görülmektedir.

COVID-19 pandemi döneminde çevrimiçi hizmetlere olan ihtiyacın artmasıyla ve bu alışkanlığın tüketiciler tarafından edinilmesiyle birlikte pandemi sonrası dönemde de özellikle gıda sektöründe devam edeceği düşünülmektedir (Hobbs 2020). Kısa vadede gerçekleşen bu değişimin sonucunda bazı fiziksel mağazaların kapatılarak çevrimiçi sistem için depolardan dağıtım yapılması şeklinin de günümüzde oluşmaya başladığı görülmektedir.

UNCTAD’ın 9 ülkeyi (Brezilya, Çin, Almanya, İtalya, Güney Kore, Rusya, Güney Afrika, İsviçre ve Türkiye) kapsayan COVID-19 ve çevrimiçi alışveriş ilişkisi analizinde, COVID-19 sırasında çevrimiçi alışverişteki artışların ülkeler arasında farklılık gösterdiği; en fazla artışın Çin ve Türkiye’de olduğu belirtilmiştir (United Nations Conference on Trade and Development [UNCTAD] 2020).

Gıda sektöründe diğer sektörler göre daha sınırlı kalmış olan e-ticaret payının, pandemi ile beraber İngiltere, ABD, Hindistan ve Çin gibi büyük ülkeler açısından önemli oranda bir artış olduğu tespit edilmektedir. Amerika’da 2020 yılı için beklenen oran %4.3’den, pandemi sonrası %10.2’ye yükselmiştir. Bu artışın gelecekte devam edeceği ve 2025’de %21.5’a yükseleceği düşünülmektedir. Bu nedenle, gıda perakende sektörüne çevrimiçi kanalların kullanımı firmaların rekabet edebilmesi açısından oldukça önemlidir. İşletme ölçeği ve talep miktarı gıda perakendeciliğinde iki farklı yönden bakmayı sağlar. Bunlara ek olarak gıda ürünlerinin özellikle duyuşal özellikler açısından da dikkate alınması gerekmektedir. Gıda ürünlerinde çevrimiçi ticarete benimsenmesi için tüketiciler ve işletmeler için diğer ürünlere göre farklı bir yaklaşıma sahip olmalıdır.



4. Sonuç

Ticari faaliyetler yaşadağımız dönemde teknolojinin de desteği ile farklı bir boyut kazanarak gelişmeye devam etmektedir. İletişim teknolojilerinin hızla gelişmesi ile dünyada yeni bir ekonomik düzen oluşmaya başlamıştır. E-ticaretin pratik, kolay ve hızlı olması en önemli avantajlarından biri olarak gösterilebilmektedir. Bunun yanında işletmeler için e-ticaret alanı fiziksel olarak sınırlı kalmayarak geniş pazarlar sayesinde hedef kitlelerine ulaşabilirliği artırır. E-ticaret tüketiciler açısından da pek çok fayda ve kolaylık sağlamaktadır. Kazanılan yeni alışkanlıklarının da tüketiciler tarafından benimsenmesiyle beraber firmalar e-ticaret konusunda kendilerini geliştirerek tüketici isteklerine yanıt verebilmelidir. Firmaların yeni gelişimlere ayak uydurması gerekmekte ve e-ticaretin kendilerine de sağlayabileceği faydalar göz önüne alınarak yatırımların ve gelişmelerinin bu yönde yapılması büyümeleri açısından da faydalı olabilmektedir.

COVID-19 pandemi döneminde çevrimiçi hizmetlere olan ihtiyacın artmasıyla ve bu alışkanlığın tüketiciler tarafından edinilmesiyle birlikte pandemi sonrası dönemde de özellikle gıda sektöründe devam edeceği düşünülmektedir.

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COMPARISON OF THE ANTIMICROBIAL EFFECT OF THREE NATURAL PRODUCTS FORMULATED AS A GEL DOSAGE FORM

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ABSTRACT

Background: Nowadays, there is an increase in the incidence of life-threatening bacterial infections accompanied by antimicrobial failure due to different reasons including multidrug resistance. There is a huge effort to find new compounds to treat this problem which should have no toxicity on humans with specific activity on bacteria and should demonstrate acceptable bioavailability. The pathway to find such compound is long and expensive. However, natural compounds or compounds derived from natural products represent a good alternative.

Aims: This work has selected three different natural products which are known for their antimicrobial effects, and investigated their antimicrobial effects on different types of microbes including Gram-positive bacteria, Gram-negative bacteria and fungi.

Materials and Methods: The exudate and two extracts of three natural products include *Aloe vera*, *Glycyrrhiza glabra*, and Propolis, were prepared and incorporated into Carbomer-934 as a gelling agent, and propylene glycol as a plasticizer to form N-1, N-2, and N-3 formulae containing the aforesaid natural substances, respectively. Antimicrobial susceptibility *in-vitro* tests of the selected formulae were studied against different types of microbes. Then, the three mentioned products were subjected to an additional *in-vitro* susceptibility test against the three common microorganisms (*Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*). Moreover, stability studies for their physicochemical properties were conducted longer than six months after their production.

Results and Discussion: The study findings demonstrated no significant difference ($p \leq 0.05$) in physicochemical properties among all three formulae and for each formula before and after storage at room temperature for six months. Selection of the best antimicrobial natural product may be not that simple to decide because results showed a significant difference ($p \leq 0.05$) in the *in-vitro* susceptibility tests for N-1 before and after storage at room temperature for six months; however, the susceptibility test of (N-2 and N-3) revealed persistence of some antimicrobial effectiveness against microbes especially *Staphylococcus aureus*.

Conclusion and recommendations:

Aloe vera gel containing exudate (N-1) may not be very stable and therefore not very efficient against microbes. The gels prepared from Liquorice and Propolis extracts (N-2 and N-3) are often very efficient antimicrobials on *Staphylococcus aureus*, which appears to be the most susceptible organism. The antibacterial activity, especially against *Candida* species, could be diminished with time after the preparation of the gels. More research should be done to develop natural antimicrobial gels that are more stable over time so they can be used as substitutes for commercial products.

Keywords: *Aloe vera*, Liquorice, Propolis, gel, antimicrobial activity, *Staphylococcus aureus*.



Introduction

Historically, the use of natural products for treating human diseases was very long. Several plant species have been used in several cultures such as *Aloe vera* which is a member of the lily plant known as *Aloe barbadensis* which was used therapeutically, nearly 6000 years ago in Egypt. The antimicrobial effect might be attributed to the plant's natural anthraquinones constituent.(1) Another plant species is Liquorice (*Glycyrrhiza glabra*) and which was mentioned in the clay tablets from ancient Mesopotamia in 2600 BC; such plants (roots) are still used either alone or as one of the components of herbal formulations for the treatment of various diseases including treatment of infection. Furthermore, Propolis (bee glue), which is made from plant-based materials-resins and was extensively utilized by the ancient Greeks, Romans, and Egyptians who were familiar with the healing properties of Propolis and made great use of it as a medicine. Propolis contains high concentrations of polyphenols and flavonoids, which might be responsible for various activities. Generally, Propolis is used by both bee's feral colonies in tree cavities and domesticated colonies in commercial hive boxes, for covering holes and gaps in the nest, and restricting the hive entrance which is clear from the origin of the word Propolis ("Pro": in front of; "polis": the city). Utilizing Propolis in this manner by bees is thought to function as a way for colonies to better maintain homeostasis of the nest environment. This could be a result of decreasing microbial growth on hive walls and waterproofing the walls against external moisture, in addition to providing some protection against intruders. (2,3) These traditional and important natural sources of medicines were shown in figure1.

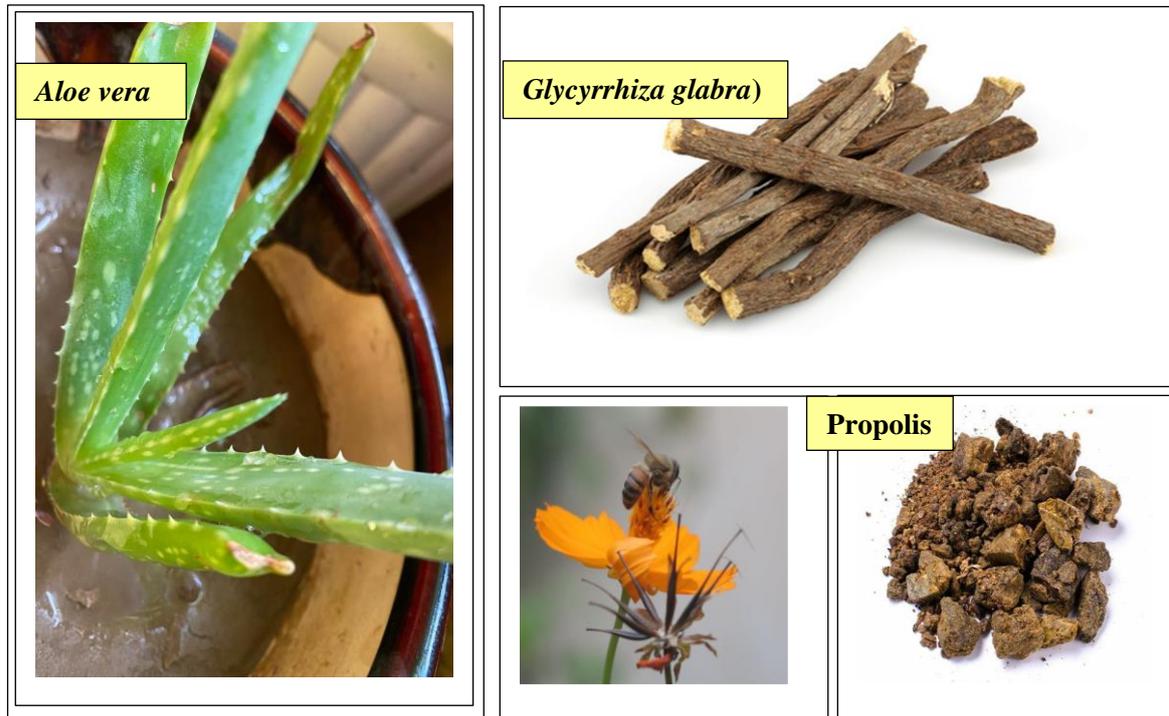


Figure (1) some important natural sources of medicines

Gel dosage forms (sometimes known as Jellies) are semisolid systems consisting of either suspension made up of small inorganic particles or large organic molecules included in a liquid. Gels are classified as two-phase system or single-phase systems. (4) Gels of Single-phase consist of organic macromolecules evenly distributed throughout a liquid in such a way that no apparent boundaries exist between the dispersed macromolecules and the liquid. Single-phase gels may be formulated using synthetic macromolecules (e.g. Carbomer) or natural gums (e.g., Tragacanth). (5) Natural medicinal ingredients such as extracts or exudates may be incorporated in carbomer-based gels to be formulated a gel dosage form which can be used to deliver medication topically or into the body.(6–8)

Topical skin infections commonly occur and frequently give therapeutic challenges to professionals, despite the numerous existing antimicrobials available today. Common examples of topical skin infections include diaper rash which is a type of irritant contact dermatitis, mouth sores, and tinea (also known as pityriasis) versicolor, acne, and eczema. In addition, any burn or wound may result in skin infection. The need to develop new antimicrobial agents has increased significantly due to growing concerns about multidrug-resistant strains of bacteria, viruses, and fungi (8).



Consequently, in the field of antimicrobial chemotherapy, attention has been paid to safe, new, and/or alternative antimicrobial materials.

In previously published works of our lab, new formulae of (*Aloe vera*, Liquorice, and Propolis gel), were prepared and evaluated successfully and from each work a product was selected that met all the required criteria of topical gel as well as for their good antimicrobial effects.(6,7)

This work aims to compare these three natural products in terms of their antimicrobial effect against two different types of bacteria including *Staphylococcus aureus* (as a Gram- positive bacteria) and *Pseudomonas aerogenosae* (as a Gram- negative bacteria) and against *Candida albicans* as fungus in order to select the best one which may be used for burn wound infections or other types of skin infections.

Materials

Materials for preparing the three natural products: The fresh *Aloe vera* (*Aloe barbadensis*) leaves and the dried coarse powder of Liquorice root were purchased from the local market in Mosul City, Iraq. Propolis samples were collected from honey bee beehives in the city of Babylon, Iraq during the 2017 and 2018 spring seasons. Carbomer-934 was purchased from (HIMEDIA, India). Ethanol, sodium sulphite, and triethanolamine were obtained from (Tedia, USA). Propylene glycol was purchased from (THOMAS BAKER Co., India). All other chemicals were of analytical grade.

Methods

Production of the three products

Carbomer-934 gel formula was prepared as published earlier with some modifications. During the preparation procedure, Carbomer-934 dispersions were prepared by adding little amount of distilled water (D.W.) to the polymer with slight hand-mixing and then stirred by using a magnetic stirrer (Fisher Scientific, Korea) at moderate speed with slight heating at about 50-55°C for 2-3 hours. The Carbomer-934 dispersion was cooled and covered with a piece of aluminum foil overnight to remove air bubbles. The following day, the calculated amount of each of the natural substances (*Aloe vera* exudate, extracts of Liquorice, and Propolis) was added separately for the above mentioned dispersion, stirred using the magnetic stirrer, completed the volumes with D.W. and then sufficient quantities of triethanolamine was added as a final step of preparation to get the three natural gel products designed as (N-1, N-2, and N-3, respectively) and the resulting formulae were wrapped with aluminum foil and placed in the refrigerator. (6,7,9)



All physicochemical tests, including those to measure pH, viscosity, torque, spreadability, appearance, consistency, colour and odor, were carried out in accordance with the methodology published earlier. (6,7)

Antimicrobial effects of the three products

In-vitro antimicrobial effects

Susceptibility Test

Antimicrobial susceptibility effects of the selected formula (N-1) were studied against bacterial species including *Staphylococcus aureus* (gram+) and *Escherichia coli* (gram-) and for the selected formulae (N-2 and N-3) were also studied by well diffusion method against bacterial species including *Staphylococcus aureus* (gram+), *Pseudomonas aeruginosa* (gram-), and against one fungal type which is *Candida Albicans*. A 39 g of Muller-Hinton agar was diluted with 1 Liter of D.W. to prepare Mueller-Hinton agar (Lab M, UK). The mixture was stirred, brought to a boil using a hot plate stirrer (Stuart, UK), then autoclaved for 15 minutes at 115°C using a portable autoclave (Guangzhou, China). The prepared agar was then transferred onto a petri dish to cool and solidify and then a 6 mm diameter well inside the prepared agar was made. With a concentration of 0.5 McFarland standard (1.5x10⁸ CFU/ml), fresh cultures of *Staphylococcus aureus* (*Staph.aureus*), *Pseudomonas aeruginosa* (*Pseud.aeruginosa*), and *Candida albicans* (*C.albicans*) were prepared by adding and spreading the necessary bacterial suspension on the top of the agar plates with a sterile cotton swab. Standard antibiotic discs were used as a positive control and placebo polymer gel was used as a negative control. After 15 minutes, 100 µl of the three prepared natural gel formulae were added to the resulting wells. Then the plates were incubated aerobically at 37°C for 24 hours for bacteria and also at 37°C for 48 to 72 hours for yeast. (6,10)

Stability study for the three products

The prepared gels (N-1, N-2, and N-3) which were incorporated with the three natural substances were tested for stability. Well-closed containers were used for six months of stability testing at 25°C. The prepared gels were assessed for their physicochemical characteristics after six months, including their appearance, color, homogeneity, consistency, lack of clogs or aggregates, pH, viscosity, spreadability. The antimicrobial properties were also examined to ensure the gels' efficiency against gram positive and gram negative bacteria in addition to the yeast, by which D.W. was used for gel dilutions (as four concentrations of the gel were prepared: 25. 50. 75, and 100%). The positive control employed was (Streptomycin 25 g, Ciprofloxacin 10 g,



and Nystatin 30 g) discs, whereas the negative control was carbomer-934-based gel without any integration with a natural material.(11)

Selecting the best antimicrobial product

The potential for an antimicrobial effect, along with good physicochemical stability, were the criteria used to select the best antimicrobial formula among the three natural products (N-1, N-2, and N-3). This was done by studying an additional test of antimicrobial effectiveness of the three above products against the three common microbes (*Staph.aureus*, *Pseud.aeroginosa*, and *C.albicans*) which was carried out after approximately more than 6 months from the products' preparations.

Statistical Analysis

The results were taken as mean \pm standard deviation and statistically analyzed using *t-test*. A value of $p \leq 0.05$ was considered significant.

Results and Discussion

The Physicochemical Properties

The physicochemical properties of the prepared natural gels (N-1 and N-2) were measured according to the established procedure published earlier (6,7). In addition, the prepared natural gel (N-3) was measured according to another procedure mentioned in a recent work (submitted to be published) and all the three natural products (N-1, N-2, and N-3) exhibited good characteristics, as demonstrated in Table 1.

Table1. Physicochemical properties of the three natural products containing *Aloe vera exudate*, liquorice extract, and Propolis extract with their assigned batch codes, N-1, N-2, and N-3 respectively (All values are expressed as mean \pm SD, n = 3)

Measured parameters	N-1	N-2	N-3
pH	5.40 \pm 0.5	5.50 \pm 0.5	5.70 \pm 0.09
Viscosity (Pa.s)	122.846 \pm 0.14	112.750 \pm 0.25	132.880 \pm 0.16
Spreadability (mg.cm/s)	26.0-27.2	0.45-0.89	5.15-6.23
Appearance	Good	Good	Good
Colour	Pale-pink	Dark- brown	Golden brown
Homogeneity and consistency	Smooth	Smooth	Smooth
Removal	Easy	Easy	More sticky

Antimicrobial effects of the three products

In-vitro antimicrobial effects (Susceptibility Test)

Staph. aureus is a typical pathogen that causes infections of the soft tissues and musculoskeletal system. The three formulae (N-1, N-2, and N-3), were used to investigate the antimicrobial efficacy against different types of microorganisms including *Staph.aureus*.



The results of antimicrobial effect of *Aloe vera* are presented in table 2 and figure 2. The measurement of inhibition zone of *Aloe vera* exudate gel product (N-1) against both *Staph.aureus* and *E.coli* was in the range of (0-30 mm) with higher antibacterial activity against *Staph.aureus*. (7) These findings corroborated those of V.C. Pawar *et al.*, who found that using *Aloe vera* gel extract completely inhibited the growth of *Staph.aureus*.(12) Additionally, Sahu RK *et al* findings, which compared various plant extracts, including *Aloe vera*, against various types of bacteria, including *E. coli*, reported that the majority of bacterial species were susceptible to all *Aloe vera* extracts when used in high concentrations and this is in agreement with our findings.(13) In addition, some other studies indicated that the use of *Aloe Vera* leaf and root ethanol extracts can be used in conjunction with traditional antibiotics to combat the infection-causing chemicals that are so common in skin infections.(14)

Indeed, it is expected that the results from using of *Aloe vera* exudate is going to be not in accordance with the results of using extract. In addition, the type of solvents in the extraction process, the methodology and other variables like the time of extraction and method of purification have a pronounced effect on the product and its efficacy against different microbes. Concerning Liquorice, the results, which are presented in table 3 revealed that natural Liquorice gel product (N-2) had a preferable antimicrobial activity against *Staph.aureus* and *C.albicans* with zone of inhibition ranged from (0-25) mm for *Staph. aureus*, while for *C.albicans* the zone of inhibition varied from (0–10) mm in comparison with control.(6) However no antimicrobial activity was detected against the gram-negative bacteria *Pseud.aeruginosa*(6), which showed higher resistance to the product N-2 than the tested Gram-positive bacteria and yeast. Because *Pseud.aeruginosa* is a type of bacteria that is assumed to be multi-drug resistant, the distinction between (Gram-positive) and (Gram-negative) bacteria's cell membrane structures may help to explain this. (15)

Results also indicated that the prepared Liquorice gel product (N-2) had higher antimicrobial effect against *Candida* species than against the tested bacterial species with zone of inhibition for *Staph.aureus* ranged from (0-25) mm, while for *C.albicans* (12-30) mm. Supportive results were obtained from work conducted by Karahana *et al* in 2016. (16) Their research demonstrated that Liquorice had an anti-bacterial action utilizing the disc agar diffusion method. The zone of inhibition for *Staph.aureus* ranged from (12-19) mm, but there was no anti-bacterial activity against *Pseud.aeruginosa*. In 2013, Geetha and Anitha demonstrated that the diameter of the Liquorice-treated *C.albicans* zone of inhibition ranged from (9-20) mm.(17).



This antifungal effect of Liquorice against candida might be attributed to the presence of licochalcone A and glabridin, two isoflavonoids derived from Liquorice. These two showed a fungicidal action on *candida albicans* at relatively low minimum inhibitory concentrations.(18) Regarding the antimicrobial effect of the prepared Propolis gel product, which are demonstrated in table 4 and figure 4; product N-3 effect was investigated toward (*Staph. aureus*, *Pseudo. aeruginosa* and *enterococcus fecalis*) and fungi (*C.albican*). Results showed large inhibition of the growth of *C. Albicans* (13.7mm) and showed (15.5, 12 and 13.2 mm) zones of inhibitions towards *Staph. aureus*, *Pseudo. aeruginosa* and *enterococcus fecalis*, respectively. The effectiveness of Propolis extract in gel formula against *Staph.aureus* was previously screened by Kehribar L,S, *et al.* (2021) who indicated that incorporation of Propolis extract into gel formula would improve the antibacterial effectiveness of Propolis against different kinds of bacteria. (19) The antifungal effectiveness of Propolis in gel dosage form was previously studied by many researchers including Berretta AA *et al* (2013) who developed many gel-based formulae containing different Propolis extracts and studied their use in preclinical treatment of candidiasis vulvovaginal infection and came to the conclusion that *in-vivo* efficacy had demonstrated that Propolis-based gels provide antifungal action similar to that of clotrimazole cream. (20)

Stability study for the three products

When the three prepared natural product formulae were kept tightly closed and stored at room temperature for six months, no significant difference ($p \leq 0.05$) in visual appearance, colour, homogeneity, and consistency was observed. Aggregates and clogs were not present. Additionally, after six months of storage, there was no significant difference in the pH, spreadability and viscosity.

Selecting the best antimicrobial product

Results obtained after a period of six months showed that the three products (N-1, N-2, and N-3) revealed good physicochemical stability including: pH, viscosity, spreadability, general appearance, and consistency. However, some contradicting results were found in the antimicrobial efficiency against (*Staph.aureus*, *Pseud.aeruginosa*, and *C.albicans*). The susceptibility test of the *Aloe vera* gel product (N-1) showed resistance (R) to *Staph.aureus*, *Pseudomonas* and *C.albicans* as represented in table 2 and figure2, in all concentrations used.



:Table 2 Susceptibility test for different concentrations of *Aloe vera* gel against different types of microorganisms after six months period at room temperature

Bacteria and Fungus	% Natural gel product (<i>Aloe vera</i> gel)				Control	
	100%	75%	50%	25%	Negative	Positive
Zone of Inhibition (mm)						
<i>Staphylococcus aureus</i>	R	R	R	R	R	22.9
<i>Pseudomonas aerogenosa</i>	R	R	R	R	R	14.3
<i>Candida albicans</i>	R	R	R	R	R	21.3

(R): Resistant. Streptomycin, 25Ciprofloxacin 10, and Nystatin 30 as positive controls for testing susceptibility of the gel against *Staphylococcus aureus*, *Pseudomonas aerogenosae* and *Candida albicans*, respectively.



Staph.aureus

Pseudo.aeruginosa

C.albicans

Figure 2: Susceptibility test showed zone of inhibition of different concentrations of *Aloe vera* gel (N-1) against *Staph.aureus*, *Pseudo.aeruginosa*, and *C.albicans*.

Although the susceptibility test of the liquorice gel product (N-2) exhibited resistance (R) to *Pseudomonas* and *C.albicans* in all concentrations utilized following preparation of more than six months at room temperature, a good antibacterial activity was revealed against *Staph.aureus* at 100%(m/v) and to a lesser extent at 75%(m/v) of N2. At 50% (m/v) concentration, there is very little impact, and at 25% (m/v) of the gel, there is none. Table 3 and Figure 3 show same findings for all applied concentrations.



:Table3 Susceptibility test for different concentrations of Liquorice gel against different types of microorganisms after more than six months at room temperature

Bacteria and Fungus	% Natural gel product (Liquorice gel)				Control	
	100%	75%	50%	25%	Negative	Positive
Zone of Inhibition (mm)						
<i>Staphylococcus aureus</i>	13.3	12	10	R	R	25.1
<i>Pseudomonas aerogenosa</i>	R	R	R	R	R	15.5
<i>Candida albicans</i>	R	R	R	R	R	20.5

(R): Resistant. Streptomycin 25, Ciprofloxacin 10, and Nystatin 30 as positive controls for testing susceptibility of the gel against *Staphylococcus aureus*, *Pseudomonas aerogenosa* and *Candida albicans* respectively.

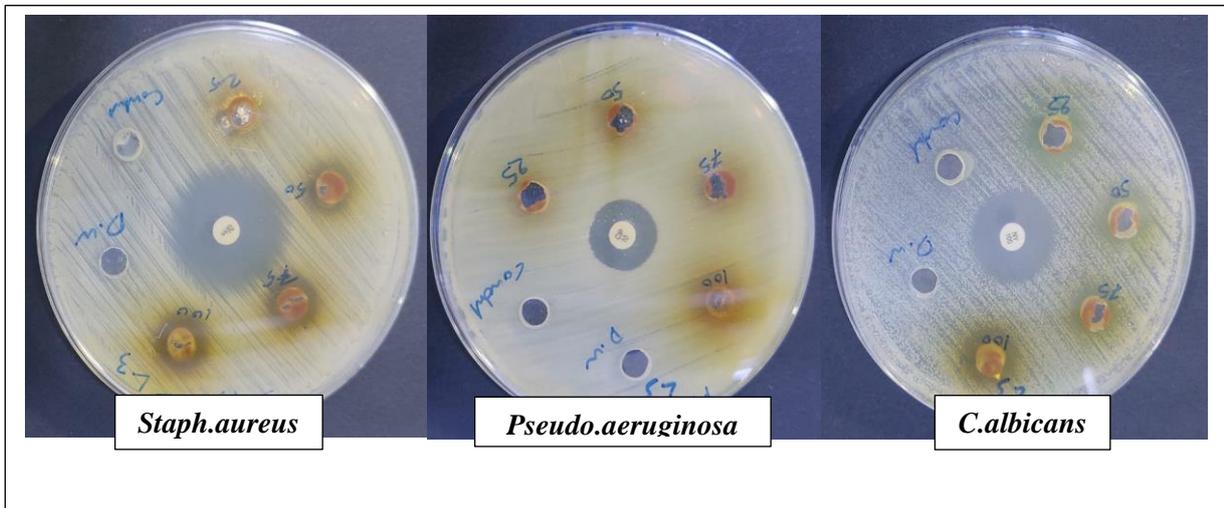


Figure 3. Susceptibility test showed zone of inhibition of different concentrations of *Liquorice* gel (N-2) against *Staph.aureus*, *Pseudo.aeruginosa*, and *C.albicans*

For Propolis gel product (N-3), at 100%(m/v) concentration, the antimicrobial activity was evident against all of the test microorganisms (*Staph.aureus*, *Pseud.aeruginosa*, and *C.albicans*). Having zones of inhibition that are , 13.3, 10.0, and 13.4 mm, respectively. In contrast, N-3 was only effective against *Staph. aureus* at a concentration of 75% (m/v). Other concentrations (25 and 50%) showed R and had no impact. (Table4 and Figure4)



.: **Table 4** Susceptibility test for different concentrations of *Propolis* gel against different types of microorganisms after six months period at room temperature

Bacteria and Fungus	% Natural gel product (<i>Propolis</i> gel)				Control	
	100%	75%	50%	25%	Negative	Positive
	Zone of Inhibition (mm)					
<i>Staphylococcus aureus</i>	13.3	12	R	R	R	22.8
<i>Pseudomonas aerogenosa</i>	10.0	R	R	R	R	14.9
<i>Candida albicans</i>	13.4	R	R	R	R	21.6

(R): Resistant. Streptomycin 25Ciprofloxacin 10, and Nystatin 30 as positive controls for testing susceptibility of the gel against *Staphylococcus aureus*, *Pseudomonas aerogenosa* and *Candida albicans* respectively.

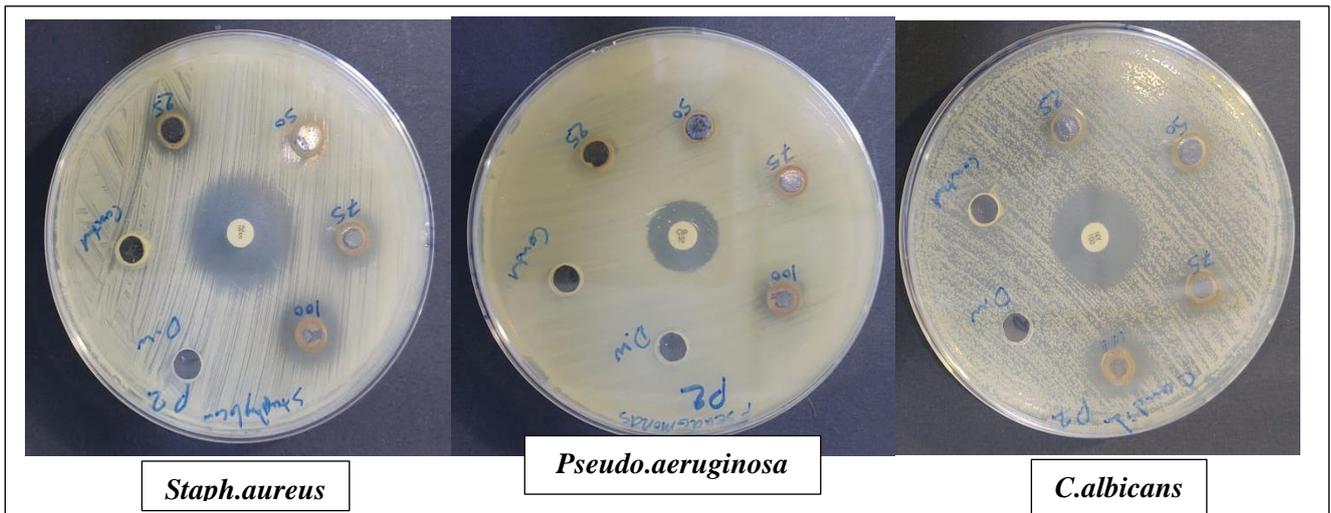


Figure4: Susceptibility test showed zone of inhibition of different concentrations of *Propolis* gel (N-3) against *Staph.aureus*, *Pseudo.aeruginosa*, and *C.albicans* .

Conclusion

In general, the three prepared gel products have favorable relationship among them as they are the most important ancient products which had been utilized before thousands of years for their therapeutic properties. All the three prepared gels have distinctive antimicrobial effects especially within the first three months of preparation. After that, there may be decrease in the level of antimicrobial activity particularly against *Candida* species. *Staph.aureus* seems to be the most susceptible organism, and the gels made from Liquorice and Propolis extracts (N-2 and N-3) are particularly efficient antimicrobials on it. *Aloe vera* as gel dosage form should be



used as an extract rather than an exudate because the latter may have little stability and so little antimicrobial effectiveness. No definitive results could be taken from other studies to support that; however more studies should be conducted to assess these natural products' stability and their effectiveness as antimicrobial products over time. The use of such natural products will still be employed instantly, and supporting studies should be carried out to make it easier to apply them as a substitute of the commercial products.

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BUĞDAY KÖK MİMARİSİ VE KURAKLIK

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ÖZET

Son yıllarda artan iklim değişikliğinin olumsuz etkileri nedeniyle çevre koşulları; bitkisel üretimi kısıtlayan en önemli faktör olmakla birlikte gıda güvenliği konusunda da daha fazla ön plana çıkmaktadır. İnsanlığın yeterli düzeyde güvenilir ve besleyici gıdaya ulaşabilmesi için gereken temel beslenme nedeniyle, iklim değişikliği ve sürdürülebilir tarım konuları tarımsal üretimde üzerinde durulması gereken en önemli temel konuları oluşturmaktadır. Gelecek iklim senaryoları ile Akdeniz iklimine sahip ülkelerin buğday veriminin önemli düzeyde azalmasına neden olabilecek daha kuru ve sıcak iklim koşullarına sahip olacağı belirtilmektedir. Kış sezonundaki yağış genellikle buğdayın gelişimi için yeterli bir seviyeye karşılık gelirken, kuraklık ve su kıtlığı koşulları genellikle buğdayın generatif büyüme dönemlerinde yüksek sıcaklık ve az yağış etkisi ile ortaya çıkmaktadır. İklim değişikliğinin etkisi altında optimum buğday verim düzeyi elde etmek için, kök-bitki-atmosfer sisteminin buğday bitkisinin ihtiyaç duyduğu dinamik ve etkili bir şekilde çalışması gerekmektedir. Buğday bitkisi topraktan su ve besin maddelerden yüksek düzeyde yararlanabilmesi için etkili bir kök sisteminin gelişmesi gerekmektedir. Buğday bitkisinin kök sistem mimarisini ve gelişimini anlamak kuraklık stresi adaptasyonu ve stres koşulları ile başa çıkabilmesi için önemli faydalara sahiptir. Yeni görüntüleme sistemi teknolojileri sayesinde buğday bitkisinin kök gelişiminin detaylı olarak incelenmesi ve görselleştirilmesine olanak sağlamaktadır. Buğdayda etkili kök fenotipleme gelişimi ile az yağış nedeniyle ortaya çıkan stres koşullarında daha yüksek düzeyde su kullanım etkinliği sağlanabilmektedir. Buğday kök sistem mimarisi, kök uzunluğu, kök hacmi, kök çapı, kök alanı ve kök:sürgün oranının ölçülmesine olanak sağlayarak kök-bitki-çevre ilişkisini anlamaya olanak sağlamaktadır. Vejetatif dönemde güçlü kök sisteminin geliştirilmesi tane dolum döneminde yeterli düzeyde toprak neminden faydalanılmasına, daha derin ve yoğun kök sistemi sayesinde generatif dönemde meydana gelen stress koşullarında bile sudan etkin bir şekilde yararlanılmasına katkı sağlamaktadır. Kök sistem mimarisi çalışmaları iklim değişikliği altında daha yüksek buğday verimi elde etmek için büyük katkılar sağlamaktadır ve buğdayda kuraklığa tolerans stratejisinin geliştirilmesinin önemli bir parçası olabileceği düşünülmektedir.

Anahtar Kelimeler: Buğday, Kuraklık, Kök, İklim değişikliği, Sıcaklık, Verim



WHEAT ROOT ARCHITECTURE AND DROUGHT

ABSTRACT

Environmental conditions are the primary factors affecting and have greater influence on crop production drawing more attention to food safety with the adverse effects of climate change in recent years. Due to the basic nourishment needed for mankind to reach adequately safe and nutritious food, climate change and sustainable crop production have prime importance issues discussed in agricultural production. Future climate scenarios show that Mediterranean countries will get drier and hotter, which might reduce wheat yield. The precipitation in the winter period generally corresponds to a sufficient level for the development of wheat whereas drought and water scarcity conditions often occur with hot weather and deficit rainfall during the reproductive stages of wheat. To achieve optimum grain yield level under the influence of climate change soil-plant-atmosphere system is required to work dynamically and effectively as the wheat plant needs. Wheat requires an effective root system for multiple reasons, including water and nutrient uptake from soil. Understanding root system architecture and root growth have benefits for adaptation and coping with drought stress. New developments in imaging technologies open up an opportunity to visualize the root of wheat grown in soil. Developing an efficient root phenotype may ensure higher water use efficiency and benefit in stress conditions caused by low precipitation amounts. The wheat root system architecture allows measuring of root length, root volume, root diameter, root area, and root: shoot ratio to understand the relationship between root-plant-environment. The development of a strong root system in the vegetative period has the benefit of preserving sufficient water for the grain filling period and deeper roots and more roots in depth contribute to be a benefit in capturing water even under stress conditions in the reproductive stages of wheat. Root system architecture studies have a great contribution to achieving higher wheat yield within the context of climate change and these studies can be part of the strategy for wheat drought tolerance.

Keywords: Wheat, Drought, Root, Climate change, Heat, Yield



1. Climate change and wheat

Climate change is the major constraint factor limiting crop production and is expected to have significant impacts on global wheat production. Considering the limitations of caused by environmental variations a significant increase in wheat productivity will be required by about 70% by 2050. In recent years, noticeable changes in temperature and precipitation amounts in both the global and regional aspects were known as climate change phenomena in terms of amount and time of occurrence and have exerted different impacts on the inputs and agricultural production (Valizadeh et al., 2014). However, the changes in temperature, precipitation patterns, and extreme weather events caused by climate change are likely to affect the growth and productivity of wheat in several ways. Global warming triggers rising temperatures and increased drought frequency that poses threats to food security (Semenov et al. 2014). Changes in precipitation patterns are one of the main reasons affecting wheat production. Drought conditions caused by reduced rainfall or changes in the timing of rainfall can reduce wheat yield and quality.

According to the RCP 4.5 and RCP 8.5 future climate scenarios for Türkiye, the annual temperature will be observed with an increasing degree 1-2°C, 1-5°C, and 1.5-5°C between 2016-2040, 2041-2070 and 2071-2099 years, respectively. Although the precipitation amount is predicted to increase during winter months, conversely it is expected to decrease in the interior part of Anatolia in the spring and summer seasons (Demircan et al. 2014; Demircan et al. 2017).

Mediterranean climate has typical properties that insufficient and variable rainfall and humid winter period but dry and warm summer seasons. The Mediterranean climate presents disadvantages in terms of the adaptation of plants due to the rainless summer period. The rainfall is sufficient to grow wheat plants vigorously as soon as the temperature goes up during winter and spring. Rain is stored in the soil during the winter season, which supplies the spring and summer water requirements, but drought occurs due to soil water is usually not enough to supply water requirements toward maturity periods. Soil moisture content is sufficient during the vegetative growth stages of wheat while wheat plants are faced with high temperature and water stress conditions during the generative growth period in this type of climate. Water stress leads to reduce carbon assimilation during forming stages of grain resulting in decreasing grain yield by post-anthesis photosynthesis (Acevedo et al. 1999; Gevrek and Atasoy, 2012).

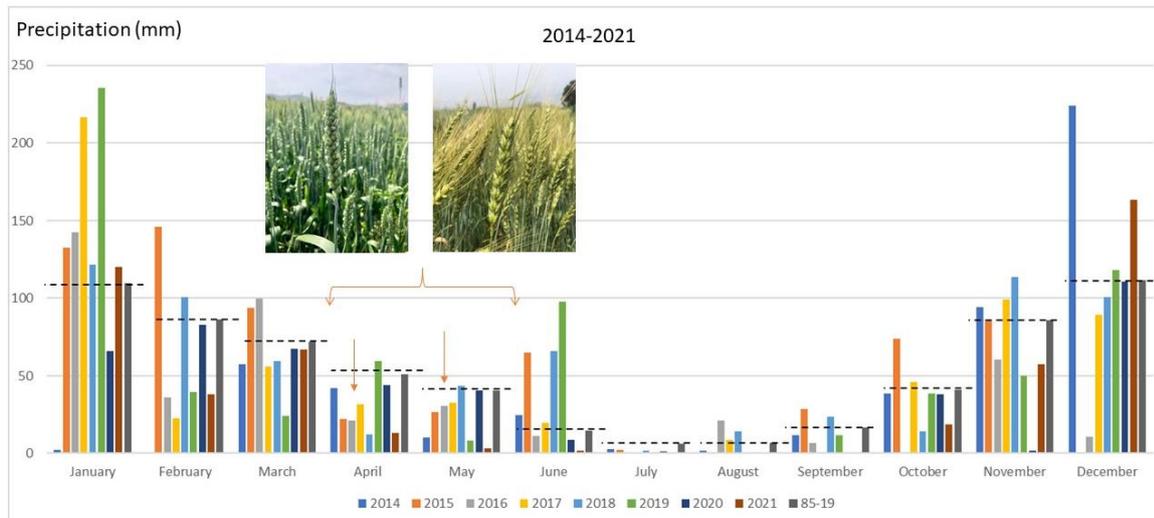


Figure 1. Precipitation amounts during 2014-2021 and long-term (1985-2019) periods in Aydın province.

Year-to-year rainfall variability makes it difficult to define exact drought periods in winter growing seasons but as shown in Figure 1. the seasonal water availability and rainfall amount are clearly low in flowering and grain-filling periods (April and May). In these periods low rainfall amounts cause wheat plants to deal with unfavorable environmental conditions. To achieve optimum grain yield under climate change conditions, effective wheat root development is one of the main steps to get rid of adverse weather effects.

2. Root architecture

Plants under drought stress contribute positively and can be improved as a resistance strategy through morphological, photosynthetic activity, antioxidant enzyme mechanisms, and osmotic adjustment mechanisms. In addition to all these mechanisms, the root is the most important part of the plant for water and nutrient uptake, so studying its physiology and development under stress conditions has grown in importance in recent years as a resistance mechanism (Duan et al. 2017).

Root image analysis systems have facilitated rapid measurements of root architecture and with the development of computer software enabled to measure root morphology with automated systems have been extremely used e.g., WinRHIZO (Regent Instruments, Canada). WinRHIZO imaging system provides important root growth parameters by processing images obtained from washed roots. It allows the image obtained from washed plant roots to be decomposed down to a pixel size (1 pixel = 0.69 mm resolution) and the measurement of root length, root area, root volume, and root diameter by multiplying the pixel size by the number of pixels in the total size of the image (Wang ve Qiang, 2009).

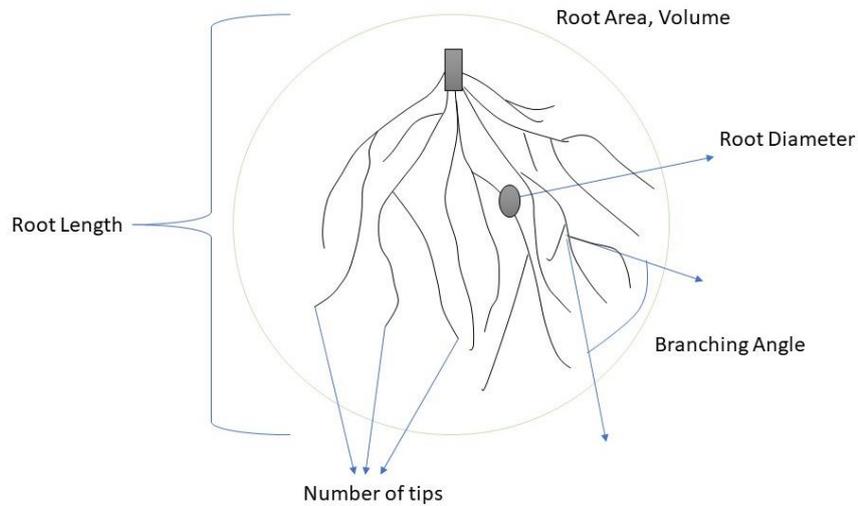


Figure 2. Root architecture measurements

The root architecture system simulates root growth according to measurements including root elongation, root length, number of tips, root diameter, root area, root volume, and branching angle (Figure 2).

3. Wheat root and drought

Wheat root architecture plays a crucial role in the plant's ability to withstand drought stress. A well-developed root system can help the plant access deeper soil layers for water and nutrients, improving its chances of survival during periods of drought.

One key aspect of root architecture is root depth, which refers to the depth at which the roots grow in the soil. Wheat plants with deeper roots are better able to access water stored in lower soil layers, which can be particularly important during dry periods. As mentioned above low spring precipitation value leads to less water availability in the roots near the surface of the soil. According to the study carried out by Khalil et al. (2020); early development of wheat (14th and 21st days after germination) plant root development and photosynthetic metabolism changes were observed under water-limited conditions (25%, 50%, 75% and 100% Field capacity).

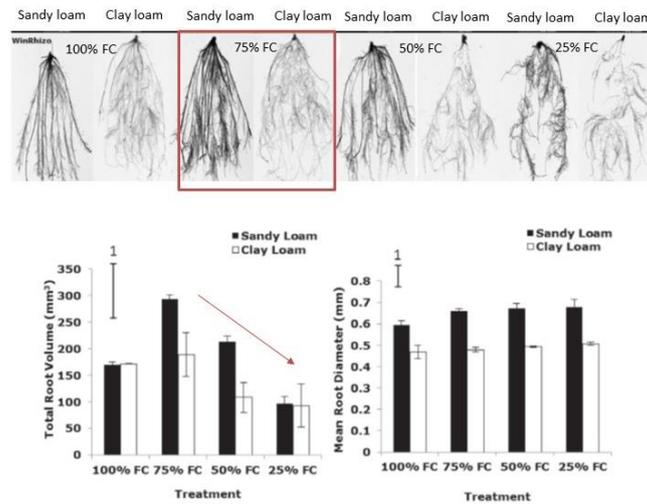


Figure 3. WinRHIZO root images and total root volume under different water deficit conditions (modified from Khalil et al. 2020)

It was stated that root dry weight decreased significantly in sandy-loam soil type with decreasing soil moisture (from 75% field capacity to 25% field capacity), but root diameter increased in limited water conditions in contrast to root volume and dry weight in limited irrigation conditions. Restricted water conditions resulted in a reduction in root length and total root volume (highest in 75% Field capacity) in both soil types under extremely limited irrigation conditions (25% field capacity) and plant root development was significantly affected in drought conditions (Figure 3).

Wheat root development and water-use efficiency of post-flowering drought stress and early drought stress conditions were examined to investigate the effects of groundwater on wheat root development and grain yield were determined by Kirkegaard et al. (2007). According to their study, the root penetration rate was 11-12 mm per day from the sowing to the flowering period. Root development and penetration rate were severely impaired when the plant water utilization rate was 45% or less. In the post-flowering drought period, 4.8 mm at 1.35 m depth and 15.3 mm at 1.85 m depth water amount were extracted from the roots, and it was concluded that more humid groundwater had a higher level of water use efficiency by increasing the stay flag leaf green, low senescence, root length, and density.

Root characteristics were investigated in three locations with different soil properties (Lyons, Ireland; HAU, England; Southoe, England) to investigate the effects of soil properties and environmental conditions on wheat root development and yield potential. It was concluded that a statistically negative relationship was observed between root properties (root density, root volume, root surface area, and length) and soil bulk density. Despite the reduced root development, significantly higher yield values were achieved in clay loam soils. Although



higher root volume, surface area, and root length were obtained in sandy-loamy areas where lower yield values were obtained. Considering the climatic characteristics, it was stated that moisture losses in the soil were higher in Southoe and HAU locations in May and June, and it was understood that this value was higher, especially in the location with sandy-loam soil structure. In high bulk density soil properties lead to reduced vertical growth and increased horizontal spread of the roots (Hobson et al. 2022).

Crop root systems capture the water and nutrients required for crop growth, and improved root systems customized to the challenges of specific agricultural environments may improve climate resilience (Ober et al. 2021). Root angle, main root length, number of lateral roots, and mean root diameter are the most important and critical root system architecture features that control water uptake under drought stress conditions. The root system resistance mechanism in arid environments is generally known as plants with phenotypically smaller root diameters and higher root length values. In the early development period, the narrower root angle can reach a greater root depth compared to plants with a wider root angle (Koch et al. 2021). Another important aspect of root architecture is root branching, which refers to the degree to which the roots branch out within the soil. Wheat plants with a high degree of root branching can effectively explore a larger volume of soil for water and nutrients, improving their ability to withstand drought stress (Christopher et al. 2008; Wasson et al. 2012; Lynch, 2013).

4. Conclusion

Root system architecture studies have a great contribution to achieving higher wheat yield in the context of climate change and perhaps this could be exploited through wheat drought tolerance in breeding studies. Overall, wheat root architecture plays a critical role in the plant's ability to withstand drought stress. By developing a more extensive and well-adapted root system in early growth stages in the winter season wheat can better survive in the periods of water scarcity conditions that occur in generative growth stages and may achieve optimal yield values even under challenging environmental conditions.



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THE EFFECTS OF HEAT STRESS ON SOME PARAMETERS IN SHEEP AND GOATS

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ABSTRACT

Sheep and goats constitute one of the important meat and milk sources in the world. In the context of environmental changes, the improvement and conservation of these species is a must to meet the growing meat and dairy needs of people, both nationally and internationally, in a sustainable way. Sheep and goat breeding is important, especially in developing countries, as it has good adaptability and is resistant to harsh environmental conditions. However, heat stress leads to serious changes in body functions and temperature tolerance depends on many factors such as breed, age, sex, body weight, nutrition, health status, physiological condition of the animal. Under the changing climate scenario, different strategies should be developed in order to ensure sustainability by ensuring the economic security of the poor farmer in sheep and goat breeding. To be able to reduce the effects of all stress factors that directly or indirectly affect sheep and goat production can be listed as grazing management, shelter management, breeding management, use of feed resources, nutrition management, water management, disease management and genetic improvement. Basically, all these strategies are based on physical modification of the environment, genetic modification and improved nutritional management. In order to achieve optimum production in a changing climate scenario, a holistic approach is needed according to environmental conditions and available resources. In this study, it is aimed to reveal the effects and importance of heat stress on some physiological parameters in sheep and goats.

Keywords: Sheep, goat, physiological parameters, heat stress



1. Introduction

Sheep and goats constitute one of the important meat and milk sources in the world. In the context of environmental changes, the improvement and conservation of these species is a must to meet the growing meat and dairy needs of people both nationally and internationally in a sustainable way. According to the researches, it is estimated that the global demand for food products will increase by 35-50% between 2012 and 2050 (FAO, 2019). Sheep and goats represent 57.4% of ruminant animals in the world, with a total of 1 263 136 644 sheep and 128 106 236 goats (FAO, 2022).

In general, sheep and goats are raised on pastures in large groups based on low inputs in terms of feed, water and labor and have high thermotolerance compared to bovine (Aleena et al., 2018). About 50% of the sheep and goat population are found in the arid regions of the world. This is an indication of their versatility and tolerance to increasing temperatures (Gowane et al., 2017). Sheep and goat breeding is important, especially in developing countries, as it has good adaptability and is resistant to harsh environmental conditions. However, heat stress leads to serious changes in body functions, temperature tolerance depends on many factors such as breed, age, sex, body weight, nutrition, health status, physiological condition of the animal. In farm animals, stress is an effective factor on prenatal and postnatal offspring growth rate, immunity, adaptation, yield, behavior and reproductive ability. Stress can negatively affect the emergence of hereditary characteristics (Altınçekiç and Koyuncu, 2012). The factors that cause stress in small cattle are given in Table 1, and the parameters used to measure the effects of stress are given in Table 2.

Table 1. Factors causing stress in sheep and goats (Tüfekci and Tozlu Çelik, 2022)

Stress Factor	Source
Hunger	Durmuş and Koluman (2020)
Thirst	Durmuş and Koluman (2020)
Bad treatment	Durmuş and Koluman (2020)
Increase or decrease of heat	Macías-Cruz et al., (2018); Kalaitzidis et al., (2021)
Noise	Durmuş and Koluman (2020)
Congestion	Durmuş and Koluman (2020)
Disease	Harle et al., (2007); Napolitano et al., (2002)
Fear	Durmuş and Koluman (2020)
Toxin intake with feed	Cao et al., (2021)
Poor shelter conditions	Durmuş and Koluman (2020)
Temperature, humidity and wind	Kalaitzidis et al., (2021)
Breeding practices	Napolitano et al., (2002)
Separation from mother	Napolitano et al., (2002)



Table 2. Parameters used to measure the effects of stress (Tüfekci and Tozlu Çelik, 2022)

Effect	Source
Respiratory rate	Fonseca et al., (2019); Maurya et al., (2019)
Pulse	Fonseca et al., (2019); Maurya et al., (2019)
Rectal temperature	Fonseca et al., (2019)
Changes in T3, T4 and Cortisol hormones	Macías-Cruz et al., (2018); Maurya et al., (2019)
Body weight loss	Durmuş and Koluman (2020)
Increase in body temperature	Fonseca et al., (2019)
Increased incidence of diseases	Karthik et al., (2021)
Decline in yield	Kalaitzidis et al., (2021)
Plasma Cortisol	Napolitano et al., (2002); Pulido-Rodríguez et al., (2021)

Respiration rate can be a good indicator of heat stress (Haheeb, 1992). Physiological respiratory rate in sheep is 25-30 breaths per minute. An increase in breath of more than 40 breaths per minute can be considered panting and the animal exhales water vapor, using it to increase temperature loss. In severe thermal stress, the respiratory rate reaches 300 breaths per minute (Table 3). Thermal stress determination based on respiratory rate has advantages such as remote observation and ease of evaluation (Silanikove, 2000).

Table 3. Thermal stress level based on the respiratory rate (Silanikove, 2000)

Breaths/minute	Level of heat stress
40-60	Low
60-80	Medium
80-120	High
>200	Severe heat stress

Climate change causes sudden changes in temperatures, resulting in a decrease in feed and water resources, and a decrease in the species and diversity of forage crops in pastures. Sheep and goat breeding is done by grazing in the pasture. Changes in feed and water resources cause stress (Altınçekiç and Koyuncu, 2012). High environmental temperatures, along with relative humidity (RH), airflow, and solar radiation, raise body temperature above critical levels. This causes physiological side effects in animal production (Kadim et al. 2008).



In 2021, the global mean annual temperature anomaly was 1.4 °C. 2021 tied with 2019 as the third warmest year over the period 1961-2021 (Figure 1), following 2016 (1.6 °C) in second position and 2020 (1.7 °C) as the warmest year on record. Also, the last decade (2012-2021) was on average 1.3 °C warmer than 1951-1980; this represents a warming of 0.3 °C in the previous decade (2002-2011) and a warming of 0.7 °C compared to 1992-2001 (FAO, 2022).

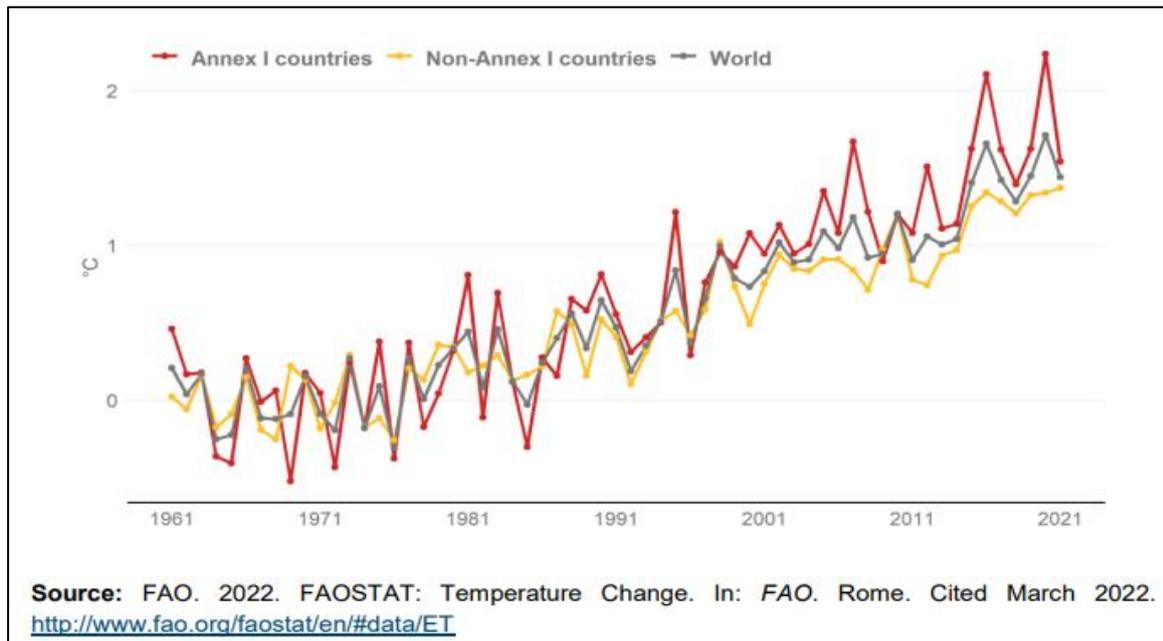


Figure 1. Mean annual temperature anomalies over land (FAO, 2022)

2. Heat stress in sheep and goats

High temperature adversely affects animal welfare and this situation negatively affects the immune, nervous and endocrine systems in animals, increasing the health problems of the animal and negatively affecting parameters such as the animal's life time, quality and productivity level. For optimum production for each species, the comfort zone (thermal comfort zone) temperature values are different, as well as the temperature sensitivity of the species in age and periods.

Under the influence of heat stress, animals will reduce their food intake and digestive capacity, resulting in less nutrient absorption. In this case, reproduction will be the first to be affected, followed by production and growth. In the advanced stages of heat stress, only energy will be used for vital activity (McManus, et al., 2020). When sheep are exposed to high air temperatures, they first keep their metabolism stable and increase evaporation. It has been reported that sheep are more sensitive to cold, heat loss is affected even at a relatively moderate air temperature of 24 °C (Fonseca et al., 2019). High environmental temperatures jeopardize



productivity in lactating sheep and goats, increasing energy requirements partly due to higher respiration rates. Along with the progression of lactation, heat stress may cause a decrease in milk yield and quality (Brasil et al., 2000; Peana et al., 2007; Sevi and Caroprese, 2012; Smith et al., 2013).

In addition, heat stress may endanger udder health and milk quality by causing more bacterial colonization in the udder in sheep (Sevi and Caroprese, 2012). Heat stress also affects meat yield and meat quality in sheep and goats, some studies have reported that higher pH and darker meat are obtained (Kadim et al., 2006; Archana et al., 2018). Temperature increases increased the risk of udder infection in lactating animals (Koyuncu and Akgül, 2018), and it also caused decreases in birth weight and survivability in kids (Luo et al., 2020). High body temperature in rams during heat stress causes decreased sperm quality, decreased percentage of normal and fertile spermatozoa, low ejaculate volume, and high semen pH (Hansen, 2009; Hamilton et al., 2016; Rahman et al., 2016). Studies have reported that heat stress is the most important external factor affecting the reproduction of sheep (West, 2003; Wall et al., 2010; Sejian, 2013).

Studies have reported that high temperatures during the mating period adversely affect fertilization and embryo survival, and consequently significantly reduce the pregnancy rate (Dutt, 1964; Lindsay et al., 1975; Kleemann and Walker, 2005). The results of studies investigating the effects of heat stress on the estrus cycle indicate that it reduces behavioral estrus duration, estrus incidence and cycle length (Naqvi et al., 2004; Indu et al., 2015; Romo-Barron et al., 2019).

3. Conclusion

In changing climate conditions, different strategies should be developed in order to ensure sustainability by ensuring the economic security of poor farmers in sheep and goat breeding. To be able to reduce the effects of all stress factors that directly or indirectly affect sheep and goat production can be listed as grazing management, shelter management, breeding management, use of feed resources, nutrition management, water management, disease management and genetic improvement. Ensuring that animals can consume enough water in reducing the effects of heat stress is an issue that should be emphasized. In particular, there should be enough number of drinkers in which they can easily reach the animals in the supply of clean water, and these drinkers should be in the shaded area. Grazing should be done in cool times of the day, animals should not be walked in too hot and milking should be done in shaded areas in pastures. Enough area per animal should be provided in shaded areas to prevent



cramped animals. In addition, by providing enough ventilation (natural and mechanical ventilation) in the shelters, both animal health and mold and bacteria growth can be prevented. Care should be taken to select the materials to be used in the construction of shelters and canopies in a way that will provide heat insulation. Planning should be done by considering the topographic structure and climatic conditions of the region in the construction of shelters for animals.



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ÖZET

Kaz eti, diğer etlerle kıyaslandığında insanların beslenmesi açısından esansiyel amino asitlerin tamamını ve tüm et türleri arasında en yüksek miktarda doymamış yağ asitlerini içeren özel lezzete sahip bir gıdadır. COVID-19 pandemisi gıdanın ne kadar değerli ve önemli olduğunu toplumlara tekrar hatırlatmıştır. Bu açıdan gelişmiş ülkeler alternatif hayvansal protein kaynaklarından sürekli faydalanmaya çalışmaktadırlar. Türkiye’de kaz yetiştiriciliği özellikle son yıllarda tüketici talepleri nedeniyle artış göstermektedir. Uzun yıllar geleneksel ekstansif üretim sistemiyle yetiştirilen kazlar günümüzde entansif koşullarda da yetiştirilmeye başlanmıştır. Bunun sonucunda başarılı girişimler ile kaz eti büyük zincir market raflarında yerini almıştır. Bu durum önemli bir aşama olsa da özellikle kaz etinin kendine has bir tat ve aromaya sahip olması ve uzun yıllar geleneksel yapısını korumuş olması nedeniyle henüz geniş bir tüketici kitlesine sahip değildir. Ayrıca üretimin çoğunluğunda (kırsalda geleneksel üretim koşullarında) standart bir yetiştirme prosedürü ve kesim koşullarının gıda güvenliğine uygun olmaması da önemli sorunlardandır. Bununla birlikte yöresel ürünlere, gastronomiye ve serbest sistemlerde yetiştirilen hayvanların ürünlerine olan ilginin artması ve eti dışında diğer ürünlerinin de katma değerli olması kaz yetiştiriciliğine olan talebi artırmaktadır. Hali hazırda ülkemizde hem entansif hem de geleneksel üretim yapılmaya devam etmektedir. Her iki sistemde de kaz etinin elde edilmesi ve et kalite özellikleri üzerine iyileştirmeler yapılması gerektiği öngörülmektedir. Çünkü kesim ve depolama koşulları ile etin nakliyesi önemli oranda kontrolsüz olarak devam etmektedir. Sonuç olarak, ülkemizde kazların kesim işlemlerinin kaçak yapıdan yasal duruma geçmesi için minimum standartlara sahip kesimhane yönetmeliğine ihtiyaç olduğu açıktır. Yerli gen kaynağı olarak Türk kazının korunması için yabancı orjinli kaz hareketleri biyogüvenlik prosedürlerine uygun ve kontrollü hale getirilmeli ve damızlık düzeyinde materyal kabul edilmelidir. Yerli kazların nispeten düşük verim seviyelerini artırmaya yönelik bilimsel projeler ve üretim faaliyetleri desteklenmeli, kaz eti tüketimi için özendirici tanıtımlar gerçekleştirilmelidir.

Anahtar Kelimeler: Kaz, Et kalitesi, Kesim, Üretim sistemleri, Su kanatlıları



ADVANTAGES OF GOOSE MEAT PRODUCTION AND CURRENT SITUATION IN TURKEY

ABSTRACT

Compared to other meats, goose meat is a food with a special taste that contains all the essential amino acids for human nutrition and the highest amount of unsaturated fatty acids among all meat types. The COVID-19 pandemic has reminded societies how valuable and important food is. In this respect, developed countries are constantly trying to benefit from alternative animal protein resources. Goose production in Turkey has increased especially in recent years due to consumer demands. Geese, which have been raised with the traditional extensive production system for many years, have started to be raised in intensive conditions today. As a result, goose meat took its place on the shelves of big chain markets with successful initiatives. Although this is an important stage, it does not have a large consumer base yet, especially since goose meat has a unique taste and aroma and has preserved its traditional structure for many years. In addition, in most of the production (in rural traditional production conditions), a standard rearing procedure and the lack of food safety in slaughter conditions are also important problems. In addition, the increasing interest in local products, gastronomy and the products of animals raised in free systems and the added value of other products besides meat increase the demand for goose production. Currently, both intensive and traditional production continues in our country. In both systems, it is envisaged that goose meat should be obtained and improvements should be made on meat quality characteristics. Because the slaughter and storage conditions and the transportation of meat continue uncontrollably. As a result, it is clear that there is a need for a slaughterhouse regulation with minimum standards in order for the slaughter of geese to become legal from illegal construction. In order to protect the Turkish goose as a domestic gene source, the movements of the foreign origin goose should be made in accordance with the biosecurity procedures and controlled, and material at the breeder level should be accepted. Scientific projects and production activities for the improvement of domestic geese, which have relatively low productivity levels, should be supported, and promotions should be made to encourage goose meat consumption.

Keywords: Goose, Meat quality, Slaughter, Production systems, Waterfowls



1. Giriş

Kaz yetiştiriciliği ülkemizde geleneksel bir üretim yapısına sahip olmakla beraber kültürel ve sosyal bir alt yapıya da sahiptir. Türkiye’de hali hazırda önemli bir ticari yetiştiricilik alanı olmamasına rağmen Dünya’nın birçok ülkesinde önemli bir yer tutmaktadır. Kaz eti tüketiciler için alternatif bir üründür ve birçok ülkede olduğu gibi ülkemizde de tüketicilerin talepleri artış göstermektedir (Lukaszewicz et al., 2008; Kumar, 2009; Pingel, 2011; Boz et al., 2019; Wołoszyn et al., 2020).

Türkiye’de kaz yetiştiriciliğinin yoğun olarak yapıldığı bölgeler; Doğu Anadolu, Güney Doğu Anadolu, Batı Karadeniz, İç Ege, Orta Anadolu ve Göller Bölgesi kırsalıdır (Çelik ve Bozkurt, 2009; Yakan et al., 2012). Ülkemizin Doğu Anadolu bölgesinin kuzey kesiminin de içinde olduğu Kafkasya coğrafyasında yaşayan insanların kültürlerinde kaz önemli bir paya sahiptir (Kırmızıbayrak, 2020). Kazlar diğer kanatlı türlerinin yetiştiriciliğinden farklı olan bazı verim özelliklerine sahiptir. Selüloz içeriği yüksek yem maddelerini, otları ve yabani bitkileri sindirebilen, sert hava koşullarına ve hastalık etkenlerine dayanıklı, barınak gereksinimi az olan ve besi kabiliyeti yüksek bir kanatlı türüdür (Labatut, 2002; Boz et al., 2014).

Günümüzde tüketiciler, tükettikleri gıdaların besin kalitesi ve sağlıklarına olan yararları hakkında daha fazla bilinçlenmiş durumdadır. İnsan sağlığı açısından tüketilen gıdaların yağ içeriği ve yağ asidi bileşimi önem arz etmektedir. Et, temel bir diyet bileşeni olmasının yanı sıra, amino asitler, yağ asitleri, bazı vitaminler ve mineraller bakımından tüketici gereksinimlerinin büyük bir bölümünü karşılamaktadır. Etin duyu kalitesi, kas içi, kaslar arası ve deri altı yağ miktarı ile yağ asidi profilleri insan sağlığı açısından üzerinde durulan parametrelerdir (Yang et al., 2010; Costa et al., 2011). Bununla beraber tüketiciler elde edilen ürünlerin nasıl üretildiği sorusuna cevap aramakta ve temiz, sağlıklı ve daha iyi refah standartları sunan ortamlarda yetişen hayvanların biyogüvenlik esaslarına uygun şartlarda son ürün haline getirilmesini önemsemektedirler.

Kaz eti üretiminde genellikle entansif, ekstansif, yarı entansif ve geleneksel yetiştirme sistemleri kullanılmaktadır. Ülkemizde uzun yıllar geleneksel ve ekstansif üretim istemleri kullanılmıştır (Boz et al., 2014). Son yıllarda ticari yetiştiriciliğe olan talep artışı entansif ve yarı entansif yetiştirme sistemlerin kullanımını da artırmaya başlamıştır.

2. Kaz eti ve elde edilmesi

Kaz eti, diğer etlerle kıyaslandığında, insan beslenmesi açısından oldukça uygundur. Esansiyel amino asitlerin tamamını ve tüm et türleri arasında en yüksek miktarda doymamış yağ asitlerini içerir (Boz et al, 2019; Guo et al, 2020; Wereńska et al., 2021). Kazın da içerisinde bulunduğu



su kanatlıları kaliteli ve iyi bir yağ asidi bileşimine sahiptir (Biesek et al., 2020). Kaz etinde doymamış yağ asitlerinin yüksek oranda bulunması insan sağlığı açısından olumlu olmakla birlikte, bu durum etin raf ömrünün kısalmasına ve oksidatif bozulma nedeniyle etin organoleptik özelliklerinin azalmasına neden olabilmektedir (Boz et al., 2019). Bu nedenle kaz etinin özellikleri dikkate alınarak oluşturulan uygun yöntemlerle işlenmesi, paketlenmesi, depolanması ve nakledilmesi gerekmektedir. Kaz yağı en sağlıklı hayvansal yağlardan birisidir ve nispeten düşük doymuş yağ asitleri seviyesi nedeniyle tüketiciler için güvenli kabul edilmektedir (Wołoszyn et al., 2020). Kaz eti üzerinde yapılan çalışmalarda, ördek, tavşan, tavuk, hindi, sığır, domuz ve kuzu etinden daha iyi aterojenik (AI), trombojenik (TI), hipokolesterolemik/hiperkolesterolemik (h/H) indeksi tespit edilmiştir. Daha iyi AI ve TI değerleri ile h/H indeksinin düşük olması damar tıkanıklığını geciktirmek ve dolayısıyla kardiyovasküler hastalık riski açısından daha iyi olduğu anlamına gelmektedir (Boz et al., 2019; Wołoszyn et al., 2020).

Türkiye’de yetiştirilen kazların birçoğu kırsaldaki aile işletmelerinde kesilmektedir. Bu kesim koşulları, başın yerde veya asılı olarak kesilmesi, kaynayan bir kazandaki sıcak suya daldırma, el ile veya makine ile tüy yolma, el ile iç çıkarma ve temiz suyla yıkama işlemlerinden oluşmaktadır. Genellikle kesimler açık havada veya standartların tam olarak karşılanamadığı kapalı alanlarda yapılmaktadır. Bütün işlemler aynı anda ve aynı alanda yapılmaktadır. Bu durum elde edilen kaz etinin sağlık yönünden sorgulanmasını gerektirmektedir. Aynı zamanda kesime gönderilen kazların ve kesim sonrası etin sağlık yönünden gerekli incelemeleri yapılamamaktadır. Kazlardan elde edilen et ve et ürünlerinin taşıma ve nakliyesi de uygun olmayan araçlarla ve uygun olmayan depolama şartlarında gerçekleştirilmektedir. İzinli ve ruhsatlı işletmelerde elde edilen kaz eti ve ürünleri dışında diğer tüm ürünlerin nakliyesi soğuk zincire uygun değildir. Ticari işletmeler yönetmeliklere uygun üretim yapmaya çalışsa da henüz istenilen biyogüvenlik koşullarına sahip değildirler.

Bir gıda maddesinin sadece besinsel değerinin yüksek olması kalitesi için yeterli bir ölçüt olmamaktadır. İnsan sağlığına zarar verebilecek mikrobiyolojik, kimyasal ve fiziksel tehlikeleri içermemesi de gerekmektedir. Gıda kaynaklı hastalıklar halk sağlığını tehdit eden etmenlerin başındadır. Özellikle kanatlı etleri bu tip hastalıklardan sıklıkla sorumlu tutulmaktadır. Kesim, parçalama, depolama, taşıma, hazırlama ve paketleme gibi aşamalarda kanatlı karkasına mikroorganizma bulaşmasının engellenmesi ve bulaşmanın kontrol edilmesi oldukça zordur. Kazlar su ile ıslatma, tüy yolma, iç organların çıkarılması sırasında, başta bağırsak içeriği olmak üzere bakteriler ile kolaylıkla kontamine olabilmektedirler. Ayrıca depolama ve kurutma



yerlerinin şartlarının iyi olmaması nedeniyle çevreden, havadan toz ve toprakla zararlı etkenler karkaslara bulaşabilmektedir (Güven et al., 2003). Örneğin ülkemizde yöresel olarak tuzlanıp kurutulan kaz etlerinde taze tüketime sunulan etlere göre mikrobiyolojik yönden yasal limitlerin üzerinde bakteri sayısı tespit edilmiştir. Ayrıca halk sağlığını ciddi anlamda tehdit edebilecek patojenler de belirlenmiştir (Güven et al., 2003; İşgüzar ve Pingel, 2003; Kamber ve Yaman, 2016). Ülkemizin değişik coğrafyalarında farklı üretim sistemi ve besleme metodu ile yetiştirilen ve farklı yaşlarda kesilen kazların et kalitesi doğal olarak aynı olmamaktadır. Standart olmayan bu üretim şekli tüketiciler açısından da olumsuzluklara neden olabilmektedir. Yöresel üretim tekniklerinin kayıt altına alınıp, uygulanabilir olanlarının standartlaştırılması ve gıda üretim prosesine uygunluğu sağlanabilir. Bu sayede geleneksel üretim sistemleri terk edilmeden sağlıklı bir üretim gerçekleştirilebilir. Yönetmeliklere uygun yetiştirme sistemleri ve kesim koşullarının oluşturulması ile gıda güvenliği sağlanabilecektir. Ülkemizdeki son dönem gelişmeleri başarılı bir üretim sürecinin oluşabileceğini göstermektedir.

3. Kaz eti tüketim yöntemleri

Türkiye kaz eti tüketimi yönünden zengin bir kültürel alt yapıya sahiptir. Örneğin, Yozgat ilinde kaz eti ara aşı çorbası, Samsun ilinde tirit ve Kars ilinde fırında tandır yemeği olarak en çok tercih edilenlerdir. Kaz eti ve diğer ürünleri önceki yıllardaki gibi sadece yetiştiricilerin kendi iç tüketimine yönelik değil, artık pazarlanabilir bir ürün olarak da elde edilmektedir. Kaz eti üretimi, Kars, Ardahan ve Muş yörelerinde genel olarak geleneksel yöntemlerle tuzlanıp açık havada kurutulan bütün karkas şeklinde gerçekleştirilmektedir (Kırmızıbayrak, 2020). Diğer illerimizde ise bu yöntem uygulanmamaktadır. Kurutulan kaz etindeki lezzet farklılığı ülkemizdeki tüketicilerin tamamına hitap etmemektedir. Bu nedenle belirli yetiştirme prosedürlerine göre üretilip, ticari kesimhanelerde bütün ve parçalanmış kaz karkaslarının taze veya soğuk zincir ürün olarak paketlenerek market raflarında tüketicilere sunulması gerekmektedir. Yöresel olarak kurutulan, tuzlanan kaz etleri de coğrafi işaretli ürün olarak pazara hitap edebilir. Türkiye’de müteşebbislerimiz ve kurulan kooperatiflerimiz tarafından başarılı girişimler gerçekleştirilmiş ve kaz eti büyük zincir market raflarında yerini almıştır. Kaz etinin iller ve ülkeler arası satışı için soğuk zincir koşullarının türe özgü belirlenmesi gereklidir. Kazlar ülkemizde sadece bütün olarak satışa sunulmaktadır. Karkas parçalarının da satışa sunulması için gerekli girişimler yapılmalıdır. Karkas satışta daha az öneme sahip olacak sırt, kanat ve boyun eti değişik amaçlarla (Çorba, sucuk vb.) satışa sunulabilir ve kalp, karaciğer, taşlık, barsak, baş ve ayak da bu girişim içerisinde yerini almalıdır. Yöresel lezzetlerin tüketicilerin kolaylıkla ulaşabileceği raflara girmesi sağlanmalıdır. Kaz yağı



kazlardan elde edildiği haliyle kullanılmamakta, genellikle eritilip daha sonra katılması sağlanmaktadır. Bu üretim prosesi standartlaştırılarak gıda güvenliği sağlanmalıdır. Toplumun belirli kesimlerince sevilerek tüketilen kaz eti ve diğer ürünlerinin, tüm bireylerin ulaşabileceği ve tadabileceği pazarlama ağına kavuşturmak gerekmektedir.

4. Kazdan elde edilen diğer ürünler ve değerlendirme yöntemleri

Dünyada yetiştirilen kazlardan, insan gıdası olarak öncelikle et, yenilebilir iç organ, yağ ve zorla beslemeyle üretilen yağlandırılmış karaciğer elde edilmektedir. Zorla beslemeli yağlı kaz karaciğeri üretimi ülkemizde yapılmamaktadır. Bunun yanı sıra ülkemizde de sevilerek tüketilen baş, ayak ve barsak da ticarete konu olmaktadır. Gıda tüketiminin yanı sıra tüyleri tekstil sanayisinde yüksek talep gören kaliteli doğal elyaf hammaddesi olarak değerlendirilmektedir. Ayrıca bazı bitkisel üretim faaliyetlerinin yabancı ot mücadelesinde ve stratejik tesislerin çevresinde bekçi hayvan olarak da kazlardan yararlanılabilmektedir. Kaz tüyü ülkemizde bulunan tüy hammadde işleme tesislerinde kurutularak, sınıflandırma için yurt dışına gönderilmektedir. Sınıflandırılan kaz tüyleri tekrar ülkemize yüksek fiyatlarla tekstil ve mobilya üretimde kullanılmak üzere giriş yapmaktadır. Yapılacak yatırımlar ile bütün süreç Türkiye’de gerçekleştirilmelidir. Fakat bunun için kaz tüylerinin uygun koşullarda elde edilmesi ve nakledilmesi gereklidir. Et üretiminin iyileştirilmesi, kaz tüyünün de değerlendirilmesine önemli katkı sağlayacaktır. Çünkü ülkemizde kaz tüyü, kesilen kazlardan elde edilmektedir. Kazlar yabancı otlarla mücadele kapsamında birçok meyve bahçesinde kullanılmaktadır. Ülkemizin en önemli toplulaştırma projesi kapsamında oluşturulan meyve bahçesinde (Yozgat, Kadışehri, Kabalı Köyü, Deveci Havzası Meyvecilik Entegrasyon Projesi) kazlar yabancı otlarla mücadelede etkin bir şekilde yer almaktadır. Bu proje kapsamında üretilen meyvelerin büyük bir bölümü ihraç edilmektedir. Yabancı ot mücadelesi sonunda yetişkin kazlar kesilerek et üretimine katkı sağlamaktadır.

5. Kaz varlığı ve mevcut durum

FAO verilerine göre Dünyada 364 milyon adet kaz varlığı mevcuttur. Bu varlığın 312 milyonu Çin’de bulunmaktadır. Diğer önemli varlığa sahip ülkeler, Mozambik (15.911.000), Mısır (7.045.000), Myanmar (5.026.000), Polonya (5.022.000), Ukrayna (4.016.000), Rusya (3.620.000), Madagaskar (3.028.000), Türkiye (1.374.000), Macaristan (1.173.000), Tayvan (1.097.000), İran (995.000) ve İsrail (905.000)’dir (FAOSTAT, 2022). Tüketimde ve dış ticarete önemli bir yere sahip olan Almanya’da 608 bin, Fransa’da 316 bin ve İngiltere’de 140 bin adet kaz varlığı mevcuttur. Kaz varlığı açısından ilk 10 ülke arasında yer alan Türkiye’nin 2021 yılı mevcudu ise artarak 1.477.569 olmuştur. Türkiye önemli bir kaz varlığına sahip olsa



da et ve diğer ürünlerinin üretiminde yönetmeliklere uygun olmayan ve kayıt dışı üretim nedeniyle ticari kayıtlarda düşük seviyededir. Kaz varlığımız, üretim potansiyelimizin yüksek olduğunu ve gerekli ticari üretim koşulları sağlandığında iç ve dış satım için gerekli alt yapının hızla tamamlanabileceğini göstermektedir. Mevcut durumun hızlı bir şekilde iyileştirilmesi ve özellikle yüksek tüketim gösteren ülkelere ihraç edilebilir hale gelmelidir.

6. Kazlarda genetik iyileştirme çalışmaları

Ülkemiz kaz varlığı bakımından iyi bir konumda bulunsa da yetiştirilen kaz genotipleri açısından karmaşık bir yapıya sahiptir. Özellikle 2015 yılına kadar yerli genotip Türk kazlarla üretim yapılırken, artan talebi karşılamada yetersiz kalan gen kaynağımız yerine maalesef yurt dışından kaçak yollarla giren kaz genotipleri ülkemizde yetiştirilmeye başlamıştır. Damızlık vasıfta olmayan bu yurt dışı orjinli kaz genotipleri ile beraber ülkemizde birçok hastalık tespit edilmiş ve geri dönüşü zor maliyetler ortaya çıkmıştır.

Yerli genotip kazlarımız özellikle üreme verimi yönünden diğer kaz genotiplerine göre düşük seviyededir. Yerli genotip kaz yetiştiriciliğinde üreme performansının artırılması karlı ve sürdürülebilir bir üretim için önemli görülmektedir. Bu da kazların yetiştirildikleri çevre koşulları ile birlikte genetik yapının da iyileştirilmesine bağlıdır. Ülkemizde yerli kazlarda üreme ve büyüme özelliklerini iyileştirmeye yönelik büyük çapta genetik ıslah çalışması yürütülemediği görülmektedir. Yapılan çalışmaların neredeyse tamamı yerli ırklarda mevcut büyüme ve üreme performansını fenotipik düzeyde ortaya koyma üzerinedir. Diğer yandan üretici elindeki popülasyonların bazı morfolojik özelliklerini de dikkate alarak yumurta verimi, kuluçka özellikleri ve yumurtlama periyodlarını entansif ve yarı entansif üretim koşullarında ortaya koyan çalışmalar da oldukça yetersizdir. Yumurta verimi ile ilgili değerlendirmelerin çoğu üreticilerden elde edilen anket bilgilerine dayanmaktadır (Boz, 2015). Kazlar yabancı ülkelerde yerel gen kaynakları olarak oldukça rağbet görmekte ve değişik verimler yönünde ıslah ve seleksiyon uygulanırken Türkiye’de yerli genotip kazların ekonomik öneme sahip verim özelliklerinin iyileştirilebilme olanakları ile kazların genetik potansiyellerini ortaya koyan bir çalışma bulunmamaktadır.

Diğer yandan yerli kazlarda büyüme ve üreme performansının ticari bir üretim için yeterli olmaması işletmeleri doğrudan dış kaynaklı yüksek verimli ebeveyn materyal arayışına yöneltmektedir. Ancak yerli genotip kazların yerel koşullara adaptasyon sağlaması bu materyali geçmişten geleceğe taşıyan değerli bir gen kaynağı yapmaktadır. Bu sebeple hem genetik kaynağın korunması hem de karlı ve sürdürülebilir bir üretim için bu materyalin genetik özelliklerinin ortaya koyulması önemlidir. Tüm bu nedenlerle, bildiri yazarları tarafından 2022



yılında TÜBİTAK destekli “Yozgat yöresi yerli genotip kazlarda üreme, kuluçka, büyüme ve karkas özelliklerine ait genetik parametrelerin tahmini” adlı bir araştırma projesi başlatılmıştır. Ekonomik özelliklerin fenotipik olarak yerli kazlarda her ne kadar yetersiz olduğu ortaya koyulsa da bu özelliklerin genetik olarak iyileştirilebilme potansiyeli halen ortaya koyulmuş değildir. Bu proje ile yerli kazlarda üreme, kuluçka, büyüme ve karkas gibi ekonomik verim özelliklerine ait genetik parametreler ortaya koyulacaktır. Çalışma sonuçlarına bağlı olarak ülkesel ıslah çalışmaları planlanabilecek ve uygun stratejiler geliştirilebilecektir.

7. Sonuç

Ülkemizde kaz yetiştiriciliği büyük oranda aile işletmelerinde geleneksel yetiştirmeye dayalı olarak gerçekleştirilmektedir. Aynı şekilde kesim işlemlerinin de geleneksel koşullara göre yapılması yasal gerekliliklerin yerine getirilememesine neden olmaktadır. Bu nedenle, kaz ve diğer bazı kanatlı türlerini de kapsayacak minimum standartlara sahip kesimhane yönetmeliğine ihtiyaç duyulduğu açıktır. Aksi halde, kesimlerin neredeyse tamamı kaçak olarak gerçekleşmeye devam edecektir.

Ülkemize özellikle 2015 yılından sonra kontrolsüz şekilde giren yabancı orjinli kaz genotipleri yerli gen kaynağımız olan Türk kazı popülasyonlarının korunmuş yapısını tehlikeye sokmaktadır. Bunun yanında ülkemizde daha önce görülmemiş hastalıkların da görülmesine neden olmakta ve kanatlı hayvancılık için biyogüvenlik riskleri oluşturmaktadır. Bu nedenlerle yerli gen kaynağımızın korunması amacıyla yabancı orjinli kaz girişlerinin kontrollü hale getirilmesi ve bu materyalin de hibrit yerine damızlık düzeyde temin edilmesi daha uygun olacaktır.

Yerli kazların üreme ve büyüme düzeyinin artırılmasına yönelik kamuda başlatılan genetik ıslah çalışmaları mevcut genetik yapıyı bozmadan devam etmelidir.

Kaz etinin ekonomik olarak üretimine yönelik proje ve üretim destekleri artırılmalı, tüketimi için de görsel ve yazılı medyada özendirici tanıtım faaliyetleri gerçekleştirilmelidir.



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ISOLATION OF ASYMPTOMATIC CARRIER ISOLATES OF GROUP A BETA HAEMOLYTIC STREPTOCOCCI FROM CLINICAL SAMPLES IN KARIMNAGAR

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ABSTRACT

Streptococcus pyogenes, also known as group A *Streptococcus* (GAS), causes mild human infections such as Pharyngitis and impetigo and serious infections such as necrotizing fasciitis and streptococcal toxic shock syndrome. Furthermore, repeated GAS infections may trigger autoimmune diseases, including acute post streptococcal glomerulo-nephritis, acute rheumatic fever, and rheumatic heart disease. Combined, these diseases account for over half a million deaths per year globally. Genomic and molecular analysis have now characterized a large number of GAS virulence determinants, many of which exhibit overlap and redundancy in the process of adhesion of colonization innate immune resistance and the capacity to facilitate tissue barrier. Group A Streptococcal infections occur when bacteria enter your body and causes an illness. Most illness are mild and effect the skin and throat. The GAS bacteria is contagious and spreads easily. In this work we have collected samples from different hospitals and diagnostic centers. Throat swabs were collected and streaked on blood agar media and incubated for 24 to 36 hours.

Aim

The study was conducted to isolate beta-hemolytic streptococci (Bet H S) in Karimnagar



Introduction

Among the Gram-positive cocci, *Streptococcus pyogenes* (colloquially termed the “group A streptococcus” or “GAS”, based on the presence the group A cell wall polysaccharide antigen), is one of the most successful pathogens worldwide. It causes superficial and deep (invasive) infections almost exclusively in humans. Among those are the quite common upper respiratory tract infections (pharyngotonsillitis—“sore throat”) predominantly occurring in children, superficial skin infections (*impetigo*), and deep skin infections, such as erysipelas and cellulitis, and invasive infections appearing as necrotizing fasciitis (NF, “flesh-eating disease”, necrotizing soft tissue infections—NSTI or sepsis. In addition, superficial and invasive GAS infections can be associated with reactions to toxins produced by *S. pyogenes*, appearing (among other signs) as scarlet fever (*scarlatina*) or as streptococcal toxic shock syndrome (STSS). Moreover, late non-suppurative sequelae might appear weeks after a streptococcal infection, namely the acute rheumatic fever (ARF, including rheumatic heart disease—RHD primarily after throat infections or an acute glomerulonephritis (AGN, affecting the kidney) occurring after both streptococcal throat and skin infections. These sequelae are ascribed to autoimmune reactions directed against cross-reactive streptococcal antigens or neoantigens developing during an acute GAS infection.

Symptoms

Symptoms range in severity and vary based on the illness that the group A streptococcus bacteria caused. Mild symptoms of group A streptococcal infection include:

Difficulty swallowing or pain when swallowing.

- Headache.
- Small red spots on the roof of your mouth (petechiae).
- Sore throat.

Symptoms that affect the skin from a group A streptococcal infection include:

- Rash on your neck, underarms or groin.
- Small, red to purple sores on the nose, mouth, arms and legs.
- Itchy skin.

Materials and Methods

1. Study population In this prospective study:

children 3-15 years of age with acute tonsillopharyngitis who attended. Children’s Hospital emergency ward in local private Hospitals were enrolled in a sequential manner



2. Sample collection, transport, and culture:

A throat sample was obtained with a Dacron swab from the patients by a physician

Method

Streptococci are generally grown on agar media supplemented with blood. This technique allows the detection of β -hemolysis, which is important for subsequent identification steps, and enhances the growth of streptococci by the addition of an external source of catalase. Selective media for culturing Gram-positive bacteria (such as agar media that contains phenylethyl alcohol, or Columbia agar with colistin and nalidixic acid) also provide adequate culturing conditions for *S. pyogenes*. Optimal incubation conditions for the vast majority of streptococcal strains include a temperature range of 35°C to 37°C in the presence of 5% CO₂ or under anaerobic conditions. During examination of patients, throat swabs were obtained from every patient using transport medium for culture valuation. After throat swabs were obtained, bacterial cultures were made within 2 hours by inoculating agar plates containing 5% sheep blood and incubated at 37°C for 20–24 hours. When the Beta hemolytic colonies were identified on the basis of 10 or more CFU on a blood agar plate, colonies suggestive of β -hemolytic Streptococcus were collected and subculture was performed a sheep blood agar slide (5%).

Results

In this study, GAS strains was isolated from tonsillo pharyngeal cultures of 15 patients

Discussion

GAS infections that cause tonsillo pharyngitis are important infectious disease with regard to some complications of these infections in the pediatric age group. Particularly in developing countries, these diseases remain significant public health problems. Pharyngitis with GAS and other infections have remained unchanged in both developed and developing countries.

Conclusion

The objectives of this study were to identify isolates of *S. pyogenes* obtained from tonsils pharyngeal s infections, and now we have to assess their suceptibilty to several antibiotics.



KEÇİBOYNUZU (*Ceratonia siliqua*) AĞAÇ YAPRAKLARININ *in vitro* GAZ ÜRETİMLERİNİN BELİRLENMESİ

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ÖZET

Bu çalışmada farklı illerden (Antalya, Mersin, Adana, Osmaniye, Kahramanmaraş) toplanan keçiboynuzu (*Ceratonia siliqua*) ağaç yapraklarının 24 saatlik inkübasyon süresi boyunca ürettikleri toplam gaz (TG) ($\text{ml}^{-1}200 \text{ mg}$), metan (ml) ve yüzde metan (%) değerlerinin belirlenmesi amaçlanmıştır. Toplam gaz (TG) ($\text{ml}^{-1}200 \text{ mg}$), metan (ml) ve yüzde metan (%) değerlerinin yaprakların toplandığı illere göre önemli derecede farklılık gösterdiği saptanmıştır ($P<0.05$). Keçiboynuzu ağaç yapraklarının TG üretimleri 19.23-26.52 $\text{ml}^{-1}200 \text{ mg}$, net metan 1.94-3.16 ml, yüzde metan değerleri ise %10.10-13.28 arasında değişmiş ve bu değişim istatistiki olarak önemli bulunmuştur ($P<0.05$). En yüksek TG ve net metan değerleri Kahramanmaraş ilinden, en düşük TG ve net metan değerleri Mersin ilinden toplanan yapraklardan elde edilmiştir. Yüzde metan değerleri ise en yüksek Antalya, en düşük Mersin ilinden toplanan yapraklardan elde edilmiştir.

Anahtar Kelimeler: Gaz üretimi, metan, ağaç yaprağı.



DETERMINATION of CAROB (*Ceratonia siliqua*) TREE LEAVES OF IN VITRO GAS PRODUCTION

ABSTRACT

In this study, was purposed to determine the gas production and methane production at 24 h Carob (*Ceratonia siliqua*) leaves collected in different (Antalya, Mersin, Adana, Osmaniye, Kahramanmaraş) province. Leaves samples collected from different provinces had a significant ($P<0.05$) effect on gas production, methane production. The gas production and methane production at 24 h ranged from 19.23-26.52 ml⁻¹200 mg, 1.94-3.16 ml, %10.10-13.28 respectively. The highest TG production and net methane was determined in Kahramanmaraş, while the lowest was determined in Mersin. While the percent methane production values the highest in Antalya, the lowest in Mersin.

Keywords: Gas production, methane, tree leave.



Giriş

Türkiye'nin büyük bir bölümünde geniş getiren hayvanların üretkenliği, yaz mevsiminde yüksek kaliteli kaba yem üretiminin en düşük düzeyde olması nedeniyle düşük düzeyde enerji ve protein alımı ile sınırlıdır. Yaz dönemindeki bu kritik dönemi geçirmek için ruminant hayvanların beslenmesinde ağaç ve çalılardan elde edilen yaprak ve kabuklar kullanılmaktadır (Kamalak ve ark., 2005).

Yem fiyatlarındaki süregelen artışlardan dolayı, yem maliyetlerini azaltabilmek adına doğal olarak yetişen bitkilerden alternatif yeni kaynaklar aramaya yöneltmiştir (Boğa ve ark., 2022). Bu kaynaklardan biri olan Keçiboynuzu (*Ceratonia siliqua* L.), baklagil (fabaceae) ağacı olup çoğunlukla Akdeniz bölgesinde doğal olarak yetişen, bakla üreten ve herdem yeşil bir ağaçtır. Öyleki keçiboynuzunun meyvesi, yaprağı, kabuğu, küspesi hem hayvan beslemede hemde insan beslenmesin kullanıldığı bildirilmektedir (Silanikova *et al.* 2006, Youssef *et al.*, 2013). Ruminant hayvanlar fermantasyon sırasında önemli miktarda metan üretmektedir. Üretilen bu metan enterik metan olup küresel ısınmaya önemli bir katkısının olması ve enerji kaybına neden olduğu için arzu edilen bir olay değildir (Başer ve Kamalak, 2020).

Ülkemizde yetişen baklagil ağaç yapraklarının antimetajenetik özellikleri henüz bilinmemekle birlikte baklagil ağaçlarının ruminant hayvanlarda kullanımlarının metan emisyonunu azalttığı söylenmektedir (Frutos ve ark., 2002; Castro-Montoya ve Dickhoefer, 2020).

Bu çalışmada keçi boynuzu ağaç yapraklarının *in vitro* gaz üretimleri ve metan üretimlerinin belirlenmesi amaçlanmıştır.

Materyal ve Metod

Keçiboynuzu ağaç yaprakları yaz döneminin Temmuz ayında Akdeniz bölgesinin 5 farklı ilinden (Kahramanmaraş, Antalya, Osmaniye, Adana, Mersin) her bir il için beşer ağaçtan olacak şekilde elle toplanmıştır. Ağaç yaprakları toplandıktan sonra kuruması için laboratuvara getirilmiştir.

Laboratuvarda kurutulmuş yapraklar, 1 mm elekten geçecek şekilde öğütülerek *in vitro* gaz üretimleri tespiti için hazırlanmıştır. Rumen sıvısı Kahramanmaraş hayvan pazarında kesilen 3 farklı koçtan hemen alınmış ve termosu konulmuş, mikroorganizma faaliyetlerinin devam edebilmesi için hızlı bir şekilde laboratuvara getirilmiştir. Tampon solüsyonla karıştırılan örnekler (0.2 gram) koçlardan alınan rumen sıvısıyla 39°C'de 24 saatlik fermantasyona tabi tutulmuştur (Menke ve Steingass, 1988). Gaz üretimleri standart yeme ve kör ölçüme göre düzenlenmiştir.



Çalışma sonucunda elde edilen veriler tek yönlü varyans analizi (ANOVA) ile ortalamalar arasındaki farklılıklar ise Tukey testi ile belirlenmiştir ($P < 0.05$).

Bulgular ve Tartışma

Keçiboynuzu ağaç yapraklarının gaz ve metan üretimleri Tablo 1 de verilmiş olup ağaç yapraklarının gaz ve metan üretim değerleri toplandığı ile göre önemli seviyede değişiklik göstermiştir. Ağaç yapraklarının 24 saatlik rumen sıvısı inkübasyonu sonucu üretmiş oldukları toplam gaz değerleri 19.23-26.52 ml arasında değişmiştir. En yüksek gaz üretimi Kahramanmaraş ilinden, en düşük gaz üretimi Mersin ilinden toplanan yapraklardan elde edilmiştir. Farklı ağaç yapraklarının kullanıldığı bir çalışmada gaz miktarları 17.33-35.33 ml $200 \text{ mg}^{-1} \text{ KM}$ arasında belirlenmiştir (Özdemir ve Kaya, 2020). Başer ve Kamalak, (2020), bazı baklagil ağaç yapraklarının kullanıldığı çalışmalarında keçiboynuzu ağaç yaprağının net gaz üretimini 52.20 ml olarak belirlemişlerdir. Kurt (2022), gladiçya ağaç yapraklarının net gaz değerini 27.41-41.43ml olarak saptamıştır.

Tablo1. Keçiboynuzu ağaç yapraklarının gaz ve metan üretimleri

İl	Net Gaz	Metan (ml)	Metan (%)
Kahramanmaraş	26.52 ^a	3.16 ^a	11.91 ^{ab}
Antalya	23.54 ^{ab}	3.13 ^a	13.28 ^a
Osmaniye	21.21 ^{bc}	2.26 ^b	10.66 ^{bc}
Adana	19.89 ^{bc}	2.37 ^b	11.90 ^{ab}
Mersin	19.23 ^c	1.94 ^c	10.10 ^{bc}
Ö.S.	**	**	**
SHO	4.2148	0.7698	1.7506

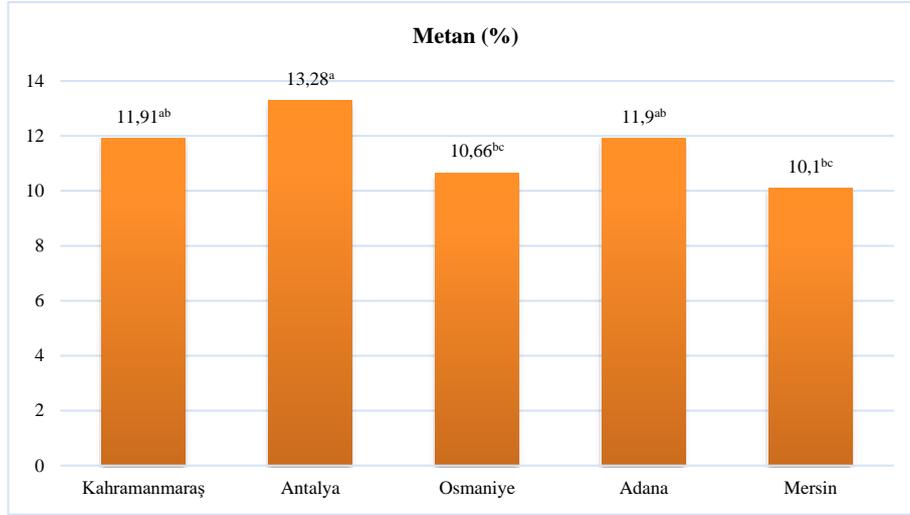
^{abc} Aynı üst simgeye sahip ve aynı satırda yer alan ortalamalar arasında fark yoktur ($P > 0.05$), SHO: Standart hata ortalaması, ÖS: Önem seviyesi.

In vitro koşullarda karbondioksit (CO_2) gazı yemlerin mikrobiyal fermentasyona uğraması sonrasında oluşur. CO_2 gazı doğrudan yemlerde bulunan karbonhidratların fermentasyonu sonucu oluşabildiği gibi bu fermentasyon sonucu açığa çıkan uçucu yağ asitlerinin (UYA) tampon çözeltisiyle reaksiyona girmesi ile de oluşabilmektedir (Wolin, 1960).

Metan gazı, küresel ısınmaya etki eden sera gazları içerisinde oldukça önemli bir gazdır (Steinfeldve ark., 2006). Metan gazı salınımının meydana gelmesinde tarımsal üretim, organik atıklar, hayvancılık faaliyetleri en önemli kaynaklardır. Toplam sera gazı salınımının %10-18'lik kısmını tarımsal üretim faaliyetleri oluştururken %3-5'lik kısmını ise ruminantlardan kaynaklı metan üretimi oluşturur (O'Mara, 2011).



Keçiyoynuzu ağaç yapraklarının 24 saatlik inkübasyonu süresince üretilen net metan miktarı 1.94-3.16 ml aralığında değişmiştir. En yüksek net metan Kahramanmaraş ili ile aynı istatistiksel grupta yer alan Antalya ilinden toplanan yapraklardan, en düşük net metan Mersin ilinden toplanan yapraklardan elde edilmiştir. Özdemir ve Kaya (2020), farklı ağaç yapraklarına ait metan içeriklerini 2.70-5.41 ml olarak tespit etmişlerdir. Başer ve Kamalak (2020), bazı baklagil ağaç yapraklarının kullanıldığı çalışmalarında keçiyoynuzu ağaç yaprağının net metan değerini 5.96 ml olarak belirlemiştir.



Şekil 1. Keçiyoynuzu ağaç yapraklarının metan (%) üretim değerleri

Keçiyoynuzu ağaç yapraklarının 24 saatlik inkübasyonu süresince üretilen %CH₄ miktarı %10.10-13.28 olarak belirlenmiştir. En yüksek %CH₄ Antalya ilinden toplanan yapraklardan, en düşük %CH₄ Mersin ilinden toplanan yapraklardan elde edilmiştir. Özdemir ve Kaya (2020), farklı ağaç yapraklarına ait %CH₄ içeriklerini 14.07-15.53 olarak, Başer ve Kamalak (2020), bazı baklagil ağaç yapraklarının kullanıldığı çalışmalarında keçiyoynuzu ağaç yaprağının %CH₄ değerini 11.42 olarak belirlemiştir. Yemlerin antimetanojenik özellikleri fermantasyon sırasında çıkan gazın metan içeriğine göre %11-14 arasında olan yemler düşük antimetanojenik, %6-11 arasında orta antimetanojenik, %0-6 arasında yüksek antimetanojenik olarak sınıflandırılmıştır (Lopez ve ark.,2010). Mevcut çalışmada keçiyoynuzu ağaç yapraklarının düşük antimetanojenik potansiyele sahip olabileceği söylenebilir.

Sonuç

Mevcut çalışmada keçiyoynuzu ağaç yapraklarının sadece gaz ve metan üretim değerleri verilmiştir. Yemlerin antimetanojenik özellikleri fermantasyon sırasında çıkan gazın metan içeriğine göre belirlenmektedir. Söz konusu çalışmada elde edilen %CH₄ değerlerinde göre



keçiboynuzu ağaç yapraklarının düşük antimetanojenik özellikte olduğu saptanmıştır. Keçiboynuzu ağaç yapraklarının ruminant beslemede kullanımına yönelik önerilerde bulunabilmek için söz konusu yaprakların kimyasal bileşimleri ile birlikte diğer inkübasyon parametrelerinde verilmesi gerektiği kanısına varılmıştır.



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MUŞ İLİNİN YEM BİTKİLERİ ÜRETİM ALANLARI VE DEĞİŞİMİNE BİR BAKIŞ

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ÖZET

Bu çalışma da Muş ili son on yıllık yem bitkileri ekim alanı, üretim miktarı ve verimlerinin bir değerlendirilmesi yapılmıştır. İlde yaklaşık 58 bin ha alanda yem bitkisi ekimi yapılmakta, 1.209.169 ton yeşil ot üretilmekte ve verim 11.073 kg/da olmaktadır. Muş genel olarak meraya dayalı hayvancılığının yapıldığı bir il olarak karşımıza çıkmaktadır. Meraların yıllardır süregelen bilinçsiz kullanımları sonucu verimliliklerini kaybetmeleri yem bitkilerine olan ihtiyacın önemini artırmaktadır. Ancak son on yılın verilerine göre ilde yem bitkisi ekilişi, üretimi ve verimi genel olarak azalmaktadır. Bu durumda ilk olarak üreticilere yem bitkileri kültürünün benimsetilmesi, yem bitkilerinin ekonomik anlamda diğer bitki gruplarıyla rekabet edebilecek konuma getirilmesi, yem bitkilerinin hayvan besleme dışındaki diğer faydalarının üreticilere anlatılması, meraların amenajman ilkelerine uygun kullanımlarının sağlanması ve ıslah edilerek söz konusu ilkelere uygun kullanımlarının sağlanması gerekmektedir.

Anahtar Kelimeler: Kuru ot, On yıl, Yeşil ot, Verim



A PERSPECTIVE ON THE PRODUCTION AREAS AND CHANGES IN FEED PLANTS OF THE PROVINCE OF MUŞ

ABSTRACT

In this study, forage crops cultivation area, production amount and productivity of the last ten years in Muş province were examined. Forage crops are cultivated in approximately 58 thousand hectares of land in the province. In this area 1.209.169 tons of green herbage is produced and the yield is 11,073 kg/da. Muş is generally seen as a Livestock Dependent on Rangelands. The loss of productivity of rangelands as a result of years of unconscious use increases the importance of the need for forage crops. However, according to the data of the last ten years, it has been observed that forage crops cultivation, production and yields have decreased in general in the province. In this case, first of all, it is necessary to adopt the forage crops culture to the producers and farmers, to bring the forage crops to a position to compete with other plant groups economically, to explain the other benefits of forage crops other than animal nutrition to the producers, to ensure that the pasture are used in accordance with the management and to ensure their use in accordance with these principles by improving them.

Keywords: Decade, Green herbage, Dry herbage Yield



Giriş

Yem bitkileri, hayvansal üretimin en önemli girdilerinden biri olan kaba yemi sağlamaktadır. Bunun yanında toprakların fiziksel ve kimyasal özelliklerine, kendinden sonra gelen kültür bitkilerinin verim ve kalitesine olumlu etkilerinin yanı sıra ucuz bir kaynak olması, hayvanların mide mikro florası için gerekli besin maddelerini içermesi, mineral ve vitaminlerce zengin olması, hayvanların üreme gücünü artırması ve yüksek kalitede hayvansal ürün sağlaması bakımından hayvan beslemede önemlidir (Serin ve Tan, 2001). Yem bitkileri tarımı, kaba yem üretiminin tedarik ve arzının en önemli yolu olması nedeniyle, ekonomik olarak yapılacak olan bitkisel ve hayvansal üretimin sigortası konumundadır (Açıkgöz, 2001).

Bugün hayvansal üretimde maliyetlerin %70'ini tek başına yem girdisi oluşturmaktadır (Sağlamtimur ve ark., 1998). Ekonomik bir hayvancılık yapılabilmesi içinse mera alanlarının iyileştirilmesi ve yem bitkileri birim alan verimlerinin artırılması gerekliliği vardır. Zira verimsiz meralara, ağırlıklı olarak saman ve anız ile hayvan beslemesine ve yüksek girdili kesif yem kullanılmasına dayalı hayvancılığın karlılık getirmesi mümkün değildir. Bununla birlikte son yıllarda kültür ve melez ırkı hayvanlarımızın sayılarında yerli ırka oranla gözle görülür bir artış görülmektedir. Dolayısıyla kalite düzeyi artış gösteren hayvan varlığının yeterli ve dengeli beslenebilmesinde gerekli olan kaba yem ihtiyacının karşılanması için yem bitkileri birim alan verimlerinin artırılması daha da elzem olmuştur.

Muş genel olarak meraya dayalı hayvancılığının yapıldığı bir il olarak karşımıza çıkmaktadır. Meraların yıllardır süregelen bilinçsiz kullanımları sonucu verimliliklerini kaybetmeleri yem bitkilerine olan ihtiyacı artırmaktadır. Tarımı gelişmiş ülkelerde yem bitkileri ekilen arazilerin tarla arazileri içerisindeki payı %20-50 arasında iken (Acar, 2017), ülkemizde bu oran ancak %13.6 kadardır (Anonim, 2022). Muş ilinde yem bitkileri ekim alanlarının ilin toplam tarla alanına oranı %25 olup, bu rakam ülke ortalamasından yüksektir (Anonim, 2022).

Türkiye'nin yem bitkileri üretim durumunu ortaya koyan birçok çalışma (Acar ve ark., 2020; Okcu, 2020; Özkan, 2020) yapılmasına karşın, farklı iklim ve toprak özelliklerine sahip ekolojik bölgelerde yer alan iller için yapılan değerlendirme (Temel ve Şahin, 2011, Özkurt ve Çınar, 2020; Kurt ve Güllap, 2021) sınırlı sayıda olup yeni güncellemeler gerekmektedir.

Bu sebeple Türkiye İstatistik Kurumu (TÜİK) verilerine dayanarak Muş ilinin son on yıllık yem bitkileri ekim alanı, üretim miktarı ve verimleri değerlendirmeye alınarak bu bildiri hazırlanmıştır.



1.1. Muş ili yem bitkileri üretim durumu

Muş ilinin on yıllık süre boyunca yem bitkileri ekim alanları tablo 1’de yer almaktadır. Buna göre 2013-2022 yılları arasında Muş ilinde tahıllar ve diğer bitkisel ürünlerin ekim alanları bir artış göstermiştir. Bu artış yaklaşık 24 bin ha olarak gerçekleşirken, yem bitkileri ekimindeki azalış ise yaklaşık bu artışın yaklaşık $\frac{1}{4}$ ’i kadardır. Bu oran tahıllar ekim alanına kaydığı varsayılsa bile geriye kalan $\frac{3}{4}$ ’ünün nereden geldiği tam olarak net değildir. Bu artışın da özellikle bölgede en çok yapılan uygulamalardan biri olan mera alanlarının tarlaya dönüştürülmesi olarak düşünülebilir.

Tablo 1. Muş ili yem bitkisi ekim alanlarının on yıllık kıyaslaması

Yıllar	Tahıllar ve diğer bitkisel ürünler Ekim alanı	Yem bitkileri ekim alanı toplam	Yem bitkilerinin oranı
2013	209.785 ha	65 bin ha	%31
2022	232.983 ha	58 bin ha	%25

Tahıllar ve diğer bitkisel ürünlerdeki artışa karşılık , yem bitkileri ekim alanları toplam yetiştirilen ürünlerin içindeki oranı %31 iken 2022 yılına gelindiğinde bu oran %25’e gerilemiştir. Son yıllarda yem bitkilerine verilen teşviklere rağmen ekim alanlarının azalması düşündürücüdür. Bu duruma neden olarak (i) yem bitkilerine verilen desteklemelerin yetersiz olması, (ii) yem bitkilerinin üretiminden elde edilen gelirlerin diğer tarımsal ürünler ile kıyaslandığında daha düşük olması, (iii) yem bitkileri üretiminde yıllardır süregelen ve bir türlü çözüme kavuşturulamayan yem bitkileri tohumluk tedarik sıkıntısı gibi nedenler sayılabilir.

1.2. Muş ili yem bitkileri ekim alanı, üretim ve verim durumu

Muş ilinin son on yıllık yem bitkisi ekim alanı, üretim miktarları ve verimleri Tablo 2,3 ve 4’de verilmiştir. Muş ilinde 2022 yılı itibariyle toplam yem bitkisi ekim alanı 57.288 ha dır. 2013 yılında 96.088 ha olan ekim alanı bu 2022 yılına gelindiğinde on yıllık süreçte %40 azalmıştır. İlde yetiştirilen yem bitkilerinin toplam yeşil ot üretimleri 2013 yılında 1.287.618 ton iken 2022 yılında 1.209.169 tondur. Yem bitkilerinin üretim miktarları on yıllık süreçte %6 azalmıştır. Muş ilinde yetiştirilen başlıca yem bitkileri yonca, korunga silajlık mısır ve fiğdir.



Tablo 2. Muş İli yıllara göre Yem bitkileri ekim alanları (ha)

Yıllar	Yem bitkileri								Toplam
	Fiğ	Macar Fiğ	Fiğ (Diğer)	Yonca	Korunga	Sorgum	Silajlık Mısır	Yem Bezelyesi	
2013	34.904	-	-	55.092	3.979	10.5	2.103	-	96.088
2014	-	-	3.807	59.896	4.990	-	2.175	-	70.868
2015	-	-	3.507	59.783	5.246	-	2.173	-	70.709
2016	-	-	3.719	57.150	5.324	-	2.160	-	68.353
2017	-	-	3.951	51.754	6.353	-	1.949	-	64.007
2018	-	-	3.962	53.140	6.160	-	2.113	-	65.375
2019	-	-	3.607	50.358	5.387	-	2.259	-	61.611
2020	-	-	3.577	49.427	5.438	-	2.314	-	60.756
2021	-	-	3.452	49.598	5.482	-	2.008	-	60.540
2022	-	68.1	2.887	48.106	3.849	-	2.310	68.0	57.288

2013-2022 yılları arasında en fazla ekim alanına sahip olan bitki yoncadır. Yonca 2013 yılında yem bitkisi ekim alanının %57'sini oluştururken, 2022 yılı itibariyle Muş ili yem bitkisi ekim alanlarının yaklaşık %84'ünü oluşturmaktadır.

Tablo 3. Muş İli yıllara göre Yem bitkileri üretim alanları (ton)

Yıllar	Yem bitkileri								Toplam
	Fiğ	Macar fiğ	Fiğ (diğer)	Yonca	Korunga	Sorgum	Silajlık mısır	Yem bezelyesi	
2013	60254	-		1.067.258	74.200	158	85.748	-	1.287.618
2014	-	-	79.868	1.404.205	92.815	-	87.249	-	1.664.137
2015	-	-	72.847	1.397.212	99.450	-	96.443	-	1.665.952
2016	-	-	74.574	1.341.770	98.188	-	105.200	-	1.619.732
2017	-	-	74.040	1.290.277	130.311	-	97.100	-	1.591.728
2018	-	-	74.790	1.343.140	132.943	-	105.255	-	1.656.128
2019	-	-	60.659	1.241.044	102.455	-	111.581	-	1.515.739
2020	-	-	60.634	1.234.224	106.200	-	114.190	-	1.515.248
2021	-	-	50.107	1.077.623	82.964	-	96.994	-	1.307.688
2022	-	170	36.631	994.811	50.716	-	126.365	476	1.209.169

Her ne kadar Muş ili yonca yetiştiriciliğinde yüksek potansiyele sahip olsa da yoncanın ekim alanı, üretim miktarı ve verimi son on yılda genel olarak azalan bir grafik çizmektedir. Bu durumda kullanılan çeşit, yetiştiricilikte yapılan uygulamalar gibi faktörlerin etkisinin olduğu düşünülmektedir. Muş ilinde yonca ekiminde sertifikalı tohumluk kullanılmamaktadır.



Tablo 4. Muş İli yıllara göre Yem bitkileri verimleri (kg/da)

Yıllar	Yem bitkileri							
	Fiğ	Macar fiğ	Fiğ (diğer)	Yonca	korunga	sorgum	Silajlık mısır	Yem bezelyesi
2013	1732	-	-	1.939	1.889	1505	4.077	-
2014	-	-	2.097	2.344	1.860	-	4.011	-
2015	-	-	2.078	2.337	1.896	-	4.448	-
2016	-	-	2.005	2.348	1.844	-	4.870	-
2017	-	-	1.874	2.493	2.051	-	4.980	-
2018	-	-	1.887	2.528	2.158	-	4.980	-
2019	-	-	1.681	2.464	1.902	-	4.939	-
2020	-	-	1.695	2.497	1.953	-	4.933	-
2021	-	-	1.451	2.170	1.526	-	4.830	-
2022	-	250	1.269	2.068	1.317	-	5.469	700

Buda kaynağı belli olmayan tohumların kullanımı sonucu yabancı ot bilhassa küsküt istilasına sebep olmakta verimi düşürücü etki yapmaktadır. Muş ilinde yonca ekiminde halen serpmek ekim uygulanmaktadır. Bu durumda hem gerekenden daha fazla tohumluk kullanımına yol açmakta hem de çıkışta problemler yaşanmaktadır. İlde yonca hasatları toprak seviyesinin hemen üzerinden yapılmakta bu durumda kök tacı zarar görmekte biçim sonrası tesis sıklığına ve verime zarar veren bir uygulama olarak karşımıza çıkmaktadır. Ayrıca biçimler zamanında yapılmamaktadır.

Korunga ekim alanları ise düzenli bir şekilde artmış ancak 2018 yılından sonra azalarak 2022 yılında on yıl öncesine gerilemiştir. Korunga üretim miktarı ve verimde tıpkı ekim alanlarında olduğu gibi önce artmış, sonrasında azamla eğilimi göstermiştir. Korunganın ekim alanında düzenli bir artışın olmayışının en önemli nedeni kök kurtlarıdır. Kök kurtları korunga tarlalarında erken seyreilmeye sebep olduğu için çiftçiler tarafından daha az tercih edilmektedir. Silajlık mısır ise son on yılda istikrarını korumuş, üretim miktarı ve verim genel olarak artış göstermiştir. Bunun sebebi bölge ekolojisine uygun sertifikalı verimi yüksek çeşitlerin kullanılması ve iklim koşulları ile ilişkilendirilebilir.

Yem bezelyesi ve macar fiğın istatistiklerde henüz 2022 yılında yer aldığı öncesinde yetiştiriciliğinin yapılmadığı görülmektedir. Yem bezelyesi 2022 yılında ilk defa istatistiklerde yer almış 6.8 bin ha alanda, 476 ton üretim ve 700 kg/da verim elde edilmiştir. Aynı şekilde macar fiğ de istatistiklere 2022 yılında girmiş 68.1 ha alanda, 170 ton üretim ve 250 kg/da verim sağlanmıştır. Yonca ve korunganın dışında bölgede kış aylarının sert geçmesi nedeniyle soğuğa dayanıklı Macar fiği önem kazanmaktadır. Fiğler ve yem bezelyesi gibi tek yıllık baklagil yem



bitkilerinin gelecek vadettiği ve üretim desenlerinde daha fazla yer alması gerektiği düşünülmektedir.

Sonuç

Muş ilinde hayvancılığın temel kaba yem kaynağı çayır-meralardır. Ancak mera amenajman ilkelerine uygun olmayan kullanımları nedeniyle ilin çayır meraları verimliliklerini kaybetmiş durumdadır. Bu durum yem bitkilerine olan ihtiyacı artırmaktadır. Ancak son on yıllık veriler incelendiğinde yem bitkileri ekim alanları ve üretim miktarlarında bir azalış söz konusudur. Bunun nedeni olarak (i) yem bitkilerine verilen desteklemelerin yetersiz olması, (ii) yem bitkilerinin üretiminden elde edilen gelirlerin diğer tarımsal ürünler ile kıyaslandığında daha düşük olması, (iii) yem bitkileri üretiminde yıllardır süregelen ve bir türlü çözüme kavuşturulamayan yem bitkileri tohumluk tedarik sıkıntısı gibi nedenler sayılabilir.

İlde yem bitkileri yetiştiriciliği halen geleneksel yöntemlerle yapılmaktadır. Üreticiler yem bitkileri yetiştiriciliğinin önemi ve bilimsel yetiştirme teknikleri hususunda bilinçlendirilmelidir. Yem bitkileri yetiştiriciliğinin en önemli dar boğazı olan tohumluk tedarik sorunu, bölgesel olarak uyum gösteren kaliteli yem bitkisi çeşitlerinin geliştirilmesi ve bunların üretilmesi ile çözümlenmelidir. Mevcut yem bitkileri bilimsel yetiştirme teknikleri ile ekim alanlarında uygun karışımlarla desteklenerek verimlilikleri artırılmalı ve yetiştirilen yem bitkisi türlerinin çeşitlendirilmesine ihtiyaç vardır. Sürdürülebilir verimliliğin sağlanabilmesi için ekim nöbeti içerisinde yem bitkilerine yer verilmelidir. Yem bitkilerinin ilde yetiştiriciliği yapılan tahıllar ve endüstri bitkileri ile rekabet güçleri artırılmalıdır. İl ekolojisine uygun yem bitkisi tür ve çeşitlerinin tespit edilip sonuçların üreticilerle paylaşılması gerekmektedir. Silajlık yem bitkisi yetiştirme ve silaj yapımı konusunda üreticiler bilinçlendirilmelidir. Alternatif kaba yem kaynaklarının değerlendirilmesi gerekmektedir.



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**MARKETING ANALYSIS OF VARIOUS TYPES AND CHARACTERISTICS OF
DAMAR MATA KUCING (*Shorea javanica*) TO SUPPORT THE ECONOMIC
SECTOR OF PEKON PAHMUNGAN COMMUNITIES, WEST COAST KRUI,
LAMPUNG, INDONESIA**

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ABSTRACT

Damar Mata Kucing resin is known as the best resin commodity at the international level. In order to succeed in marketing resin resin Damar Mata Kucing (*Shorea javanica*) this requires an optimal number of workers because as long as the marketing path is long, it creates an inefficient marketing system. The purpose of this study was to analyze marketing and to find out the price for each type of Damar Mata Kucing resin (*Shorea javanica*), Pekon Pahmungan, Krui District, West Coast District. This study uses descriptive analysis and statistics to determine the profit margin ratio and market integration. The field study was conducted in October 2022 in Pekon Pahmungan, Pesisir Barat District. The results of the study show that



there is only one damar marketing channel that offers the highest yield percentage for farmers, and has a simple marketing channel, namely from farmers to village-level collectors. Then sent to the company PT. Indo Gala Murni Pratama and exported to foreign countries, namely China and India. On the other hand , operational efficiency and price transmission explain that resin marketing is inefficient because the market structure is an oligopoly market. In marketing gum damar resin, the price of gum damar is determined by its quality. The highest price of gum resin reaches Rp. 30,000/kg until the lowest price of resin resin reaches Rp. 12,000/kg. In 2022 the price of damar sap has decreased sharply by up to 50% or reached an average selling price of only IDR 12,000/kg. This is due to fluctuations in the price of sap resin at the global level.

Keywords : Resin, gum resin, pahmungan, marketing



Introduction

Damar Mata Kucing resin (*Shorea javanica*) is known as the best resin commodity at the international level. Especially the resin produced by Pekon Pahmungan, Krui District, West Coast Regency is well known internationally. Pekon Pahmungan has an area of managed damar repong area of \pm 2600 hectares, the forest area is divided into two parts, namely an area of 40 hectares dominated by plantations and rice fields and an area of \pm 25 hectares dominated by residential residents who live in Pekon Pahmungan. Pekon Pahmungan is bordered by Pekon Way Ngison to the north, and borders Forest Areas and National Parks to the east. The population living in Pekon Pahmungan is 1170 people with 582 men and 588 women, where most of the people work as repong damar farmers (Yulyoni et al., 2016)

The Damar Mata Kucing resin (*Shorea javanica*) produced has clear resin characteristics and is quite large in size. The process of taking Damar Mata Kucing resin (*Shorea javanica*) by tapping on a damar tree trunk using a certain tool, then the resin will come out on the stem that has been tapped so that the resin can be harvested and collected for sale to collectors or resin collection warehouses. Damar Mata Kucing (*Shorea javanica*). The potential of resin trees to produce Damar Mata Kucing (*Shorea javanica*) resin according to Yulizar *et al.* (2014) produced 59 kg/ha of resin in one area.

Recent research related to Damar Mata Kucing (*Shorea javanica*) is a study related to the conservation of Damar Mata Kucing (*Shorea javanica*) based on traditional zones (Yulizar *et al.*, 2014), a study related to the potential for carbon sequestration in Damar Mata Kucing (*Shorea javanica*) stands (Putri *et al.* , 2015), studies related to the use of suitable planting media for Damar Mata Kucing (*Shorea javanica*) can develop well (Kurniawati et al., 2013) and studies related to the purification of Damar Mata Kucing (*Shorea javanica*) (Putra, 2021). However, there has been no research related to the marketing analysis of Damar Mata Kucing (*Shorea javanica*), either specifically in Pekon Pahmungan or in general in Krui. The marketing of Damar Mata Kucing (*Shorea javanica*) that occurred in Pekon Pahmungan was carried out to find out the marketing of Damar Mata Kucing (*Shorea javanica*) and the price for each type produced from Repong Damar which has been carried out by the community. Therefore, this research is useful for knowing the marketing flow and can be used as a reference in increasing the marketing of Damar Mata Kucing (*Shorea javanica*) so that the economy and people's welfare in Pekon Pahmungan increase.



Research Methodology

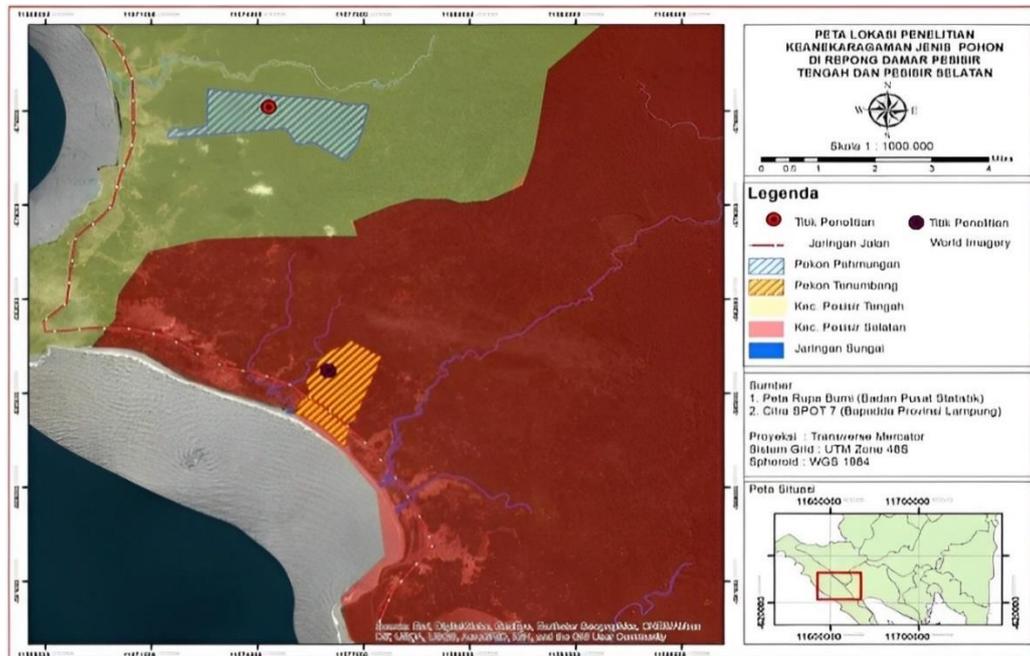


Figure 1. Map of Research Locations

The research was conducted in October 2022 in Pekon Pahmungan, Pesisir Tengah District, West Coast District, Lampung Province. This research uses descriptive analysis and statistics to determine the profit margin ratio and market integration. Data collection was carried out using an expert survey method, namely conducting interviews by filling out questionnaires that were given to respondents and conducting interviews with respondents to find information related to selling and buying prices, sales systems, pricing systems, and resin marketing channels. The number of respondents used in data collection was 10 people with established criteria, namely the Yangpong Damar community, community leaders/traditional elders, users and/or people who know about Repong Damar and people who have damar warehouses.

Results and Discussion

1.1. Marketing of Damar Mata Kucing Resin (*Shorea javanica*)

Marketing is a process of commodity flow with the transfer of property rights to goods and services carried out by marketing institutions concerned by carrying out the applicable marketing functions (Makkarennu, et al. , 2017). The marketing scope consists of actors who influence the market and have the ability to develop and maintain profitable transactions for targets including companies, suppliers, market intermediaries, and competitors (Espinoza, et al., 2015) . Marketing plays a fairly important role in a company which is able to maintain the



sustainability of a company through the sale of goods and services. This marketing is expected to meet the needs of a consumer for both an individual and a company and marketing can work well if it is mutually beneficial for all parties and marketers (Sawyer, et al., 2008 ; in Utama, *et al.*, 2019).

In marketing gum resin, farmers usually come directly to village-level collectors to offer the gum resin they produce. Information about the existence of collectors at the village level is usually obtained from fellow damar farmers. Damar sap is sold directly from farmers without grade separation due to the large number of harvested results, so the resin quality grade separation is only carried out at village-level collectors. The series of activities carried out in the sales process include: weighing and transportation to the warehouse belonging to the village-level collectors.

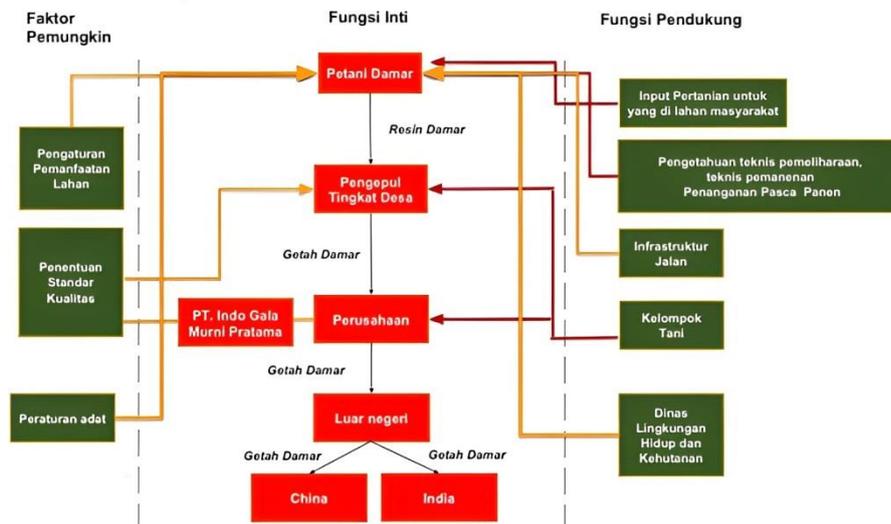


Figure 2. Marketing Channels of Damar Mata Kucing Resin (*Shorea javanica*)

Marketing channels are channels created by companies to sell products offered to consumers to target agencies and individuals (Wijaya *et al.*, 2019). The process of determining the selling price is determined by collectors at the village level as part of the loan agreement between damar farmers and collectors at the village level where the loan funds obtained are used to finance the operational activities of the resin business. The next stage of the market chain, damar resin from the hands of village-level collectors is directly sold to an exporter company located in Jakarta , namely PT. Indo Gala Murni Pratama. The resin produced by Pesisir Barat Regency - Lampung itself is capable of fulfilling 80% of national production and has export destination countries to China and India.



1.2. Prices for Each Type of Damar Mata Kucing Resin (*Shorea javanica*)

The price of sap resin is determined by quality. The highest price of resin sap ever reached Rp. 30,000/kg until the lowest price for resin resin reaches Rp. 12,000/kg. In 2022 the price of damar sap has decreased sharply by up to 50% or reached an average selling price of only IDR 12,000/kg. This is due to fluctuations in the price of sap resin at the global level. In addition, each type of Damar Mata Kucing resin can be grouped based on its color or texture so that there are price differences for the types of Damar Mata Kucing resin resin, which can be seen in Figure 1 below.



Figure 3. Quality Type of Resin Mat Cat Resin

As for the price of each quality type, the good quality ABX type has a selling price of Rp 30.000/kg, the CDX quality type has the same selling price as the ABX type, which is Rp 30.000/kg. Furthermore, the AC quality type has a selling price of Rp 26.000/kg and the DBU quality type has a selling price of Rp 20.000/kg. The price received by the farmers certainly plays a very important role in determining the income level of damar farmers from the business, while the price level that collectors can afford is not too high due to the absence of shape changes made by damar farmers.

Damar itself is a plant that has a long period of time to reach production, but the damar plant that is currently being managed by the Pekon Pahlungan community is a plant that has reached the age of being ready for harvest so that it can be harvested once a month (Rajaguguk et al.,



2018) . Therefore, in selling resin, market analysis is needed so that damar farmers do not suffer losses. Damar farmers sell their damar resin considering each collector to compare higher prices, to obtain higher incomes. Damar farmers consider aspects, continuity of production, income, ease of maintenance and local wisdom in managing damar. These considerations make damar farmers more careful in selling the damar resin.

Marketing activities play a role in connecting producers with consumers. Therefore, efficient marketing is absolutely necessary to create a low price difference received by producers and consumers. Marketing efficiency is also greatly influenced by the efficiency of the transportation system and infrastructure that connects producer and consumer locations, because transportation costs will affect prices. The marketing system for forest product commodities is inefficient, as is the case in almost every area where forest product production occurs, resulting in a less profitable position for producers.

Conclusion

The conclusions from the results and discussion that have been published in this paper are:

1. Based on segmentation analysis of damar Damar Mata Kucing marketing, the Application of Market Segmentation by damar farmers has obtained a better competitive position for existing products, has obtained a more effective position in a limited market, has identified opportunities in the market which represent opportunities for development resin resin quality, and have identified potential new customers.
2. The price of the Damar Mata Kucing resin commodity depends on the quality itself, if the best and good quality or included in the ABX or CDX category has a price of IDR 30,000. Then for good enough quality that is included in the AC category has a selling price of Rp 26.000. Whereas for poor quality or included in the DBU category, it has a selling value of Rp 20.000.



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MARKER STUDIES ON MINOR FABACEAE (LEGUMINOSAE) FORAGES

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ABSTRACT

Grain, grazed pasture, cut fodder, crop residues and by-products are the main uses for forage legumes which fed to animals as direct, dried, as hay, pellets, cube concentrates, fermented green matter (silage and haylage). Legume forages help to stabilizing the soil, reducing soil erosion, and increasing soil fertility through microbial nitrogen fixation, supplying organic matter, preventing pests and diseases of other crops as rotation crops and stop leaching of nutrients from soils. molecular markers have made a significant contribution and have been widely used in plant science in a variety of ways, including genetic fingerprinting, diagnostics, duplicate detection and core collection selection, determination of genetic distances, genome analysis, emergence of molecular maps, and identification of markers linked to desirable breeding traits. The use of molecular markers is greatly influenced by the types of markers used, how they are distributed throughout the genome, the sorts of loci they amplify, the degree of polymorphism, and the reproducibility of results.

Keywords: Markers, major, Fabaceae, Leguminosae, legumes, forages



1. Introduction

Globally, grain legumes are essential fodder and food crops (Graham and Vance, 2003). Grazed pasture or cut fodder are the main uses for forage legumes. In addition to being fed directly to animals, fodder can also be dried and used to make hay, pellets, or cube concentrates, as well as fermented green matter (silage and haylage). Pastures can be directly grazed on or cut and used to livestock feed regimens. Dual-purpose legumes are important, with crop residues and by-products as a source of feed for livestock, and the grain for human consumption. In marginal locations, forages play a significant role in preserving the natural resources by stabilizing the soil, reducing soil erosion, and increasing soil fertility through microbial nitrogen fixation and supplying organic matter. Some forage legumes are also used as rotation crops to prevent pests and diseases of other crops and to stop the leaching of nutrients from soils. Although only approximately 60 species of legumes have been domesticated and are commonly used as cultivated forages, more than 1,500 species (out of a total of about 17,000 species globally) can be utilized as animal feed. Due to features like spines, thorns, woody qualities, or substances that are toxic or unpleasant to livestock, not all *Leguminosae* are acceptable as pasture. The usage of some plant stems and leaves may be restricted by glands, glandular hairs, sticky exudates, or fragrant chemicals. With such a wide range of diversity, a broad range of methods are required for the management of forage legumes in genebanks (CGIAR Genebank, 2023).

Understanding biology and genetics at the molecular level has become crucial for manipulating and dissecting genomic architecture to answer concerns about evolution and taxonomy. For classification, the use of germplasm resources, and breeding, knowledge of genetic variation and genetic relationships among genotypes is crucial. In this regard, molecular markers have made a significant contribution and have been widely used in plant science in a variety of ways, including genetic fingerprinting, diagnostics, duplicate detection and core collection selection, determination of genetic distances, genome analysis, emergence of molecular maps, and identification of markers linked to desirable breeding traits. The use of molecular markers is greatly influenced by the types of markers used, how they are distributed throughout the genome, the sorts of loci they amplify, the degree of polymorphism, and the reproducibility of results. Random amplified polymorphic DNA (RAPD) is the most straightforward, economical, and suitable for the majority of its uses among the many DNA markers that are currently accessible. Additionally, RAPDs have the benefit of not requiring any prior knowledge of the genome being studied and can affect a large portion of the genome. The recent improvements in the RAPD technique like sequence characterized amplified region (SCAR), arbitrarily



primed polymerase chain reaction (AP-PCR), DNA amplification fingerprinting (DAF), cleaved amplified polymorphic sequences (CAPS), sequence-related amplified polymorphism (SRAP), random amplified microsatellite polymorphism (RAMPO), and random amplified hybridization microsatellites (RAHM) can complement the shortcomings of RAPDs and have enhanced the utility of this simple technique for specific applications (Babu et al., 2021).

A key challenge in marker-assisted selection for molecular plant breeding is to develop markers linked to genes of interest which are applicable to multiple breeding populations (Yang et al., 2008). Since they are numerous, highly polymorphic, locus-specific, multiallelic, codominant, and resilient, microsatellites are regarded as an effective genetic marker system (Alem et al., 2011). This marker's exorbitant development cost is by far its biggest drawback (Saha et al., 2006). It is occasionally feasible to solve this issue by transferring knowledge of microsatellite markers generated in well-known species to less studied species. Markers generated in species related to those of interest can be explored for and analysed owing to the massive amount of data on microsatellites that is available in the literature and genetic databases. By avoiding marker development, this enables the use of microsatellites, which is simpler and more affordable (Real et al., 2007).

Simple sequence repeats (SSRs) are tandem repeated sequences comprising mono-nucleotide, di-nucleotide, tri-nucleotide, tetra-nucleotide, penta-nucleotide or hexa-nucleotide units. SSRs are useful tools for studying genetic variation, genetic mapping, and molecular breeding (Yan et al., 2017). Eukaryotic genomes frequently contain transposons, which are mobile genetic components that include retrotransposons and DNA transposons. The most prevalent class of transposons in plants are long terminal repeat (LTR) retrotransposons, which have two long terminal repeats and are particularly prevalent in species with large genomes. LTR retrotransposons also have a significant impact on the evolution of genome structure and function in plants as well as phenotypic diversity. The use of insertional polymorphisms has led to the development of numerous molecular marker systems. On the basis of PCR technology, a number of molecular barcoding techniques for LTR retrotransposons have been developed, including the use of markers for inter-retrotransposon amplified polymorphism (IRAP), retrotransposon-based insertion polymorphism (RBIP), inter-primer binding sequence (IPBS), retrotransposon microsatellite amplified polymorphism (REMAP), and sequence-specific amplified polymorphism (SSAP) (Schulman et al., 2012; Zhao et al., 2019; Ouyang et al., 2021).



There is great potential for elucidating the genetic architecture of traits (e.g., number of genes, their effect sizes, additive vs. non-additive sources), as well as identifying targets for marker-assisted selection in plants and animals and by being able to identify genomic regions containing genes associated with quantitative phenotypes. The genome-wide association study (GWAS), in which statistical analyses are carried out on a set of markers spanning a species' whole genome to find which marker subsets demonstrate the highest relationships with a trait of interest, is one analysis that aims to uncover such regions (Lipka et al. 2015). In general, relationships between statistically significant markers and traits imply the presence of functional variations for the trait under investigation in the nearby genomic region. GWAS has so far proven successful in locating the genes linked to many significant traits. Testing each marker separately has been successful in identifying statistically significant marker-trait relationships in a wide range of species and traits, but it has two substantial biological limitations. Firstly, as only one marker is taken into account at a time, it is impossible to estimate the simultaneous contributions of numerous functional variations spread out over the genome in a single statistical model. Second, the effects of some non-additive sources of variation, such as epistasis, are frequently ignored by these single-marker statistical analyses. The typical statistical models used for GWAS may be improved to produce models that are more potent (Chen et al., 2019).

2. Marker studies at minor legume forage species

2.1. *Centrosema pubescens*

There are 34 species of native New World tropics and subtropic plants in the genus *Centrosema*. Numerous *Centrosema* species are indigenous to pastures and offer nutritional qualities that are on line with or superior to other tropical pasture legumes. The genus *Centrosema* has other species that have the potential to be used as pasture crops in addition to currently grown species. However, genetic knowledge in *Centrosema* species is still limited, what has restricted their domestication and exploitation in breeding programmes. A common forage legume in tropical America is *Centrosema pubescens*. Sousa et al., (2009) generated microsatellite markers for the species *C. pubescens* that can be used to explore its genetic diversity. In 11 other *Centrosema* species, the microsatellites were also examined for cross-amplifications. From the Germplasm Bank of the Brazilian Agricultural Research Corporation, 15 genotypes of *C. pubescens* were selected, and 26 polymorphic microsatellite markers were identified and characterised. Each locus had between 2 to 5 detected alleles. The potential transferability of these microsatellites was suggested by a cross-amplification test in 11 *Centrosema* species. Based on the findings, it



was determined that the polymorphic microsatellite markers produced in this study should be helpful for determining genetic variety in future breeding programmes and germplasm preservation.

2.2. *Lablab purpureus* L.

One of the oldest crops among cultivated plants is *Lablab purpureus*. It grows in tropical and subtropical climates. It is a multipurpose legume that may be used as a cover crop, animal feed and human food. *Lablab purpureus* is a drought resistant crop, which is also able to grow in a diverse range of environmental conditions. In the study of Esther et al., (2012), fifty Kenyan lablab accessions were collected from farmer fields and the Kenya National Gene Bank to determine the genetic diversity in *Lablab purpureus*. Using fifteen selective primer pairs, 180 polymorphic bands were discovered. The five populations' combined mean expected heterozygosity (H_e) was 0.189. Estimates of components of molecular variance revealed that most of the genetic variation resided within populations (99%) and only 1% variance was among the populations, while Principal Coordinate Analysis showed an overlap between accessions from different geographic origins. Most of the accessions had minimal diversity, according to the UPGMA cluster analysis produced from the distance matrix of the 50 examined accessions.



Fig. 1. Diversity of pods size, shape and color in *Lablab purpureus* harvested during the mature stage. No 1-14 represents different varieties. These varieties were collected from diverse habitat in India (Singh & Abhilash, 2019)

The genetic diversity of a group of *Lablab purpureus* accessions obtained from the southern states of India has been examined using molecular markers. When compared to a set of 15 accessions from other international germplasm collections that included African accessions, amplified fragment length polymorphism (AFLP) molecular marker studies using a total of 78 *L. purpureus* accessions with nine primer combinations revealed very little genetic diversity



within the *L. purpureus* accessions from the southern Indian germplasm collection. The group of 15 was chosen based on the highest genetic distance from a random amplified length polymorphism (RAPD) marker study. The AFLP studies were supported by further molecular analysis using polymerase chain reaction (PCR) markers from 97 expressed sequence tag (EST) and gene-specific primer pairs produced from a variety of legume sequences. Both of these methods offer an abundance of markers for mapping and diversification research. 70% of the 97 sequence-specific primer pairs examined in *L. purpureus* successfully amplified single bands, whereas 10% amplified double bands. These EST and genomic markers offer helpful cross-reference to comparative legume genomes, which may eventually be advantageous for breeding legume plants (Venkatesha et al., 2007).

2.3. *Lotus corniculatus* L.

The most significant agricultural species in the genus *Lotus* is *Lotus corniculatus* L., which has greatest global distribution. The plant originated in temperate regions of Europe and north Africa, but due to cultivation for use in pastures, ensilage, and hay production, it has spread throughout Europe, Asia, Africa, North and South America. *L. corniculatus* genotypes form complicated groups that are challenging to distinguish from a morphological and biochemical perspective. Considering how difficult and expensive it is to isolate Simple Sequence Repeats (SSR, commonly known as microsatellites), the prospect of exploiting microsatellites that have been discovered in related species is very attractive. Alem et al., (2011) conducted a study to find and validate transferable microsatellite markers in *L. corniculatus* and then employ those markers to investigate the genetic variation between four cultivars. Each cultivar of *L. corniculatus* was represented by 15 genotypes. Four microsatellite markers were selected from a total of ten after being examined for their discriminative values between cultivars. For the four markers, researchers found 29 alleles, with 7.25 alleles on average per locus. Based on the markers, high variability between individuals of the same cultivar was determined. The use of transferable microsatellite markers was found useful to differentiate individuals at a relatively low cost, showing a great potential for use in breeding programs.



Fig. 2. *Lotus corniculatus* (MacAdam & Villalba, 2015)

Santos et al., (2011) studied microsatellite markers to examine the genetic diversity of 14 different *Lotus corniculatus* L. materials. Aiming for aluminium tolerance and sensibility, four cultivars and one population of *L. corniculatus* and their related genotypes were examined. With an average of 2.2 alleles per locus, the 17 markers utilised to detect the 36 alleles in total. According to the similarity studies, three groups were constructed, one of which contained germplasm and chosen genotypes for aluminium sensibility, while the other two groups contained chosen genotypes for aluminium tolerance. The breeding programme gained useful information from the molecular analyses' accurate detection and quantification of genotype variability. The utilization of microsatellite markers permitted the distinction of genotypes originated from a selection program aiming aluminium tolerance.

2.4. *Melilotus* spp.

There are 19 annual or biennial species in the genus *Melilotus*. Self-pollination and cross-pollination are the two pollination strategies used by *Melilotus* accessions. Members of the genus *Melilotus* have higher seed yields than the majority of other pasture crops and are tolerant to challenging environmental factors like drought, cold, and excessive salinity. However development and application of *Melilotus* germplasm resources have been constrained by the absence of genetic markers. In the study of Yan et al., (2017) from several *Melilotus albus* genotypes total 104,358 unigene sequences were used to identify 19,263 possible EST-SSRs. Additionally, 550 primer pairs were selected out of 18,182 primer pairs that were effectively built utilising the base repeat type, fragment length, and annealing temperature criteria. Additionally, the transferability of the 114 polymorphic primer pairs to the 18 species of the genus *Melilotus* was assessed, and it was discovered that 70 EST-SSR markers might be shared



by all 18 *Melilotus* species. The 18 *Melilotus* species were divided into three clusters based on the STRUCTURE analysis and UPGMA dendrogram. This study offers a valuable resource for the genetic diversity and molecular assisted breeding of germplasm resources in the genus *Melilotus*.

The ability of *Melilotus* forage legume to fix nitrogen through a symbiotic relationship makes this plant helpful for crop rotation and a crucial green manure crop for farming and animal husbandry. *Melilotus* is also known as wild alfalfa, used in traditional Tibetan medicine and is planted as a honey plant owing to the biological activity of its flavones, coumarins, and saponins; however, due to its high coumarin content, this genus may not be suitable for use as pasture. In the study of Ouyang et al., (2021) by using long terminal repeat (LTR) retrotransposon-based markers, 40 accessions of the *Melilotus* plant were examined to assess the genetic diversity and population structure. Using bioinformatics methods, LTR retrotransposon sequences totaling 585,894,349 bp were found, making up 55.3% of the *Melilotus* genome. Researchers found and categorised 181,040 LTR retrotransposons as Gypsy, Copia, or other types. For the purpose of analysing polymorphisms in 15 *Melilotus albus* accessions, 350 pairs of primers were developed in total. In total, 18 *Melilotus* species were used to test the availability and transferability of 47 polymorphic primer pairs. At 47 LTR retrotransposon loci, 292 alleles were found, and all of the primer pairs were transferable. The 18 *Melilotus* species were divided into three clusters.

In the study of Winton et al., (2007), particular primers that amplify nine microsatellite DNA loci from *Melilotus alba* and *Melilotus officinalis*, two invasive plant species (Fabaceae) were analysed. Compared to *M. officinalis*, *M. alba*'s allelic diversity was a little lower, which was to be expected given its heterozygosity. At multiple loci, heterozygote deficiency was observed in both species. Both species' genotypic diversity was very high; all 29 plant samples from each species had unique multilocus genotypes.

2.5. *Desmanthus* spp.

Forage legumes belonging to the *Desmanthus* genus are found throughout America and have a lot of potential to enhance pasture and livestock productivity (Rangel and Gardiner, 2009). Because they produce a lot of seeds and have a high level of palatability, these plants are mostly utilised as fodder. Breeding programmes must employ precise methods for genotype characterization and identification. The molecular markers are crucial in these investigations since morphological markers are frequently utilised to determine genetic diversity. Using morphological features and ISSR markers, Costa et al., (2017) examined the genetic diversity



across *Desmanthus* sp. genotypes in Pernambuco (Brazil). Molecular and morphological characterizations were carried out on 18 and 26 accessions, respectively, of plants from the Universidade Federal Rural de Pernambuco's germplasm bank of fodder legumes (Brazil). 95 loci with 95.8% polymorphism were produced using eight ISSR primers. Regarding the morphological indicators, the factor that most influenced the genetic divergence was seed number. *Desmanthus* species were found to have a high level of genetic variety when they occurred naturally in Pernambuco, Brazil. For *Desmanthus* spp. to improve, the variation seen in morphological and ISSR markers is crucial.

2.6. *Indigofera pseudotinctoria*

There are 750 species in the broad pantropical genus *Indigofera*, which is a member of the *Fabaceae*. It is found on all major landmasses but is most prevalent in Africa and Asia (Woods & Leverett, 2010). Among these, *Indigofera pseudotinctoria* (false indigo) is a perennial shrub species found in grasslands, hillsides, and shrublands at elevations ranging from 100 m to 2000 m, is economically and agronomically significant. An commercially significant perennial legume shrub with a high forage production, high protein content, and excellent adaptability, *Indigofera pseudotinctoria* Mats is vulnerable to human disturbance and natural habitat fragmentation. Knowledge on intraspecific genetic diversity and genetic linkages for its wild collections is currently limited. Fan et al., (2017) studied the genetic diversity, differentiation, and structure of 364 genotypes of *I. pseudotinctoria* from 15 natural locales in Southwest China's highly structured Wushan Mountain were analysed using the amplified fragment length polymorphism (AFLP) method. 324 of the 515 distinctly scoreable bands that were produced were polymorphic. The UPGMA tree, primary coordinate analysis, and Bayesian-based cluster analyses all conclusively categorised all accessions into two separate clusters, i.e., lowland and highland groups, based on the population genetic structure. Due to a unique geographical landform, genetic barriers between nearby accessions were discovered.

2.7. *Stylosanthes seabrana*

The genetic development of *Stylosanthes* species has been slowed down by the scarcity of viable molecular markers. Genomic libraries from *Stylosanthes seabrana* were developed in order to produce simple sequence repeat (SSR) markers by Chandra et al., (2011). There were 21 functional primer pairs produced for the 76 novel microsatellites. 428 expressed sequence tag (EST) sequences from seven different *Stylosanthes* species were also tested for SSR detection due to the minimal number of primer pairs that were developed. Approximately 10% of the sequences produced usable primer pairs, and 57 microsatellite repeats were chosen after



redundancy was removed. The primary repetitive sequences in *Stylosanthes* ESTs were tetranucleotides followed by trinucleotides. A comprehensive set of 20 EST-SSR (eSSR) and 21 genomic-SSR (gSSR) markers was generated in total.

2.8. *Stylosanthes guianensis*

A new molecular marker technique called Sequence-Related Amplified Polymorphism (SRAP) was developed using the polymerase chain reaction by Huang et al., (2014). By using SRAP markers, the authenticity of 84 offspring of 8 hybrid *Stylosanthes guianensis* combinations were determined. From the parents of 8 hybrid combinations, 35 SRAP primer combinations were chosen. The authenticity of each progenie was determined using the chosen polymorphism primer combinations. 68 offspring had male parent-specific bands, indicating they were genuine hybrids. Due to the lack of male parent-specific bands, the remaining offspring were regarded as self-hybrids. The results of hybrid identification provided evidence for studies of hybrids and demonstrated SRAP molecular markers as a useful technology for assessing the purity of *S. guianensis* hybrids.

2.9. *Lupinus angustifolius*

Since more than 500 species of plants in the genus *Lupinus* have been proposed, there is an urgent need for a thorough taxonomic, morphometric, systematic, and molecular review. Chemical variety is reported to be abundant in the genus *Lupinus* (Bermudez-Torres et al., 2021). In ancient Greece and Rome, the narrow-leaved lupin (*Lupinus angustifolius* L.) was cultivated as a crop and used for both human consumption and stock feed. Early in the 20th century, plant breeding for *L. angustifolius* began in Germany. The low-alkaloid gene *iucundis* (*iuc*), the seed coat permeability gene *moll*, the white flower gene *leucospermum* (*leuc*), the lack of vernalization requirement gene *ku*, and the reduced pod shattering genes *tardus* (*ta*) and *lentus* are important domestication genes incorporated into modern cultivars of *angustifolius* (*le*). In narrow-leaf lupin, a cross between the domesticated breeding line 83A:476 and the wild type P27255 resulted in the development of a mapping population of recombinant inbred lines (RILs) descended from the F8 gene (*Lupinus angustifolius* L.). Phenotypic information was provided for the following domestication traits: *lentus* (reduced pod-shattering), *iucundis* (low alkaloid), *mollis* (soft seeds), *leucospermus* (white blossom and seed colour), *Ku* (early flowering), and moustache pattern on seed coats (Boersma et al., 2005).

3. Conclusions

Polymorphic microsatellite markers are helpful for determining genetic variety in *Centrosema pubescens* and *Lotus corniculatus* breeding programmes and germplasm



preservation. The use of transferable microsatellite markers was found useful to differentiate *Lotus corniculatus* individuals at a relatively low cost, showing a great potential for use in breeding programs. For *Desmanthus* spp. to improve, the variation seen in morphological and ISSR markers is crucial. SRAP molecular markers as a useful technology for assessing the purity of *S. guianensis* hybrids.



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**ULTRASONIC-ASSISTED EXTRACTION OF BEE POLLEN GRAINS:
DETERMINATION OF TOTAL PHENOLIC CONTENT, TOTAL ANTIOXIDANT
CAPACITY, RADICAL SCAVENGING ACTIVITY AND FATTY ACID
COMPOSITION**

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ABSTRACT

The aim of the current study was to determine the fatty acid composition of the lipid content of bee pollen extracted with n-hexane solvent, including determination of total phenolic content, total antioxidant capacity and radical scavenging capacity of methanolic and ethanolic extracts obtained from ultrasound assisted extraction of bee pollen grains collected from Isparta region. For this purpose, we determined the total phenolic content and antioxidant capacity of the methanolic and ethanolic extracts of the pollen grains using the folin assay and the copper ion (Cu²⁺) reducing antioxidant capacity (CUPRAC) assay. At the same time, the radical scavenging activity of the ethanolic and methanolic pollen extracts was investigated using the 1,1-diphenyl-2-picryl-hydrazil (DPPH) method. The fatty acid composition of the bee pollen lipids was investigated using the GC-FID analysis. The total phenolic content of the methanolic and ethanolic extracts of bee pollen grains was calculated to be 23.52 and 22.43 mg gallic acid equivalent/g extract, respectively, while the total antioxidant capacity was calculated to be 0.257 and 0.246 mmol trolox equivalent/g extract, respectively. The IC₅₀ values of the methanolic and ethanolic extracts of bee pollen corresponding to the reduction of 50% of the DPPH radical solution were 276.79 and 303.39 µg/mL, respectively. Research findings revealed that methanolic extracts of bee pollen grains were better in terms of total phenolic content, total antioxidant capacity and radical scavenging ability compared to ethanolic extracts. GC-FID results showed that the lipid content of bee pollen is composed of fatty acids composition eicosenoic acid (24%), palmitic acid (19.70%), oleic acid (10.4%), linoleic acid (10.23%), Nervonic acid (3.3%), stearic acid (%. 2.27) and Behenic acid (2.07%).

Keywords: Bee Pollen Grain, CUPRAC, DPPH, Fatty Acid, Total Phenolic



ARI POLENİ TANELERİNİN ULTRASONİK DESTEKLİ EKSTRAKSİYONU: TOPLAM FENOLİK İÇERİĞİ, TOPLAM ANTIOKSİDAN KAPASİTESİ, RADİKAL SÜPÜRME AKTİVİTESİ VE YAĞ ASİDİ KOMPOZİSYONUN BELİRLENMESİ

ÖZET

Bu çalışmada, Isparta bölgesinden toplanan arı poleni tanelerinin ultrasonik destekli ekstraksiyonundan elde edilen metanolik ve etanolik özütlerinin toplam fenolik içeriği, toplam antioksidan kapasitesi ve radikal süpürme yeteneğinin belirlenmesinin yanı sıra, n- hekzan çözücüsüyle elde edilen arı poleni lipit içeriğinin yağ asidi kompozisyonunun belirlenmesi amaçlanmıştır. Bu amaçla polen tanelerinin metanolik ve etanolik ekstraktlarının toplam fenolik içeriklerini ve toplam antioksidan kapasitelerini sırasıyla Folin ve bakır iyonları (Cu^{2+}) indirgeyici antioksidan kapasite (CUPRAC) testiyle belirledik. Aynı zamanda etanolik ve metanolik polen ekstraktlarının serbest radikal süpürme aktivitesi 1,1-difenil-2-pikril-hidrazil (DPPH•) yöntemi ile araştırıldı. Arı poleni lipitlerinin yağ asidi bileşimi ise GC-FID analizi ile araştırıldı. Arı poleni tanelerinin metanolik ve etanolik özütlerinin toplam fenolik içerikleri sırasıyla, 23.52 ve 22.43 mg gallik asit eşdeğeri / g- ekstrakt olarak hesaplanırken, toplam antioksidan kapasiteleri 0.257 ve 0.246 mmol troloks eşdeğeri/ g-ekstrakt olarak hesaplanmıştır. DPPH radikal çözücüsünün %50'sinin indirgenmesine karşılık gelen arı poleni tanelerinin metanolik ve etanolik özütlerinin IC50 değerleri sırasıyla 276.79 ve 303.39 ug/mL idi. Araştırma bulguları, arı poleni tanelerinin metanolik özütlerinin etanolik özütleriyle karşılaştırıldığında toplam fenolik içerik, toplam antioksidan kapasite ve radikal süpürme yeteneği bakımından daha iyi olduğunu ortaya çıkarmıştır. GC-FID sonuçları, arı poleni lipit içeriğinin yağ asitleri kompozisyonunun eikozenoik asit (% 24), palmitik asit (% 19.70), oleik asit (% 10.4), linoleik asit (% 10.23), Nervonik asit (% 3.3), stearik asit (% 2.27) ve Behenik asit (% 2.07) içerdiğini ortaya çıkarmıştır.

Anahtar Kelimeler: Arı Poleni Taneleri, CUPRAC, DPPH, Toplam Fenolik, Yağ asitleri



1. Introduction

Pollen is collected from the stamens of the flower by the worker bees who bring honey to the hive, moistened with nectar or honey and accumulated on the hind legs of the bee (Krell, 1996). The collected flower pollen is collected in the form of pellets in the pollen baskets (corbicles) on the hind legs of the honey bee and transported to the hive. Honey bees, while collecting honey essence, ensure pollination in plants with the pollen that sticks to their bodies without being aware of it, and the collection of pollen necessary for the nutrition of honey bees. (Erdoğan & Dodoloğlu, 2005). Honey meets the energy needs of the bee colony, and pollen meets the protein, mineral, oil and other nutrient needs of the bee colony. (Human and Nicolson, 2006; Erdoğan and Cengiz, 2020). The presence of these compounds causes pollen to be considered a human food. Pollen collected by honey bees (bee pollen) is promoted as a healthy food with a wide variety of nutritional and therapeutic properties (Haro et al., 2000; Hamamoto et al., 2006). Considering its nutritional content and according to non-scientific studies, dried bee pollen is used as a food that provides a sense of well-being in human nutrition and contributes to the functional and harmonious balance of the body (Almeida-Muradian et al., 2005).

One of the most important properties of pollen is good antioxidant activity, which can be connected to its suitable chemical composition and above all, the presence of different phenolic compounds (Mărgăoan et al., 2019; Kostić et al., 2019; Fatrcová-Šramková et al., 2016; DULGER ALTINER et al., 2020; Rocchetti et al., 2019). According to literature, the main antioxidants in pollen are small molecular weight compounds mostly phenolics and vitamin C as hydrophilic components, and vitamin E as lipophilic antioxidants (Rzepecka-Stojko et al., 2015).

The aim of the current study was to determine the fatty acid composition of the lipid content of bee pollen extracted with n-hexane solvent, including determination of total phenolic content, total antioxidant capacity and radical scavenging capacity of methanolic and ethanolic extracts obtained from ultrasound assisted extraction of bee pollen grains collected from Isparta region. For this purpose, we determined the total phenolic content and antioxidant capacity of the methanolic and ethanolic extracts of the pollen grains using the folin assay and the copper ion (Cu^{2+}) reducing antioxidant capacity (CUPRAC) assay. At the same time, the radical scavenging activity of the ethanolic and methanolic pollen extracts was investigated using the 1,1-diphenyl-2-picryl-hydrazil (DPPH) method. The fatty acid composition of the bee pollen lipids was investigated using the GC-FID analysis.



2. MATERIAL and METHOD

2.1. Material

Bee pollen grains were collected from Sorkuncak Village of Eğirdir district of Isparta. (altitude; 1276m). Prior to extraction, pollen grains were dried at room conditions out of direct sunlight to remove moisture. After drying, it was ground into powder with a coffee grinder.

2.2. Extraction of pollen grains

Ultrasonic bath system (Power sonic 180, 40 kHz frequency and maximum 150 W, internal size: 300 mm × 150mm × 100 mm) was used for the extraction of pollen grains. Ethanol, methanol and n-hexane were used as solvents. Ultrasonic extraction was carried out under the following experimental conditions: temperature: 50 °C; time: 45 minutes; solid/solvent ratio:1:8 (w/v) and maximum ultrasound power: 40 kHz and 150W power. The collected extracts were filtered through Whatman No: 1 filter paper and the solvents were removed by evaporation under vacuum at 50 °C with a rotary evaporator (IKA RV 10 digital, IKA, Germany). The extraction procedure was performed three times in parallel

2.3. Total phenolic determination by Folin method

The quantity of total phenolic substance in the turmeric and ginger extracts was figured out with Folin-Ciocalteu reagent as indicated by the technique for Slinkard and Singleton (1977). Briefly, 40 µl sample (1 mL of extract solution contains 1 mg extracts), a gallic acid calibration standard, or blank (deionized or distilled water) was put into a 15 ml falcon tube. Then, 3.16 mL water, followed by 200 µL FC reagent was added and mixed thoroughly by pipetting or inverting and incubate 1 to 8 min. After 5 min, 600 µL of Na₂CO₃ (20%) was added and afterward the mix was permitted to represent 2 h with discontinuous shaking. The absorbance was measured at 765 nm in a spectrophotometer (SHIMMADZU UV-1280 UV-Vis Spectrophotometer). The assessment was performed in triplicate. The measure of phenolic content in extracts was determined by the accompanying equation:

$$T = C1 \times V/M$$

Where, T = Total phenolic content mg g⁻¹ of extracts in GAE [Gallic acid equivalent]; C1 = The Concentration of Gallic acid established from the calibration curve µg mL⁻¹; V = The Volume of extract solution [mL] M = The Weight of the extract [g].

2.4. Total antioxidant activity

Total antioxidant capacity of pollen grain extracts was determined by the CUPRAC method developed by Apak et al., (2006). The method is briefly as follows. Add 1 mL of copper(II)



solution, neocuproin solution and ammonium acetate buffer, respectively, into a glass tube. Then, 0.5 ml of the 1000 ppm (1 mg / 1 mL) sample solution diluted with alcohol (96%) at a specific ratio (1:8, v/v) and 0.6 ml of water are added. The solutions prepared with a total volume of 4.1 mL are kept closed for 30 minutes at room conditions. At the end of this period, absorbance values are measured at 450 nm against the reference solution without sample.

$$\text{TAC (mmol TE/g - extract)} = A/\epsilon_{\text{TR}} \times V_{\text{m}}/V_{\text{s}} \times D_{\text{f}} \times V_{\text{E}}/m$$

Where; A: Sample absorbance measured at 450 nm; ϵ_{TR} : molar absorption coefficient of TR compound in the CUPRAC method ($1.67 \times 10^4 \text{ L mol}^{-1} \cdot \text{cm}^{-1}$) 36; V_{m} : Total volume of CUPRAC method measuring solution (4.1 mL); V_{s} : Sample volume (mL); D_{f} : Dilution factor (if no dilution will be made, this factor is taken as “1”); V_{E} : Volume of the prepared extract (mL); m: The amount of sample taken in the extraction process (g).

2.5. DPPH radical scavenging activity

The application of the DPPH assay is summarized as follows: x mL of sample extract was mixed in a tube with (2-x) mL of ethanol (99%) and 2 mL of DPPH• solution at 0.2 mM. Absorbance was recorded at 517 nm against ethanol after 30 min of DPPH• addition. The % radical scavenging activity was measured using the following equation.

$$\% \text{ DPPH radical scavenging activity} = (A_{\text{c}} - A_{\text{s}}) / A_{\text{c}} \times 100$$

A_{c} = Absorbance of control, A_{s} = absorbance of sample

2.6. GC analysis of fatty acids

Fatty acids analysis was as described in our previous study (Erdoğan and Erdoğan Koyuöz 2022).

3. RESULTS

3.1. Total phenolic content

Total phenolic contents of ethanolic and methanolic pollen extracts were calculated to be 22.43 and 23.52 mg gallic acid equivalent/g extract (mg GAE / g-extract), respectively.

3.2. Total antioxidant capacity

The total antioxidant capacity of ethanolic and methanolic pollen extracts was measured as 0.246 and 0.257 mmol trolox equivalent/g-extract (mmol TE/ g-extract) respectively. It was revealed that there is a positive relationship between total phenolic content and total antioxidant capacity.

3.3. Determination of radical scavenging activity

The radical scavenging activity was investigated for both ethanolic and methanolic extracts of pollen grains at different concentrations (150-350 µg/mL). The values recorded at 517 nm were



presented in Figure 1. From these data, the % radical scavenging activity was measured using the following equation.

$$\% \text{ DPPH radical scavenging activity} = (A_c - A_s) / A_c * 100$$

A_c= Absorbance of control, A_s= absorbance of sample

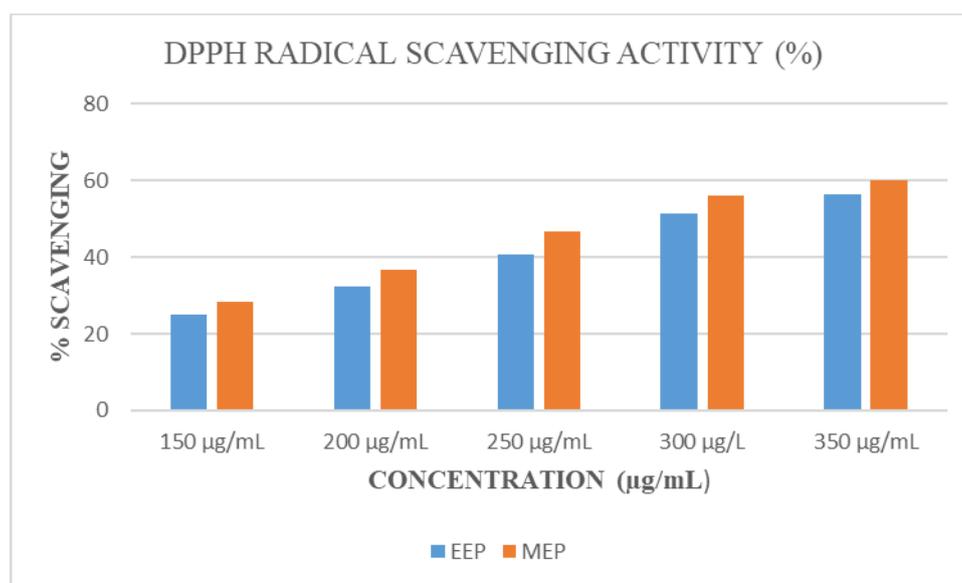


Figure 1. Radical scavenging activity of EET and MET
Abbreviations: EEP, ethanolic extract of pollen; MEP, methanolic extract of pollen

When the concentration increased, the radical scavenging activity of both ethanolic and methanolic pollen extracts increased. The data showed that the radical sweeping activity of methanolic pollen extract was better.

3.4. Calculation of IC 50 values

Calibration curves were constructed for the radical scavenging activities of the extracts versus the concentration using the data in Figure 1. With the help of graphics, IC₅₀ values of both ethanolic pollen extraction and methanolic pollen extraction were calculated. The IC₅₀ values of methanolic and ethanolic pollen extract were calculated to be 276.79 and 303.39 µg/mL, respectively. The lower the IC value, the higher the radical scavenging activity.

3.5. Fatty acid composition of pollen grains

Fatty acid composition of pollen grains was presented in Table 1. GC-FID results showed that the lipid content of bee pollen was composed of fatty acids composition eicosenoic acid (24%), palmitic acid (19.70%), oleic acid (10.4%), linoleic acid (10.23%), Nervonic acid (3.3%), stearic acid (%. 2.27) and Behenic acid (2.07%). The presence of monounsaturated fatty



acids (MUFA, 37.7%) predominated in the fatty acid composition of pollen grains, followed by saturated fatty acids (SFA, 24.04%) and polyunsaturated fatty acids (PUFA, 10.23%)

Table 1. Fatty acid composition of pollen grains

Chain lengths	Name	%
C16:0	Palmitic acid	19.70
C18:0	Stearic acid	2.27
C18:1 cis (9)	Oleic acid	10.4
C18:2 cis (9,12)	Linoleic acid	10.23
C20:1 cis (11)	Eicosanoic acid	24
C22:0	Behenic acid	2.07
C24:1 (Δ 15, cis-15)	Nervonik acid	3.3
Σ SFA		24.04
Σ MUFA		37.7
Σ PUFA		10.23

4. CONCLUSIONS

The data presented in this study showed that the extracts obtained according to the solvent type of pollen grains were different in terms of antioxidant activity, total phenolic content and radical cleaning activity. The research data showed that pollen grains are rich in total phenolic content. Pollen grains are composed of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) as well as varying amounts of fatty acids. OF All these data indicated that pollen grains could be used as a food ingredient.



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**COMPARISON OF SCENT COMPONENTS OF SOLID PHASE
MICROEXTRACTION (HS-SPME/GC-MS), DISTILLATION AND EXTRACTION
PRODUCTS OF LAVANDIN (*Lavandula × intermedia* var. Super A) AND LAVENDER
(*Lavandula angustifolia* var. Munstead) LEAVES**

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ABSTRACT

The essential oils obtained from the flowers of *Lavandula* (Labiatae, syn. Lamiaceae) have a wide range of uses such as perfumery, cosmetics, food, cleaning products and aromatherapy. However, references to the use of the leaves of the lavender plant are very limited. This research was carried out in 2019 at Isparta University of Applied Sciences Rose and Aromatic Plants Application and Research Center to determine the scent components of lavandin and lavender leaves. Floral scent compounds of fresh leaves of lavandin (*Lavandula × intermedia* var. Super A) and lavender (*Lavandula angustifolia* var. Munstead) were determined by solid phase micro-extraction (HS-SPME GC-MS) technique. The leaves of the species were subjected to *n*-hexane extraction and their concretions were obtained. The scent compounds of concrete were determined by Gas chromatography-Mass Spectroscopy (GC-MS). According to the HS-SPME GC-MS technique, 43 and 41 floral scent compounds were determined in the fresh leaves of lavandin and lavender, respectively. The main components of Lavandin leaves was 1,8-cineole (48.18%), camphor (10.39%), amyl ethyl ketone (7.10), *p*-cymene (4.56%) and borneol (3.60%). The main floral scent compounds of lavender leaves was cymol (32.86%), limonene (12.92%), *p*-cymene (10.74%), benzaldehyde (5.28%), crypton (4.87%) and *cis*-3-Hexene-1-ol (4.02%). After *n*-hexane extraction, 0.528% concrete yield was obtained from lavandin leaf and 1 kg concrete yield was determined as 221.4 kg/leaf. For Lavender, these values were determined as 0.438% and 235.1 kg/leaf, respectively. A total of 20 compounds were detected in the concrete of both species. The 1,8-cineole content of lavandin concrete was determined as 47.09%, the camphor content was 15.79% and the borneol content was 13.81. In lavender concrete, the main components were determined as cymol (33.49%), limonene (16.98%) and *o*-cymene (12.78%). As a result, although essential oils obtained from lavandin and lavender flowers are used in many industries, it is thought that the extracts obtained from lavender leaves may have the potential to be used in similar industries.

Keywords: Lavender, Lavandin, Leaf, HS-SPME, Concrete, GC-MS



LAVANDİN (*Lavandula × intermedia* var. Super A) VE LAVANTA (*Lavandula angustifolia* var. Munstead) YAPRAKLARININ KATI FAZ MİKRO EKSTRAKSİYON (HS-SPME/GC-MS), DAMITMA VE EKSTRAKSİYON ÜRÜNLERİNİN KOKU BİLEŞENLERİNİN KARŞILAŞTIRILMASI

ÖZET

Lavandula (Labiatae, syn. Lamiaceae) çiçeklerinden elde edilen uçucu yağlarının günümüzde parfümeri, kozmetik, gıda, temizlik ürünleri ve aromaterapi gibi geniş bir kullanım yelpazesi bulunmaktadır. Ancak lavanta bitkisinin yapraklarının kullanımı ile ilgili referanslar oldukça sınırlıdır. Bu araştırma 2019 yılında Isparta Uygulamalı Bilimler Üniversitesi Gül ve Aromatik Bitkiler Uygulama ve Araştırma Merkezi'nde lavandin ve lavender yapraklarının koku bileşenlerinin belirlenmesi amacıyla yürütülmüştür. Lavandin (*Lavandula × intermedia* var. Super A) ve lavanta (*Lavandula angustifolia* var. Munstead) taze yapraklarının doğal koku bileşikleri katı faz mikro ekstraksiyon (HS-SPME GC-MS) tekniği ile tespit edilmiştir. Türlerin yaprakları *n*-hekzan ekstraksiyonuna tabi tutularak konkritleri elde edilmiştir. Konkretin koku bileşikleri Gaz kromatografisi-Kütle Spektroskopisi (GC-MS) ile belirlenmiştir. Lavandin ve lavenderin taze yapraklarında HS-SPME GC-MS tekniğine göre sırasıyla 43 ve 41 adet floral koku bileşiği belirlenmiştir. Lavandin türünün yapraklarında ana bileşenler 1,8-cineole (%48.18), camphor (%10.39), amyl ethyl ketone (%7.10), *p*-cymene (%4.56) ve borneol (%3.60)'tır. Lavender yapraklarının ana floral koku bileşikleri ise cymol (%32.86), limonene (%12.92), *p*-cymene (%10.74), benzaldehyde (%5.28), crypton (%4.87) ve *cis*-3-Hexene-1-ol (%4.02)'dir. *n*-Hekzan ekstraksiyonu sonrasında lavandin yaprağından %0.528 konkret verimi elde edilmiştir ve 1 kg konkret randımanı 221.4 kg/yaprak olarak tespit edilmiştir. Lavender için bu değerler sırasıyla %0.438 ve 235.1 kg/yaprak olarak belirlenmiştir. Her iki türün konkritlerinde toplam 20 bileşik tespit edilmiştir. Lavandin konkritinde 1,8-cineole içeriği %47.09 olarak belirlenirken, camphor içeriği %15.79 ve borneol içeriği 13.81 olarak ölçülmüştür. Lavender konkritinde ise ana bileşenler cymol (%33.49), limonene (%16.98) ve *o*-cymene (%12.78) olarak tespit edilmiştir. Sonuç olarak her ne kadar lavandin ve lavender çiçeklerinden elde edilen uçucu yağlar birçok endüstride kullanılsa da lavanta yapraklarından elde edilen ekstraktlarında benzer endüstrilerde kullanılma potansiyeli bulunabileceği düşünülmektedir.

Anahtar Kelimeler: Lavandin, Lavender, Yaprak, HS-SPME, Konkret, GC-MS



1. INTRODUCTION

The glands on the surface of the flowers and leaves of all *Lavandula* species and hybrids produce intricate mixtures of essential oils, making them extremely aromatic plants. To produce essential oils for use in the perfume and cosmetic industries, however, only three taxa are crucial. These are *L. angustifolia*, *L. latifolia* and *L. hybrida* (*L. latifolia*_*L. angustifolia*), which produce lavender oil, spike lavender oil and lavandin oil, respectively (Tucker, 1985). Plant breeding has increased the amount of oil produced by these commercially grown taxa, and the composition varies from oil to oil, from one country to another, and with plant age. For example, the major components of lavender oil are linalyl acetate, linalol, *cis*-ocimene, and lavandulyl acetate, those of spike lavender oil are linalol, 1,8-cineole, camphor, α - and β -pinene and borneol and of lavandin oil are linalol, linalyl acetate, camphor, 1,8-cineole and borneol (Beetham ve Entwistle, 1982; Boelens, 1995; Kulevanova, 2000; Karapandzova, 2012). The main essential oil characteristics of both parents' essential oils can be seen in the lavandin oil produced by the hybrid plant. However, there are many minor components giving totals of over 100 constituents in lavender oil, more than 80 in lavandin oil and some 60 in spike lavender oil (Harborne ve Williams, 2002).

Currently, *Lavandula* essential oil is mainly produced from *Lavandula* flowers by conventional distillation and extraction methods, namely steam distillation, hydrodistillation, solvent extraction, and recently, using alternative technologies based on ultrasonic extraction, microwave extraction, and supercritical fluid extraction. According to ISO 3515:2002 lavender oil quality standards, it is required to contain at least 25% in lavender oil to be used in the perfume industry. However, standards specific to Abrial (ISO 3054) and Grosso (ISO 8902) varieties have been determined in lavandin oils.

It is the leaves of lavender that await evaluation and contain important secondary metabolites. Although there are studies on the polyphenolic contents of lavender leaves (Gamez et al., 1990; Lis-Balchin, 2002), there are very limited studies especially on fragrance components. (Hassanpouraghdam et al. 2011; Shafaghat et al. 2012; Nurzyńska-Wierdak and Zawisłak, (2016). The leaves of *Lavandula* species contain two hydroxycinnamic acid esters, rosmarinic acid and chlorogenic acid. There is new evidence to suggest that methanolic extracts of *L. angustifolia* (dried flowers, fresh flowers and fresh leaves) are calcium channel blockers, as are the leaves of *L. viridis* and *L. stoechas* (Gamez et al., 1990; Lis-Balchin, 2002). Investigations on the odor components of the leaves of *Lavandula* species were carried out only by obtaining essential oil by distillation. In our study, the floral fragrance components of the leaves and the



concrete components obtained from the leaves by n-hexane extraction were determined according to the HS-SPME GC-MS technique.

2. MATERIAL AND METHODS

2.1. Material

This research was carried out in Isparta University of Applied Sciences Rose and Aromatic Plants Implementation and Research Center in 2018. In this study, leaves of 9-year-old lavandin (*Lavandula × intermedia* Emeric ex Loisel. var. Super A) and lavender (*Lavandula angustifolia* var. Munstead) plants were used as material. 8-year-old lavandin and lavender species plants were used as material. The leaves were harvested in the mid-flowering period of both species. This date is 25.07.2019 for lavandin and 12.07.2019 for lavender. After the leaves of both species were collected, floral fragrance compositions were determined by solid phase microextraction technique (HS-SPME GC-MS). Then, concrete productivity and quality analyzes were performed on fresh leaves.

2.2. Determination of floral scent composition with HS-SPME GC-MS

The fresh leaves of *Lavandula* species were subjected to solid phase microextraction (SPME, Supelco, Germany) with a fibre precoated with a 75 µm-thick layer of Carboxen/Polydimethylsiloxane (CAR/PDMS). Fresh leaves (2.5 g) was put into a 10 mL vial, then immediately sealed with a silicone septum and a crimp cap. After incubation for 30 min at 60°C, SPME fibre was pushed through the headspace of a sample vial to adsorb the volatiles, and then inserted directly into the injection port of the GC-MS (Shimadzu 2010 Plus GC-MS with the capillary column, Restek Rxi[®]-5Sil MS 30 m × 0.25 mm, 0.25 µm, Crossbond[®], similar to 5% diphenyl/95% dimethyl polysiloxane) at a temperature of 250°C for desorption (5 min) of the adsorbed volatile compounds for analysis. Identification of constituents was carried out with the help of retention times of standard substances by composition of mass spectra with the data given in the Wiley, NIST, Tutor, FFNSC library. LRIs (Linear Retention Indices) were calculated by using a series of the standards of C₇-C₃₀ saturated *n*-alkanes (Sigma-Aldrich Chemical Co., USA) for reference in the same column and under the same conditions as described above for GC-MS analysis.

2.3. Solvent extraction for concrete

After the fresh leaves of *Lavandula* species were harvested, they were spread on wire shelves and kept for under shade at room temperature to remove extra moisture (Erbaş and Baydar, 2016). The fresh leaves were extracted with *n*-hexane, a non-polar solvent with high purity, by using separator funnels. The multistage extraction was performed (in triplicate) by the solvent



with 30, 20 and 15 minutes, respectively, consecutively in the funnels in order to increase the yield of the extract. After the solvents were evaporated from the extracts by a rotary evaporator under vacuum at below 50 °C, immortelle concrete, a pale yellowish, waxy, semi-solid material, was obtained. Apart from yield as % (v/w), the concrete efficiencies were also calculated. While concrete efficiency represents the amount of fresh flowers for extracting 1 kg of concrete.

2.4. Determination of concrete scent composition with GC-MS

Gas Chromatography/Mass Spectrometry (GC-MS) analysis of the concretes for *Lavandula* species was performed on Shimadzu 2010 Plus GC-MS equipped with a Quadrupole (QP-5050) detector. The analysis was performed under the following conditions: capillary column, Restek Rxi®-5Sil MS (50 m × 0.32 mm, film thickness 0.25 µm); injector and detector temperature, 240°C; stove heat program, from 60 °C (10 min. hold) to 90 °C rising at 4 °C/min., and increasing to 240 °C (11.5 min. hold) rising at 15 °C/min.; flow speed, 1 psi; detector: 70 eV; ionization type, EI; carrier gas, helium (20 mL/min.); sample injected 1 µL. Identification of constituents was carried out with the help of retention times of standard substances by composition of mass spectra with the data given in the Wiley, NIST, Tutor library.

RESULT AND DISCUSSION

In the study in which the fragrance composition of the floral scent molecules of lavandin and lavender leaves and the concretes obtained by *n*-hexane extraction were compared; According to the HS-SPME technique, 43 compounds from lavandin leaves and 41 compounds from lavender leaves were identified. The main components of lavandin leaves was 1,8-cineole (48.18%), camphor (10.39%), amyl ethyl ketone (7.10%), *p*-cymene (4.56%) and borneol (3.60%). These compounds are proportionally followed by cryptone (2.32%), *hexyl*-butyrate (2.31%), *cis*-3-hexene-1-ol (2.24%), hex-3(Z)-enyl acetate (2.22%) and benzaldehyde (2.12%). The remaining 33 compounds have concentrations below 2%. The main floral scent compounds of lavender leaves was cymol (32.86%), limonene (12.92%), *p*-cymene (10.74%), benzaldehyde (5.28%), crypton (4.87%) and *cis*-3-Hexene-1-ol (4.02%). These were followed by amyl ethyl ketone (2.86%), hex-3(Z)-enyl acetate (2.91%), and 1,8-cineole (2.54%). The other 32 components have concentrations below 2% (Table 1).

When the scent components of lavandin leaves are examined, it is seen that completely different components are obtained from the essential oil standards. The same is true for the floral scent components of lavender leaves.



Table 1. HS-SPME analysis and concrete composition of lavandin and lavender leaves

RT	Compounds	Lavender	Spike lavender	Lavandin		Floral scent composition ^a		Concrete	
		ISO 3513	Spanish ISO 4719	Abrrial ISO 3054	Grosso ISO 8902	Super A	Munstead	Super A	Munstead
5.50	2-Hexen-1-al	-	-	-	-	0.21	0.17	-	-
5.63	cis-3-Hexene-1-ol	-	-	-	-	2.24	4.02	1.42	3.41
5.95	o-Xylene	-	-	-	-	-	0.13	-	-
6.05	n-Hexanol	-	-	-	-	0.17	-	-	-
6.62	Heptan-2-one	-	-	-	-	-	0.46	-	0.37
7.70	Isopropylbenzene	-	-	-	-	-	0.21	-	-
7.68	Tricyclene	-	-	-	-	0.28	-	-	-
8.07	2,7-Dimethyloxepine	-	-	-	-	-	0.21	-	-
8.09	α-Pinene	-	-	-	-	0.67	0.54	-	-
8.65	Camphene	-	-	-	-	1.00	0.33	0.95	-
9.53	Sabinene	-	-	-	-	0.20	-	-	-
9.75	1-Octen-3-one	-	-	-	-	0.18	0.20	-	-
9.98	Vinyl amyl carbinol	-	-	-	-	0.46	1.84	1.34	1.42
10.12	Amyl ethyl ketone	-	-	-	-	7.10	2.86	4.01	4.06
10.24	β-Myrcene	-	-	0.4-0.9	0.3-1.0	0.22	0.31	-	-
10.26	1,2,3-Trimethylbenzene	-	-	-	-	-	0.44	-	-
10.46	(E,E)-2,4-Heptadienal	-	-	-	-	0.18	0.28	-	-
10.47	butyl-Butanoate	-	-	-	-	-	0.44	-	-
10.86	Hex-3(Z)-enyl acetate	-	-	-	-	2.22	2.91	1.23	1.95
11.52	Cymol	-	-	-	-	-	32.86	-	33.49
11.56	p-Cymene	-	-	-	-	4.56	10.74	0.64	12.90
11.68	Limonene	0.0-1.0	0.5-3	0.5-1.5	0.5-1.5	-	12.92	1.95	16.98
11.91	1,8-Cineole	0.0-3.0	16.0-39.0	6.0-12.5	4.0-8.0	48.18	2.54	47.09	2.21
12.13	Benzeneacetaldehyde	-	-	-	-	-	0.21	-	-
-	cis-ocimene	-	-	1.4-3.0	0.5-1.5	-	-	-	-
12.41	β-Ocimene	0.5-6.0	-	2.5-6.0	0.0-1.0	0.16	0.13	-	-
-	3-octanone	0.0-3.0	-	-	-	-	-	-	-
12.80	γ-Terpinene	-	-	-	-	0.22	-	-	-
13.24	trans-Sabinene hydrate	-	-	-	-	0.21	-	-	-
13.99	p-cymenene	-	-	-	-	0.20	-	-	-
14.46	Linalool	20.0-43.0	34.0-50.0	28.0-38.0	24.0-37.0	0.44	0.13	-	-
14.79	3-acetoxy-Octene	-	-	-	-	0.51	-	-	-
15.37	α-Campholene aldehyde	-	-	-	-	0.23	-	-	-
16.18	Camphor	0.0-1.5	8.0-16.0	7.0-11.0	6.5-8.0	10.39	-	15.79	-
16.29	hexyl-Isobutyrate	-	-	-	-	0.21	-	-	-
16.58	4-Isopropylcyclohexanone	-	-	-	-	0.42	-	-	-
17.14	Borneol	-	0.5-3.0	1.5-3.5	1.5-3.5	3.60	-	13.81	-
17.45	α-Terpineol	0.0-2.0	0.2-2.0	0.3-1.2	0.3-1.2	0.18	-	-	-
17.46	p-cymen-8-ol	-	-	-	-	-	1.99	-	1.54
17.65	Cryptone	-	-	-	-	2.32	4.87	0.79	6.23
17.98	hexyl-Butyrate	-	-	-	-	2.31	0.83	1.22	-
18.30	n-Dodecane	-	-	-	-	-	0.13	-	-
18.48	trans-7-tetradecene	-	-	-	-	-	0.22	-	-
19.22	Bornyl formate	-	-	-	-	0.56	-	-	-
19.60	hexyl-2-methylbutanoate	-	-	-	-	0.20	-	-	-
19.72	Benzaldehyde	-	-	-	-	2.12	5.28	1.49	6.21
19.79	D-carvone	-	-	-	-	1.26	1.89	0.51	1.12
20.11	Linalyl acetate	25.0-47.0	0.0-1.6	19.0-29.0	25.0-38.0	1.56	-	0.87	-
20.11	Piperitone	-	-	-	-	-	1.26	0.49	0.96
21.28	Endobornyl acetate	-	-	-	-	0.37	-	-	-
21.33	Lavandulyl acetate	0.0-8.0	-	1.0-2.0	1.5-3.5	0.53	-	-	-
-	Lavandulol	0.0-3.0	-	0.4-1.2	0.2-1.0	-	-	-	-
21.95	Tridecane	-	-	-	-	-	0.25	-	-
22.03	Eucarvone	-	-	-	-	-	0.20	-	-
24.60	Neryl acetate	-	-	-	-	0.30	0.34	-	-
24.74	β-Bourbonene	-	-	-	-	0.13	0.15	-	-
26.31	Coumarin	-	-	-	-	0.28	0.31	-	-
27.09	β-Farnesene	-	-	-	-	-	0.41	2.44	1.75
29.01	γ-Cadinene	-	-	-	-	1.58	1.11	0.94	0.97
31.12	Caryophyllene oxide	-	-	-	-	1.38	1.76	0.93	1.42
32.93	α-Muurolol	-	-	-	-	0.30	0.21	-	-
40.20	n-Octadecane	-	-	-	-	0.14	1.34	0.89	1.01

^a Linear Retention Indices, as determined on a Restek Rxi®-5Sil MS column using a series of the standards of C₇-C₃₀ saturated n-alkanes, -: not detected



When the floral scent components of lavandin leaves are compared with the essential oil standards of Abrial (ISO 3054) and Grosso (ISO 8902), it is between the variation limits of Abrial variety in terms of camphor and of Grosso variety in terms of β -ocimene. Floral scent components of lavender leaves are only within the 1,8-cineole range compared to lavender essential oil standards (ISO 3513). In addition, *cis*-ocimene, 3-octanone and lavandulol found in the standards were not detected in lavandin leaves as a result of HS-SPME analysis. In addition to these components, camphor, α -terpineol, linalyl acetate and lavandulyl acetate were not detected in lavender leaves according to HS-SPME analysis (Table 1).

After *n*-hexane extraction, 0.528% concrete yield was obtained from lavandin leaf and 1 kg concrete yield was determined as 221.4 kg/leaf. For lavender, these values were determined as 0.438% and 235.1 kg/leaf, respectively. A total of 20 compounds were detected in the concrete of both species. The 1,8-cineole content of lavandin concrete was determined as 47.09%, the camphor content was 15.79% and the borneol content was 13.81. In lavender concrete, the main components were determined as cymol (33.49%), limonene (16.98%) and *o*-cymene (12.78%). Considering the conformity of the obtained concretes to the essential oil standards; It is seen that the Super A variety does not meet the standards, but the Munstead variety is within the variation limits in terms of only 1,8-cineole (Table 1).

There is limited research on the fragrance components of lavender leaves. Studies are related to the essential oil content and components in the leaves (Hassanpouraghdam et al. 2011; Shafaghat et al. 2012; Nurzyńska-Wierdak and Zawislak, 2016). Of these studies, Hassanpouraghdam et al. (2011) reported that lavender leaves contain 0.64% essential oil and this essential oil contains 1,8-cineole between 17.6-31.9%. Similar results Shafaghat et al. (2012) had also been reported. Nurzyńska-Wierdak and Zawislak (2016) stated that the essential oil obtained from lavender leaves is different from the essential oil obtained from flowers, the main components in essential oils obtained from the leaves are epi- α -cadinol (17.8%), cryptone (10.4%), 1,8-cineole (7.3%) and caryophyllene oxide (7.2%) reported. In our study, since concrete was obtained from the leaves by *n*-hexane extraction, the content of 1,8-cineole and especially cymol in lavender was found to be quite high. Because, according to the HS-SPME analysis of both species, the same molecules were found in the floral fragrance components. In our study, it is seen that the main floral odor molecules in the leaves are completely recovered by extraction. As a result, lavandin and concretes derived from lavender leaves may have wider application possibilities in the pharmaceutical, cosmetic and food industries.



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**AN EVALUATION OF WATERMELON PRODUCTION EFFICIENCY IN A PERI-
URBAN AREA – A CASE STUDY IN CAI RANG DISTRICT, CAN THO CITY,
VIETNAM**

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ABSTRACT

We carried out this study to evaluate the efficiency of watermelon production in Cai Rang district, Can Tho city, Vietnam. We collected production data from 40 watermelon farming households in the studied area through face-to-face interviews. This study used several methods, including descriptive, cost-benefit analysis, and multiple variable regression analysis. The research results showed that watermelon farming is an effective agricultural production. The average watermelon yield per 1,000 m² crop⁻¹ is about 3,193.5 kg, the lowest is 2,500 kg, and the highest is 5,000 kg. The total cost of watermelon cultivation per 1,000 m² crop⁻¹ ranged from 3,215,000 VND to 11,813,000 VND and averaged 7,405,440 VND. Profits ranged from 600,000 to 9,005,000 VND 1,000 m⁻² crop⁻¹ and averaged 4,515,600 VND 1,000 m⁻² crop⁻¹. In general, watermelon production is positive and financial efficiency achievement. The results of the regression analysis of watermelon yield depend on several factors, such as household leaders' education level, household leaders' production years, the cost of pesticides, and other factors that have not been included in the model. In which household leaders' education level, household leaders' production years, and cost of pesticides are positively correlated with productivity. Profits in watermelon farming of farmers depend on factors including land rental cost, fertilizer cost, harvesting cost, selling price, and watermelon yield.

Keywords: Can Tho City, peri-urban area agriculture, production efficiency, watermelon



1. Introduction

In Vietnam, important cities are located in the large rivers deltas and along the coast (Kuenzer & Renaud, 2012). Due to the expansion of the inner-city area and the implementation of large-scale construction investment projects, urbanization in the peri-urban areas of significant cities has been complicated and fast (Kim, 2020). As a result, the landscape morphology in suburban areas is often confused and adversely affects the environment – society – economy. There are five national-level urban centers and five central cities, including Ha Noi, Ho Chi Minh, Da Nang, Hai Phong, and Can Tho (Ngoc et al., 2022). Can Tho City, with the advantages of being located in the center of the specialty fruit tree area, is the premise that Can Tho City becomes the only national city that still has a diversified agricultural production associated with many regional specialties (Pham et al., 2009; Son & Thanh, 2018). Cai Rang District is one of the five districts of Can Tho City and is considered an essential intersection of the Mekong Delta region (Thi et al., 2021). To gradually improve the economic efficiency of agricultural production, local authorities have encouraged the conversion of low-yielding rice and upland crop areas to cash crops with higher economic efficiency (Nhan et al., 2021; Nhan & Liem, 2021). Which watermelon cultivation model is one of the recommendations.

The Can Tho City agricultural production aims to reduce production costs and maintain or increase crop yields while enhancing quality. It is proposed to establish and strengthen agricultural production linkages to ensure stable benefits for farmers. The development of intensive fruit production and intercropping of other vegetables in the field is also encouraged, as well as the development of fruit and leafy vegetable farms in the suburbs to serve domestic consumption and develop agroecological tourism (Phuong, 2017). The crop industry applied “3 Reductions – 3 Gains”, “1 Must Do – 5 Reductions”, and Integrated Crop Management (ICM) for rice production (Duc Trung et al., 2018). The government builds up the capacity to apply Good Agricultural Practices (GAP) and organic standards for farmers and encourages them to produce on those criteria/standards (Nguyen & Jolly, 2020). Apply innovations in agricultural technologies and practices to reduce negative environmental impacts and enhance resilience to climate change (Mensah et al., 2021).

Watermelon (*Citrullus lanatus*) is grown in many regions of the country. Traditional field cultivation of watermelons is still the predominant form today. Watermelon is a fruit vegetable with high economic value and is considered one of the popular fruits of families' consumption in Vietnam. Moreover, the intestines and the peel of watermelon are used in traditional medicine as medical treatments. Over the years, watermelon cultivation development has brought



significant benefits to the household economy and the general development of the local economy. In general, the current status of watermelon cultivation, although it has achieved economic efficiency, still has many difficulties and limitations and has not brought into full play its strengths and potential. Therefore, it is necessary to analyze and evaluate the economic efficiency of watermelon to find out the causes and propose solutions to improve the economic efficiency of this crop further.

2. Methodology

Primary data collection: We used a system of pre-prepared interview questions to collect data to serve the situation research and assess the need to improve people's ability to access livelihood capital, recommendations, mechanisms, and policies to help them access livelihood resources. Our study was conducted in two wards, including Thuong Thanh and Ba Lang (Figure 1). We interviewed 40 households to collect information on livelihood and income, and families were selected by non-probability sampling.

Secondary data collection: We collected secondary data from various sources, including documents published by the Ministry of Agriculture and Rural Development, Statistical Yearbooks, scientific reports, and annual reports summarizing the economic activities of the Cai Rang District Economic Department.

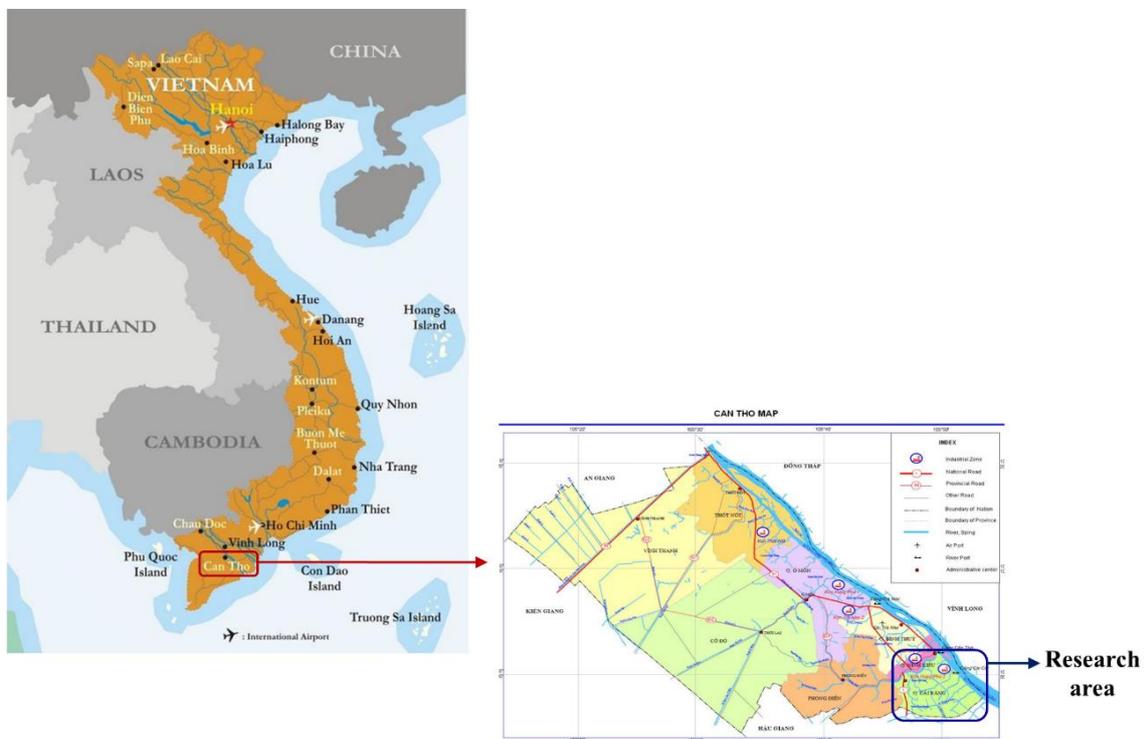


Figure 1. Research area



Figure 2. Harvest watermelon from open-field cultivation (*Source: HGTV*)

This study uses SPSS and Excel software to manage and analyze research data. We use descriptive statistics to analyze the current status of livelihood resources to meet production activities and household life. Specifically, the frequency distribution method aims to describe and learn about the distribution characteristics of a raw data sample and tabulate the frequency distribution. A frequency table is a table that summarizes the data arranged in different groups. Then determine the cluster frequency by counting the number of observations within that cluster, and the results are presented in a table or graph. Rated maximum value, minimum value, and average value. We also use the correlation regression analysis method to determine several household characteristics that affect the family's total income.

The criteria for calculating results and production efficiency:

Gross return = Output \times Price of the product

Yield = Harvested output / Planted area

Total cost = Material cost (seed, mechanization, energy, fertilizer) + Labor cost (include or exclude family labor cost and hired labor cost) + Others cost

Net return = Gross return – Total cost (Include or exclude family labor cost)

Gross return Cost Ratio (GCR) = Gross return / Total cost (Include or exclude family labor cost)

Benefits Cost Ratio (BCR) = Net return / Total cost (Include or exclude family labor cost)

Net return Gross return Ratio (NGR) = Net return / Gross return



The correlation regression analysis method was used to analyze the factors affecting productivity and net return of the maize cultivation model.

Model 1: Analysis of factors affecting the productivity of the watermelon cultivation model

The regression equation has the form of

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_nX_n$$

In which:

- + Dependent variable: Y is the yield (kg 1,000 m⁻² years⁻¹) achieved
- + X₁: Household leaders' age (year)
- + X₂: Household leaders' education level (1 = Primary; 2 = Secondary; 3 = High school)
- + X₃: Cultivated area (m²)
- + X₄: Get vocational education and training (times)
- + X₅: Agrochemicals cost (1,000 VND ha⁻¹ crop⁻¹)
- + X₆: Fertilizers cost (1,000 VND ha⁻¹ crop⁻¹)
- + X₇: Household leaders' working experiences (years)

Model 2: Analysis of factors affecting the profitability of the watermelon cultivation model

The regression equation has the form of

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \dots + \beta_nX_n$$

In which:

- + Dependent variable: Y is the net return (1,000 VND ha⁻¹ crop⁻¹) achieved
- + X₁: Renting production land cost (1,000 VND)
- + X₂: Land preparation and weed control cost (1,000 VND)
- + X₃: Seeds cost (1,000 VND)
- + X₄: Fertilizers cost (1,000 VND)
- + X₅: Agrochemicals cost (1,000 VND)
- + X₆: Covered plastic films cost (1,000 VND)
- + X₇: Harvest cost (1,000 VND)
- + X₈: Selling prize (1,000 VND)
- + X₉: Productivity (kg ha⁻¹ crop⁻¹)
- + X₁₀: Get vocational education and training (times)

3. Results and discussion

3.1 The structure of watermelon cultivation cost

The direct costs of watermelon production in Cai Rang District include renting production land; land preparation and weed control; seed cost; fertilizers cost; agrochemicals cost; covered land



plastic films cost; labor cost for watering activities; fuel costs; and harvesting costs. Fertilizers and harvesting are the two costs that account for the most significant proportion of total investment costs (each expense accounts for 26%). Because watermelon is a crop that requires a lot of nutrients to grow fruit, it needs a lot of fertilizers. When harvesting, it is necessary to sell all watermelons at once, requiring a lot of labor. Second-highest cost is pesticides, accounting for 11% of the total cost. Watermelon cultivation strongly depends on the weather conditions. Depending on the growth period, different pests and diseases attack, so most farmers use agrochemicals to prevent plant diseases. That is why the cost of agrochemicals often accounts for a relatively high proportion (ranked second) in the total cost of watermelon production. Seed cost accounted for 9%, followed by renting production land, and covered land plastic films' cost accounted for 8%. The cost of land preparation and weed control accounted for 6%. The labor cost for irrigation accounted for 5%, and the fuel for water supply cost accounted for only 1% of the total cost. Due to the use of agricultural-covered land plastic films for mulching, the soil retains good moisture. That makes watermelon roots easier to grow and less weeding development, so the costs of weed control, watering labor, and fuel costs account for a negligible proportion.

Table 1. The structure of watermelon cultivation cost (*Unit: 1,000 VND 1.000 m⁻² crop⁻¹*)

	Min	Max	Aver.	Std.	%
Renting production land	250	1,000	602.48	219.28	8.1
Land preparation and weeds control	35	1,000	424.14	203.61	5.7
Seeds	465	740	680.13	70.76	9.2
Fertilizers	1,000	2,040	1,939.50	197.08	26.2
Agrochemicals	500	2,000	785.00	318.49	10.6
Covered plastic films	450	733	602.17	84.02	8.1
Labor for irrigation	100	1,000	401.79	246.70	5.4
Fuel for irrigation	10	900	53.23	159.03	0.7
Harvest	500	2,400	1,943.0	553.39	26.0
Total	3,215	11,813	7,405.44		100

3.2 Production efficiency of watermelon cultivation

Productivity is essential and depends on many input and objective factors, such as weather and climate conditions, soil structure, and farmers' production experience. Productivity is also one of the essential factors that determine the profitability of the household. The higher the productivity, the higher the farmer's profit. The average watermelon yield per 1,000 m² of land in the Cai Rang district is about 3,193.5 kg. The lowest yield value is 2,500 kg 1,000 m⁻² and the highest is 5,000 kg 1,000 m⁻².



The selling price is the amount of money a farmer gets when he sells a unit of product, which is a factor that farmers are most concerned about after harvesting. The actual price of watermelon fluctuates quite a bit depending on the market (due to the law of supply and demand) and the fruit's quality. Different production techniques lead to fruit quality differences among producing households, and the selling price differs depending on the quality and type of fruit. The price of watermelon ranges from 2,000 to 5,000 VND/kg, and the average price is 3,642 VND kg⁻¹. The research results show that about 97.5% of households sell to traders, and only one household sells the product directly to consumers, accounting for 0.25%. Although the selling price to traders will be lower than when selling at the markets or retails; However, farmers will sell all their products simultaneously and receive cash immediately after selling.

Revenue is the total amount that farmers will earn from selling a product. The price of sale times output usually determines the revenue—profit ratio favorably with productivity and selling price. If the selling price and productivity are high, the income is high, and vice versa. The average revenue per 1,000 m² of land for watermelon production in the study area is 11,550 VND 1,000 m⁻², corresponding to the average selling price of 3,612 VND kg⁻¹ and the average yield is 3,192 kg 1,000 m⁻².

Profits fluctuate greatly due to unstable market prices, which greatly affects the profits of cultivation. The average profit is $4,515.6 \times 1,000$ VND 1,000 m⁻², the highest is $9,005 \times 1,000$ VND 1,000 m⁻² and the lowest is $600 \times 1,000$ VND 1,000 m⁻². The difference in profit comes from the difference in technique and how the farmers work in their fields. Low profits are due to various reasons, such as poor production techniques, prices, natural disasters, or epidemics. The profit/total cost index is about 0.628, which means that for every VND investment, the farmers will gain 0.628 VND of profit (if the price of one family labor is equal to the market price of hired labor). The average income/total cost index is about 1.607, meaning that with one VND of investment, farmers will gain 1.607 VND of revenue. The average profit/income index is about 0.391, meaning that one VND of revenue farmers will receive generates 0.391 VND of profit.

With the cost ranges calculated above, the average total cost of production has the price of family labor equal to the hired labor. The financial indicators show that all households in the research area are economic efficiency, but if family labor is not included in watermelon production, profits, income, and revenue will be higher than when calculating family labor.



Table 2. Production efficiency of watermelon cultivation

	Unit	Min	Max	Aver.	Std.
Productivity	kg 1,000 m ⁻²	2,500	5,000	3,192.5	455.95
Selling price	VND kg ⁻¹	2,000	5,000	3,612.8	547.81
Income	1,000 VND 1,000 m ⁻²	8,000	16,800	11,550	11,576.24
Profit	1,000 VND 1,000 m ⁻²	600	9,005	4,515.6	2,171.55
Profit / total cost	times	0.13	0.88	0.63	2.03
Income / total cost	times	1.72	1.63	1.67	10.80
Profit / Income	times	0.08	0.54	0.39	0.19

3.3 Analysis factors affect the productivity and profitability of watermelon production

3.3.1 Analysis factors affect the productivity of watermelon production

The analysis results in Table 3 show that the coefficient sig.F of the model = 0.082 is smaller than the significance level $\alpha = 10\%$, so the regression model is significant, consistent with the data set, has good results, and is usable. The independent variables affect the dependent variable Y. The model's adjusted R² coefficient is 0.155 or 15.5%, which means that the variation of watermelon productivity can explain the factors included in the model without the phenomenon of autocorrelation, and the results factors explain the remaining 84.5%. The remaining 15.5% depended on factors outside the model. The Durbin-Watson coefficient of the model is 1.922 with $1 < D = 1,515 < 3$, showing that the model does not have autocorrelation. Besides, the model's Variance Inflation Factors (VIF) is much smaller than 10, so we conclude that the factors included in the model do not have multicollinearity (Liem et al., 2023; Liem, Tinh, Kim, et al., 2022; Liem, Tinh, Loan, et al., 2022).

The analysis results show that three out of 7 variables included in the model have statistical significance (sig. 10%). Three variables with statistical significance are household leaders' education level (X₂), agrochemicals cost (X₅), and household leaders' working experiences (X₇). These three variables are positively correlated with the productivity of watermelon production.



Table 3. Analysis factors affect the productivity of watermelon production

Factors	B	β	Sig.	VIF
Constant	3,084		0.007	
X ₁ : Household leaders' age	0.037	0.041	0.836	1.799
X ₂ : Household leaders' education level	0.257	0.355	0.073	1.700
X ₃ : Cultivated area	-0.001	-0.017	0.913	1.190
X ₄ : Get vocational education and training	-0.216	-0.229	0.139	1.055
X ₅ : Agrochemicals cost	0.001	0.357	0.040	1.279
X ₆ : Fertilizers cost	-0.0004	-0.187	0.241	1.135
X ₇ : Household leaders' working experiences	0.053	0.353	0.039	1.244
R ²	0.307			
Adjusted R ²	0.155			
Sig.F	0.082			
Durbin-Watson test	1.922			

Note: Significant level of 10%

$$Y = 3,084 + 0.257X_2 + 0.001X_5 + 0.053X_7$$

3.3.2 Analysis factors affect the profitability of watermelon production

The analysis results in Table 3 show that the coefficient sig.F of the model = 0.000 is smaller than the significance level $\alpha = 10\%$, so the regression model is significant, consistent with the data set, and has good results and is usable. The independent variables affect the dependent variable Y. The model's adjusted R² coefficient is 0.980 or 98.0%, which means that the variation in watermelon cultivation profitability can explain the factors included in the model without the phenomenon of autocorrelation. The results from factors demonstrate the remaining 98.0%, and the remaining 12.0% depended on the elements outside the model. The Durbin-Watson coefficient of the model is 1.478 with $1 < D = 1,515 < 3$, showing that the model does not have autocorrelation. Besides, the model's Variance Inflation Factors (VIF) is much smaller than 10, so we conclude that the factors included in the model do not have multicollinearity (Liem et al., 2023; Liem, Tinh, Kim, et al., 2022; Liem, Tinh, Loan, et al., 2022).

The analysis results show that three out of 10 variables included in the model have statistical significance (sig. 10%). Six variables with statistical significance are renting production land cost (X₁), fertilizers cost (X₄), agrochemicals cost (X₅), harvest cost (X₇), selling price (X₈), and productivity (X₉). Two variables are positively correlated with the profitability of watermelon production, such as selling price and productivity. The other four variables, renting production land cost, fertilizers cost, harvest cost, and agrochemicals cost, are negatively correlated with the profitability of watermelon production.



Table 4. Analysis factors affect the profitability of watermelon production

Factors	B	β	Sig.	VIF
Constant	-6,998.89		0.071	
X ₁ : Renting production land cost	-1.31	-0.123	0.044	2.672
X ₂ : Land preparation and weed control cost	0.51	0.055	0.494	5.781
X ₃ : Seeds cost	0.53	0.014	0.844	4.285
X ₄ : Fertilizers cost	-3.987	-0.126	0.010	1.465
X ₅ : Agrochemicals cost	-1.288	0.091	0.096	2.308
X ₆ : Covered plastic film cost	-0.364	0.015	0.753	2.113
X ₇ : Harvest cost	-1.672	-0.463	0.001	7.500
X ₈ : Selling prize	2.984	0.729	0.000	2.305
X ₉ : Productivity	4.257	0.630	0.000	2.387
X ₁₀ : Get vocational education and training	372.378	-0.077	0.197	2.966
R ²	0.991			
Adjusted R ²	0.980			
Sig.F	0.000			
Durbin-Watson test	1.487			

Note: Significant level of 10%

$$Y = -6.998,89 - 1,31X_1 - 3,987X_4 - 1,288X_5 - 1,672X_7 + 2,984X_8 + 4,257X_9$$

4. Conclusion

Watermelon cultivation plays a significant role in agricultural economic development in Vietnam. In the peri-urban area of Can Tho City – Cai Rang District, watermelon productivity is affected by household leaders' education level, and agrochemicals cost, and household leaders' working experiences. The profit of watermelon cultivation is affected by renting production land cost, fertilizers cost, agrochemicals cost, harvest cost, selling price, and productivity.



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FARKLI AZOT KAYNAKLARI VE AZOT DOZLARININ BAZI SICAK İKLİM ÇİM BİTKİLERİNİN BİTKİ GELİŞİMİ VE ÇİM KALİTESİ ÜZERİNE ETKİLERİ

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ÖZET

Bu çalışma farklı azot kaynaklarının ve azot dozlarının bazı sıcak iklim çim bitkilerinin [Japon çim otu (*Zoysia japonica* cv. Zenit) ve kıyı yalancı darısı (*Paspalum vaginatum* cv. Seaspray)] bitki gelişimi ve çim kalitesi üzerine etkilerinin belirlenmesi amacıyla Bursa Uludağ Üniversitesi Ziraat Fakültesi Tarımsal Araştırma ve Uygulama Merkezi'nde bulunan çim bitkileri deneme alanında, 2022 Mayıs-Ekim ayları arasında 6 ay boyunca sürdürülmüştür. Deneme; Tesadüf Blokları Deneme Deseninde Bölünen Bölünmüş Parseller düzenine göre 3 tekrarlamalı olarak kurulmuştur. Denemede üç faktör yer almakta olup, birinci faktör çim türleri, ikinci faktör azot kaynakları [kimyasal gübre (%26'lık amonyum nitrat) ve solucan gübresi (Asgup %1,5 N)] ve üçüncü faktör azot dozları (0.0 ve 5.0 gm⁻²)'dir. Deneme sonuçlarına göre çim türleri arasında çim renk ve kalite değerleri bakımından çoğu gözlemlerde istatistiki anlamda bir farklılık bulunmamıştır. Çim türlerine ait kuru ot verilerinden ise sadece Ekim ayı önemsiz bulunmuş, diğer 3 ölçüm istatistiki olarak önemli bulunmuştur. Azot kaynakları arasında çim renk değerleri bakımından Temmuz ayı gözlemi, kalite değerleri bakımından ise Eylül gözlemi hariç tüm renk ve kalite gözlemleri istatistiki olarak önemli bulunmuştur. Kuru ot verileri ise tüm ölçümlerde istatistiki olarak önemli çıkmıştır. Azot dozları arasında ise tüm ölçüm ve gözlemler arasındaki farklılıklar önemli bulunmuştur. Denemede yer alan sıcak iklim çim türleri arasında ölçüm ve gözlemler bakımından önemli farklılıklar bulunmamıştır. Azot kaynaklarından amonyum nitrat solucan gübresine göre renk, kalite ve kuru ot değerleri üzerine önemli etkilerde bulunmuştur. Solucan gübresi, kimyasal gübre kadar üstün performans göstermese de renk ve kalite gözlemlerinden bazılarında kabul edilebilir renk ve kalite sınırı olan 6 değerinin üzerinde performans göstermiştir. 5.0 g/m² N dozu; renk, kalite ve kuru madde değerleri üzerine kontrol (0.0 g/m² N) parsellerine göre daha iyi sonuçlar vermiştir.

Anahtar Kelimeler: Sıcak iklim çim türleri, azot kaynağı, azot dozu, çim rengi, çim kalitesi



EFFECTS OF DIFFERENT NITROGEN SOURCES AND DOSES ON PLANT GROWING AND TURF QUALITY OF SOME WARM SEASON TURFGRASS

ABSTRACT

This study was carried out to determination of the effects of different nitrogen sources and nitrogen doses on plant growth and turf quality of some warm season turf plants [*Zoysia japonica* Steud cv. Zenit) and seashore paspalum (*Paspalum vaginatum* cv. Seaspray] in Bursa Uludağ University Faculty of Agriculture Agricultural Research and Application Center for 6 months between May and October 2022. The experimental design was a split-split plot with turfgrass species as a main plot, nitrogen sources as the sub plots and nitrogen doses as the sub sub plots with 3 replications. There are three factors in the experiment, the first factor is turfgrass species, the second factor is nitrogen sources [chemical fertilizer (%26 ammonium nitrate) and vermicompost (Asgup %1.5 N)] and the third factor is nitrogen doses (0.0 and 5.0 g/m²). According to the trial results, there was no statistical difference in most observations in terms of turf color and quality values among turfgrass species. Among the clipping yield of turfgrass species, only October was found to be insignificant, and the other 3 measurements were found to be statistically significant. Among the nitrogen sources, all color and quality observations were found to be statistically significant except the July observation in terms of turfgrass color values and the September observation in terms of quality values. Clipping yield was statistically significant in all measurements. Among the nitrogen doses, the differences between all measurements and observations were found to be significant. There were no significant differences between the warm climate turfgrass species in the experiment in terms of measurements and observations. Ammonium nitrate, one of the nitrogen sources, had significant effects on color, quality and clipping yield compared to vermicompost. Although vermicompost did not perform as well as chemical fertilizers, it performed above the acceptable color and quality limit of 6 in some of the color and quality observations. Dose of 5.0 g/m² N; that gave better results on color, quality and dry matter values than control (0.0 g/m² N) plots.

Keywords: Warm season turf species, nitrogen source, nitrogen dose, turf color, turf quality



1. GİRİŞ

İnsan nüfusunun giderek arttığı teknolojinin ve sanayileşmenin hızla geliştiği günümüz çağında, insanların rahatça nefes alabilecekleri, keyifli vakit geçirebileceği, şehir hayatının sıkışıklığından bir nebze de olsa uzaklaşabileceği yeşil alanlar gittikçe azalmaktadır. İnşaat sektörünün sürekli gelişmesiyle beraber yoğun kentleşme, yeşil alanların tahrip edilerek azaltılması sonucuyla karşımıza çıkmaktadır. Bu sorunlar spor alanlarında, park ve bahçelerde huzurlu, temiz ve güvenli bir ortam yaratan çim bitkilerinin önemini ortaya koymaktadır.

Nitekim insanın günlük yaşamı süresince evde ve iş yerinde doğrudan ilişkide bulunduğu yeşil alanlar, güzel düzenlenmiş yollar, kent meydanları ve yaya bölgeleri içerisinde kentsel yeşil dokunun temel yapısını oluşturur (Altan, 1989). Öte yandan, şehir içi ve çevre yollarının banket ve orta refüjlerinde, bölgesel piknik ve park alanlarında, hava meydanlarında yeşil alanlar hem estetik hem de fonksiyonel işlevlere sahiptir. Örneğin çimler sıcak günlerde gündüz güneş radyasyonunu emerek etrafın serinlemesine katkıda bulunurken, gece ise gündüz topladığı radyasyonu geri vererek dış mekân ısısına olumlu yönde etki yapar. Terleme ile su kaybetmesi sonunda yazın çevre sıcaklığında 5 dereceye kadar sıcaklık azalmasına sebep olabilir. Aynı çevre betonla kaplandığı zaman bu sıcaklık farkı 20-25 derece fazla olmaktadır. Çünkü iyi yapılmış 1 m²'lik çim yüzeyinde yaklaşık 4000'e yakın çim bitkisinin enerji absorpsiyonu özelliği nedeniyle bir klima gibi serinletici işlev gördüğü söylenebilir (Avcıoğlu, 1977).

Denemedeki bitki materyallerinden ilki, Japon çim otu (*Zoysia japonica*) oluşturduğu yüksek kalitedeki çim dokusuyla dünyanın pek çok ülkesinde ev bahçeleri, parklar, golf ve spor sahalarında kullanımı yaygın olan önemli bir sıcak iklim çim türüdür (Beard 1973, Richardson vd 2003). Çok yıllık bir çim türü olup stolon ve rizomlarıyla yayılmakta ve yavaş bir büyüme göstermektedir (Hitchcock ve Chase 1955, Anderson 2000, Patton vd 2006). Ancak 'Zenith' tohumlu bir çeşit olup California Riverside Üniversitesi tarafından geliştirilmiş ve Patten Tohum Şirketi (Patten Seed Company) tarafından 2000 yılında tanıtılmıştır (Samples ve Sorochon 2007). *Zenith*, soğuğa dayanıklılığı yüksek ve kaba dokulu (>2mm) bir çeşittir (Patton 2009). İkincisi ise, Kıyı yalancı darısı (*Paspalum vaginatum*) çok yıllık bir sıcak iklim çimidir, 30-35° kuzey-güney enlemlerinde deniz seviyesinde, tropik ve yarı tropik sıcak iklimlerde bulunmaktadır. Su altında kalma ve bataklık koşullarında yaşama yeteneğine sahiptir (Colman ve Wilson 1960). Tuzluluğa toleransı yüksektir ve birçok stres koşullarına adapte olabilir. Diğer sıcak iklim çimlerinin aksine olumsuz koşullara maruz kaldığında (aşırı trafik etkisi, hastalık ve zararlı etkisi ve aşırı derin biçim) eski haline daha çabuk dönebilmektedir (Duncan ve Carrow 2007).



Önemli bir bitki besin elementi olan azot bütün kültür bitkilerinde özellikle buğdaygil familyasında bulunan türlerde vejetatif gelişmeyi hızlandırır, kardeşlenmeyi artırır, bitki boyu, renk ve büyüme hızını olumlu yönde etkilemektedir (Kacar ve Katkat, 2010). Çim bitkilerinde azot; sürgün ve kök büyümesi, sürgün sıklığı, renk, hastalık ve zararlılara dayanıklılık ve kendini yenileme kabiliyeti gibi çeşitli özelliklere etki yapar (Oral ve Açıkgöz 2002).

Solucan gübresi son dönemde sıklıkla gündeme gelmekte ve kullanımı gittikçe yaygınlaşmaktadır. Ekolojik tarımda kaydedilen gelişmelere paralel olarak, solucan gübresi üretimi ve kullanımı hızlanmış olup; organik bir kompostlaşma sonucu ortaya çıkan bu materyal “Biohumus” veya “Vermikompost” adları ile de anılmaktadır (Karaçal ve Tüfenkçi 2010). Organik bir materyal olan solucan gübresi, toprak özelliklerini iyileştirici etkisi ile beraber bitkilere besin maddeleri sağlamaktadır (Demir ve ark. 2010).

Bilgili ve Açıkgöz (2005), aylık olarak farklı dozlarda tüm yıl boyunca uygulanan azotlu gübrelemenin çim bitkilerinin büyüme ve kaliteleri üzerine etkilerini inceledikleri araştırmada; amonyum nitrat ve iki farklı yavaş salınımlı gübre kullanmışlardır. Artan azot dozlarının çim türlerinde renk, kalite kaplama oranı ve kuru ot gibi özellikleri artırdığını belirtmişlerdir. Ayrıca azotlu gübre uygulamalarının, tüm tarihlerde renk ve kalite değerleri ile doğrusal bir ilişkisi olduğu belirtilmiş olup; özellikle 5.0 ve 7.5 g/m² azot dozları ile büyüme sezonu süresince koyu yeşil ve yüksek kaliteli çim oluşumunu tespit etmişlerdir. Araştırma sonucunda 5.0 ve 7.5 g/m² azot dozlarından elde edilen renk ve kalite değerlerinin çoğu gözlemde aynı istatistikî grupta yer alması nedeniyle 5.0 g/m² azot dozunun çim alanlarda kullanımı tavsiye edilmiştir.

Bu araştırma, son yıllarda gündeme gelmeye başlayan ve kullanımı gittikçe artan solucan gübresinin çim alanlardaki kullanımını belirlemek amacıyla yürütülmüştür. Bu amaçla araştırmamızda 5.0 g/m² azot dozu esas alınarak solucan gübresini kontrol azot kaynağı olan amonyum nitrat ile birlikte, iki sıcak iklim çim türü üzerinde uygulayarak araştırmamız yürütülmüştür.

2. MATERYAL VE YÖNTEM

Araştırma, farklı azot kaynakları ve dozlarının bazı sıcak iklim çim bitkilerindeki etkilerini belirlemek amacıyla Bursa Uludağ Üniversitesi Ziraat Fakültesi Uygulama ve Araştırma Merkezi'ndeki Çim Deneme Alanı'nda 2022 yılında yürütülmüştür. Araştırma yerinin gerek iklim ve gerekse toprak özellikleri, araştırmamızda materyal olarak kullanılan sıcak iklim çim bitkilerinin yetiştirilmesi açısından kısıtlayıcı bir etki içermemektedir.

Deneme; Tesadüf Blokları Deneme Deseninde Bölünen Bölünmüş Parseller düzenine göre 3 tekrarlamalı olarak kurulmuştur. Denemede üç faktör yer almakta olup, birinci faktör çim türleri



Japon çim otu (*Zoysia japonica* Steud. cv. Zenith) ve kıyı yalancı darısı (*Paspalum vaginatum* Sw. cv. Seaspray), ikinci faktör azot kaynakları [kimyasal gübre (%26'lık amonyum nitrat) ve solucan gübresi (Asgup %1,5 N)] ve üçüncü faktör azot dozları (0.0 ve 5.0 g/m²)'dir. Solucan gübresi üzerine çim bitkileriyle daha önce yapılmış araştırma olmadığından 5.0 g/m² azot dozu kontrol dozu (0.0 g/m²) ile test edilmiştir. Denemede çim türleri (2) ana parsellere, azot kaynakları (2) alt parsellere, azot dozları (2) ise altın altı parsellere yerleştirilmiştir. Deneme 3 tekerrürlüdür. Ana parsel boyutu 4 m × 6 m = 24 m², alt parsel boyutu 2 × 6 = 12 m², altın altı parsel boyutu ise 1 × 2 = 2 m²'dir.

Tablo 1. Denemenin yürütüldüğü Bursa İline ait 2022 yılı sıcaklık (°C), yağış (mm) ve nem (%) değerleri

Aylar	Ortalama Sıcaklık (°C)	Toplam Yağış (mm)	Ortalama Nem (%)
Ocak	4.6	94.75	76.4
Şubat	7.0	62.15	75.4
Mart	4.8	58.55	73.6
Nisan	14.0	44.33	69.9
Mayıs	17.8	56.13	71.2
Haziran	22.3	47.66	69.9
Temmuz	24.0	14.01	63.8
Ağustos	25.3	12.29	63.9
Eylül	20.7	32.43	66.7
Ekim	15.8	50.94	71.0
Kasım	13.1	41.30	75.6
Aralık	10.2	80.97	78.0
Toplam	-	618.21	-
Ortalama	14.9	-	71.3

Denemenin yürütüldüğü Bursa İli, genel olarak ılıman bir iklime sahiptir. Kuzeyde Marmara Denizi'nin yumuşak ve ılık iklimine karşılık güneyde Uludağ'ın sert iklimi görülmektedir. En sıcak aylar Temmuz–Eylül, en soğuk aylar ise Şubat–Marttır. Yağışlar en çok kış ve ilkbahar aylarında görülmektedir. Kışların çok sert geçmediği ilde yaz dönemlerinde kuraklık görülmektedir (Anonim 2022). Araştırmanın yürütüldüğü 2022 yılına ait iklim verileri Tablo 1'de sunulmuştur.

Deneme başlangıcından önce çok yıllık sıcak iklim çim bitkisi ile tesis edilmiş olan deneme alanına azot 6 ay boyunca (Mayıs-Ekim) 0 ve 5 g/m² N oranlarında uygulanmıştır. Sezon boyunca ayda bir kez her parselin çim rengi ve çim kalitesi görsel olarak, 1-9 skalasına göre alınmıştır. Renk 1: sarı, 6: kabul edilebilir ve 9: koyu yeşil; kalite: 1-9 değerleri, üniformite, sıklık, renk ve yabancı ot yoğunluğuna göre 1: çok kötü, 6: kabul edilebilir ve 9: mükemmel olacak şekilde alınmışlardır (Sills ve Carrow, 1983 Mehall et al., 1983, Goatley ve ark., 1994, Bilgili ve Açıkgoz, 2005). Parsellerdeki bitkiler 6-8 cm boya ulaştıklarında 4 cm yükseklikten



biçme makinesi ile biçilmişlerdir. Her biçimde kenar tesirleri alındıktan sonra parselin ortasında kalan 0.5 x 1.0 m'lik alanda biçimler yapılmış, biçilen bitkiler kese kağıtlarına konularak 70°C'de 48 saat kurutulup tartılmıştır.

Denemeden elde edilen veriler JMP7 istatistik paket programı kullanılarak değerlendirilmiştir. Önemlilik testlerinde 0.01 ve 0.05, farklı grupların belirlenmesinde ise 0.05 olasılık düzeyi kullanılmıştır. Araştırma sonuçlarının sunulduğu çizelgelerde (*) ve (**) işaretleri sırası ile 0.01 ve 0.05 olasılık düzeyinde istatistiki olarak önemliliği, (öd) ise istatistiki olarak önemli olmamayı ifade etmektedir. Ortalamalar arası farklılık LSD testi ile 0.05 düzeyinde belirlenmiştir.

3. Araştırma Sonuçları ve Tartışma

Çim türleri (ÇT), azot kaynakları (AK), azot dozları (AD) ve bunların interaksyonlarına ait varyans analiz sonuçları Tablo 2'de yer almaktadır. Tablo 2 incelendiğinde çim renk ve kalite değerleri bakımından çim türleri arasında istatistiksel anlamda bir farklılık olmadığı görülmektedir. Araştırmada yer alan farklı azot kaynakları arasında çim renk değerleri bakımından Eylül ayı gözlemi, çim kalite değerleri bakımından ise Temmuz ayı gözlemi dışında diğer tüm gözlemlerde istatistiksel anlamda önemli farklılıklar bulunmuştur. Azot dozları bakımından ise tüm çim renk ve kalite değerleri istatistiksel anlamda önemlidir. Araştırmada 4 farklı tarihte gerçekleştirilen biçimlerden elde edilen kuru ot değerleri tüm aylarda da ÇT, AK, ve AD bakımından istatistiksel anlamda önemli bulunmuştur.

3.1. Renk

Renk, çim alanların kalitesini ortaya koyan en önemli kantitatif değerlerden biridir. Estetik açıdan çim alanların değerini artırması sebebiyle arzulanan bir niteliktir. Çim alanlarda rengin her mevsimde mümkün olduğunca değişmemesi ve tercihen koyu yeşil olması istenmektedir (Morris 2005).



Tablo 2. Çim Türleri (ÇT), Azot Kaynakları (AK), Azot Dozları (AD) ve ÇT x AK, ÇT x AD, AK x AD ve ÇT x AK x AD İnteraksiyonlarına Ait Varyans Analiz Sonuçları

Varyasyon Kaynakları	Renk					
	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
ÇT	öd	öd	öd	öd	öd	öd
AK	*	**	*	*	öd	**
AD	**	**	**	**	**	**
ÇT x AK	öd	öd	öd	*	öd	*
ÇT x AD	*	öd	öd	**	öd	öd
AK x AD	öd	**	**	öd	öd	öd
ÇT x AK x AD	öd	öd	öd	öd	öd	öd
	Kalite					
	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
ÇT	öd	öd	öd	öd	öd	öd
AK	*	**	öd	**	*	**
AD	**	**	**	**	**	**
ÇT x AK	öd	öd	öd	öd	*	öd
ÇT x AD	*	öd	öd	öd	öd	öd
AK x AD	*	**	öd	öd	öd	öd
ÇT x AK x AD	öd	öd	öd	öd	öd	öd
	Kuru Ot					
	Haziran	Temmuz	Ağustos	Eylül		
ÇT	**	**	**	**		
AK	**	**	**	**		
AD	**	**	**	**		
ÇT x AK	**	**	**	**		
ÇT x AD	**	**	**	**		
AK x AD	**	**	**	**	öd	
ÇT x AK x AD	**	**	**	**	**	

*: 0,05 olasılık düzeyinde istatistiki olarak önemlidir,

** :0,01 olasılık düzeyinde istatistiki olarak önemlidir,

***: ÇT: Çim türü, AK: Azot kaynakları, AD: Azot dozları

Çim türleri arasında renk değerleri bakımından istatistiksel anlamda bir farklılık bulunmamaktadır. Ancak; Zoysia çim türü Mayıs ve Ekim ayları, Paspalum çim türü ise Mayıs ayı hariç olmak üzere diğer tüm aylarda kabul edilebilir çim renk değeri olan 6 değerinin üzerinde renk değeri vermişlerdir (Tablo 3).

Tablo 3. Çim Türlerine Ait Renk Ortalama Değerleri

Çim Türleri	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
Zoysia	5,6	6,4	6,5	6,5	6,4	5,9
Paspalum	5,2	6,1	6	6	6,3	6,2
LSD (0,05)	öd	öd	öd	öd	öd	öd

Azot kaynaklarının renk değerleri üzerine etkisine bakıldığında, kimyasal gübre olan Amonyum Nitrat yüksek renk değerleri göstermiştir. Solucan gübresi ise Temmuz, Ağustos ve Eylül aylarında kabul edilebilir çim renk değeri olan 6 değerlerini görmüştür (Tablo 4).



Tablo 4. Azot Kaynaklarına Ait Renk Ortalama Değerleri

Azot Kaynakları	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
Amonyum Nitrat	5,8 a	6,8 a	6,5 a	6,5 a	6,5	6,5 a
Solucan Gübresi	5,0 b	5,7 b	6 b	6 b	6,1	5,6 b
LSD (0,05)	0,5	0,3	0,3	0,3	öd	0,1

Azot kloroplastlarda bulunan klorofil molekülünün yapısal bir üyesidir ve ortamda bol bulunduğunda klorofil molekül sayısını arttırmaktadır. Renk özelliği klorofil miktarına bağlıdır. Dolayısıyla renk klorofil miktarından kaynaklanmaktadır (Türkan 2008). Azot dozlarının renk değerleri üzerine etkisine bakıldığında, 5 g/m² N dozunun tüm gözlemlerde en yüksek renk değeri verdiği, buna karşılık kontrol parsellerinde ise en düşük renk değerlerinin elde edildiği görülmektedir (Tablo 5).

Tablo 5. Azot Dozlarına Ait Renk Ortalama Değerleri

Azot Dozları (g m ⁻²)	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
0	4,3 b	4,7 b	4,5 b	4,6 b	4,3 b	4,3 b
5	6,5 a	7,8 a	8 b	8 a	8,4 a	7,8 a
LSD (0,05)	0,4	0,4	0,3	0,2	0,4	0,3

3.2. Kalite

Bir çim alanın; üniform yapıda, yabancı bitki barındırmayan, hastalık ve zararlı hasarı bulunmayan kusursuz görünümde olması onu kaliteli kılan en önemli unsurlardır. Kusursuz bir görüntüyü sağlamada ise; çim bitkisinin türü ve yapısal özellikleri, bakım uygulamaları, gübreleme ve ilaçlama uygulamaları gibi birçok faktörler etkilidir (Salman 2008).

Çim türlerine ait ortalama kalite değerleri incelendiğinde her iki tür arasında istatistiksel anlamda bir farklılık bulunmamıştır (Tablo 6).

Tablo 6. Çim Türlerine Ait Kalite Ortalama Değerleri

Çim Türleri	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
Zoysia	5,1	6,1	6,1	6,5	6,5	6
Paspalum	4,7	5,5	5,8	6	6,2	6
LSD(0,05)	öd	öd	öd	öd	öd	öd

Tablo 7’de yer alan azot kaynaklarına ait kalite değerlerine bakıldığında, Solucan Gübresinin Ağustos ve Eylül aylarında 6 değerlerinin üzerine çıktığı görülse de Amonyum Nitrat Solucan Gübresine göre istatistiksel anlamda daha yüksek çim kalite değerleri vermiştir.



Tablo 7. Azot Kaynaklarına Ait Kalite Ortalama Değerleri

Azot Kaynakları	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
Amonyum Nitrat	5,3 a	6,3 a	6	6,5 a	6,6 a	6,4 a
Solucan Gübresi	4,5 b	5,4 b	5,9	6 b	6,1 b	5,5 b
LSD(0,05)	0,5	0,4	öd	0,1	0,3	0,4

Azot dozlarının kalite değerleri üzerine etkisi incelendiğinde, 5 g/m² N dozunun tüm gözlemlerde en yüksek kalite değeri verdiği, buna karşılık kontrol parsellerinde ise en düşük kalite değerlerinin elde edildiği görülmektedir.

Trenholm ve Unruh (2005), yüksek azot oranının çim kalitesine olumlu etki yaptığını bildirmişlerdir. Araştırmamızda bu sonuçlara benzer şekilde olup yüksek azot dozunun çim kalitesine olumlu etki yaptığını belirlenmiştir (Tablo 8).

Tablo 8. Azot Dozlarına Ait Kalite Ortalama Değerleri

Azot Dozları (g m ⁻²)	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
0	4,0 b	4,5 b	4,5 b	4,6 b	4,5 b	4,4 b
5	5,9 a	7,2 a	7,4 a	7,9 a	8,3 a	7,5 a
LSD (0,05)	0,4	0,5	0,4	0,6	0,4	0,3

3.3. Kuru Ot

Bitkilerin kuru madde içeriği, büyüme ve gelişme olaylarına bağlı metabolizma sonucu ortaya çıkan, kalıtsal olarak kontrol edilen, ancak çevre koşullarından da büyük oranda etkilenen kantitatif bir özelliktir (Avcıoğlu, 1997). Tablo 9’da yer alan çim türlerine ait ortalama kuru ot değerlerine bakıldığında Zoysia çim türü Ağustos ve Eylül aylarında, Paspalum çim türü ise Haziran ve Temmuz aylarında en yüksek kuru ot verimleri vermiştir.

Tablo 9. Çim Türlerine Ait Kuru Ot Ortalama Değerleri

Çim Türleri	Haziran	Temmuz	Ağustos	Eylül
Zoysia	138,7 b	26,0 b	98,0 a	161,6 a
Paspalum	275,5 a	216,8 a	11,1 b	68,3 b
LSD (0,05)	24,6	12,1	18,3	9,9

Azot kaynaklarına ait kuru ot ortalama değerlerine bakıldığında, amonyum nitratın solucan gübresine göre çok yüksek kuru ot değerleri vermiş olduğu görülmektedir (Tablo 10). Tablodan da anlaşıldığı üzere kimyasal gübre çim bitki gelişimini hızlandırmakta ve daha fazla kuru ot verimi meydana gelmesine yol açmaktadır.



Tablo 10. Azot Kaynaklarına Ait Kuru Ot Ortalama Değerleri

Azot Kaynakları	Haziran	Temmuz	Ağustos	Eylül
Amonyum Nitrat	336 a	184,1 a	89,3 a	176,6 a
Solucan Gübresi	78,1 b	58,6 b	19,8 b	53,3 b
LSD(0,05)	16,5	3,6	16,5	16,3

Çim alanların en önemli bakım uygulamalarından birisi hiç kuşkusuz biçimdir. Bitkiler aktif büyüme dönemlerinde ne kadar sık biçime gelirse ve her biçimde ne kadar çok bitki artığı ortaya çıkarsa bakım maliyetleri de o kadar artacaktır. Dolayısıyla çim alanların yönetiminde dikkat edilmesi gereken en önemli hususlardan birisi kabul edilebilir çim renk ve kalitesi elde ederken, gübreleme, biçim sıklığı ve kuru ot verimi arasındaki dengeyi en düşük bakım maliyeti ile gerçekleştirebilmektir. Verilecek fazla gübre sadece bakım maliyetlerini arttırmakla kalmamakta aynı zamanda çevre kirliliğine de neden olmaktadır.

Nizam (2009), azot uygulamasının biyolojik verimde önemli derecede artışa neden olduğunu, bitki boyu ve fertil kardeş sayısının azotlu gübrelemeyle arttığını bildirmiştir. Rowland ve ark. (2010), melez bermuda çimi [*Cynodon dactylon* (L.) Pers. × *C. transvaalensis* Burt Davy]'nin 'TifDwarf' ve 'TifEagle' çeşitleri, *Paspalum vaginatum* Swartz'ın 'SeaDwarf' çeşidi ve zoysia [*Zoysia japonica* Stued. by *Zoysia tenuifolia* (L.) Merr.]'nin 'PristineFlora' çeşidi üzerine haftalık 1.2, 2.4, 3.7 ve 4.9 g/m² azot ve potasyum dozlarının etkinliğini inceledikleri çalışmalarında; 2.4 g/m² N dozunun bitki gelişimi üzerine daha yüksek azot dozları kadar etkili olduğunu, 4.9 g/m² N dozunun ise aşırı gelişmeyi teşvik ettiğini saptamışlardır. Aşırı bitki sıklığının ve biçim miktarının azaltılması amacıyla 2.4 g/m² N dozunu önermişlerdir.

Azot dozlarının kuru ot değerleri üzerine etkisine bakıldığında, 5 g/m² N dozunun tüm biçimlerde en yüksek kuru ot değerleri verdiği, buna karşın kontrol parsellerinde ise en düşük kuru ot değerleri elde edildiği görülmektedir. Araştırmamızda da, yukarıdaki benzer araştırmalardaki gibi artan azot uygulamasıyla aynı paralellikte kuru ot veriminde de artışa neden olduğu belirlenmiştir (Tablo 11).

Tablo 11. Azot Dozlarına Ait Kuru Ot Ortalama Değerleri

Azot Dozları (g m ⁻²)	Haziran	Temmuz	Ağustos	Eylül
0	65,9 b	80,8 b	13,5 b	36,6 b
5	348,3 a	162 a	95,6 a	193,3 a
LSD (0,05)	19,8	13,2	11,3	11,7



4. Sonuç

Bir yıllık araştırma sonuçlarına göre, çim türleri arasında çim renk ve kalite değerleri bakımından istatistiki anlamda bir farklılık bulunmamıştır.

Solucan gübresi, kimyasal gübre kadar üstün performans göstermese de renk ve kalite gözlemlerinden bazılarında kabul edilebilir renk ve kalite sınırı olan 6 değerinin üzerinde performans göstermiştir. Su kirliliği ve özellikle azot kirliliği çevre sorunları arasında önemli bir yer tutmaktadır. Aşırı azotlu gübreleme fazla azotun yıkanmasıyla yer altı sularının ve akarsuların kirlenmesine yol açmaktadır. Denemede yer alan amonyum nitrat tüm gözlem tarihlerinde en iyi çim renk ve kalite değerlerini vermiştir. Ancak solucan gübresi de çoğu gözlemlerde kabul edilebilir renk ve kalite değerinin alt sınırı olan 6'nın üzerinde değerler vermiştir. Dolayısıyla solucan gübresin uygulanması hem kabul edilebilir bir çim renginin elde edilmesini sağlayacak hem de maliyetlerin düşmesine ve çevrenin korunmasına yardımcı olacaktır.

Bilgili ve ark. (2016), Marmara (Geçiş) İklimi kuşağında farklı sulama sistemlerinin ve azotlu gübreleme rejimlerinin bazı sıcak iklim çim bitkilerinin bitki gelişimi ve kalite özellikleri üzerindeki etkilerini belirlemek amacıyla, Uludağ Üniversitesi Araştırma ve Uygulama Merkezi'nde yürüttükleri çalışmada; kuru ot değerleri üzerine, 5 g/m² N dozunun tüm biçimlerde en yüksek kuru ot değerlerini; hiç azot verilmeyen kontrol parsellerinde ise en düşük kuru ot değerlerini tespit etmişlerdir. Aynı şekilde denememizde, 5.0 g/m² N dozu; renk, kalite ve kuru madde değerleri üzerine kontrol (0.0 g/m² N) parsellerine göre daha iyi sonuçlar vermiştir.



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GREEN SCIENCE AND TECHNOLOGY FOR GREEN PLANET: EMERGING ISSUES AND PROSPECTS

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ABSTRACT

In the last few decades, scientists, policymakers and governments around the world develop a growing concern about the negative impacts of science and technology in relation to their processes and products on humanity and environment. These challenges call for need to engineer alternatives to bypass or minimize these impacts for realizing green planet. One major step to curtail the problems is the promotion of green science and technology which deals with the application of scientific principles and technology to address environmental challenges and promote sustainability. Therefore, this paper highlights some major green science initiatives that can contribute toward achieving green planet which include; renewable energy, green chemistry, sustainable agriculture, waste management, clean water and air, conservation and restoration of ecosystems, green transportation and green infrastructure. The paper also highlighted the current emerging issues pertinent to green science and technology which include; e-wastes, carbon capture, water scarcity, biodiversity loss, food wastes, policy support and implementation, lack of funding, lack of interdisciplinary collaboration and lack of public awareness and engagement. Some prospects of green science and technology were also highlighted among which; energy storage, circular economy, green buildings, sustainable transportation and consumption, climate adaptation and digital technologies. Based on the reviews, it was suggested that; governments, businesses, and individuals need to focus on strategies and measures that can reduce carbon footprints, promote renewable energy, and reduce reliance on fossil fuels; should focus on reducing waste and using resources more efficiently through circular economy principles; should invest in research and development of green technologies and sustainable infrastructure, such as public transportation systems, green buildings, and renewable energy infrastructure; should also invest in education and awareness programs that promote sustainable practices and raise awareness about environmental issues.

Keywords: Green, Science, Technology, Planet, Emerging, Issues, Prospects, Sustainability



Introduction

Few decades ago, there has been a growing concern about the consequences of science and technology process and products by scientists, policymakers, governments and even public around the world. These consequences are due to science and technological processes and products on humanity and environment. Green science refers to the application of scientific principles and technology to address environmental challenges and promote sustainability. The goal of green science is to find innovative solutions that minimize the negative impact of human activities on the environment, conserve natural resources, and support the well-being of people and ecosystems. A green planet is a world where people live in harmony with nature, where ecosystems are healthy and thriving, and where human activities are sustainable and do not harm the environment.

Achieving a green planet requires a concerted effort by individuals, communities, governments, and businesses to adopt sustainable practices and technologies. Therefore, the shift towards green science and technology has become an urgent necessity due to the significant negative impacts of traditional methods of production and consumption on the environment, human health, and the economy. In essence, there are some factors that mandate the transition to green science and technology which include; Environmental Concerns, Resource Depletion, Economic Benefits, Health Benefits, Policy Changes.

Climate change is a critical environmental challenge, and the use of fossil fuels is the main contributor to its acceleration. The burning of fossil fuels releases carbon dioxide and other greenhouse gases into the atmosphere, trapping heat and leading to global warming. The Intergovernmental Panel on Climate Change (IPCC) warns that limiting global warming to 1.5 degrees Celsius above pre-industrial levels will require “rapid, far-reaching and unprecedented changes in all aspects of society,” including significant reductions in greenhouse gas emissions (IPCC, 2018). Green science and technology offers solutions such as renewable energy, green buildings, and sustainable transportation that can reduce carbon emissions and mitigate climate change.

Traditional methods of production and consumption have led to the depletion of natural resources, including fossil fuels, minerals, and water. Green science and technology aims to reduce the consumption of natural resources and promote sustainable practices, such as the use of renewable energy and the adoption of circular economy models that prioritize waste reduction, recycling, and reuse. Also, green science and technology can also improve human health by reducing exposure to pollutants and harmful chemicals. Air and water pollution, for



example, have been linked to respiratory and cardiovascular diseases, cancer, and other health problems (World Health Organization, 2021).

Green technologies such as electric vehicles and renewable energy sources can reduce air pollution and improve public health. Government policies and regulations are driving the shift towards green science and technology. Many governments around the world have implemented policies and regulations to encourage the adoption of sustainable practices and technologies in order to realise green planet. These policies include incentives for renewable energy development, carbon pricing, and energy efficiency standards. Thus, the adoption of green science and technology is necessary to ensure a sustainable future for the planet and its inhabitants.

Some Green Science Initiatives that can Contribute to Achieving Green Planet

Green science and technology offer promising solutions to promote a safe and sustainable environment. Some green science initiatives that can contribute to achieving green planet include: Renewable energy, sustainable agriculture, green chemistry, waste management, water conservation, ecosystem restoration

- **Renewable Energy**

One of the primary causes of environmental degradation is the use of fossil fuels. Renewable energy has gained significant attention in recent years as an alternative to fossil fuels. In a study by International Renewable Energy Agency (IRENA), it was found that renewable energy could provide more than three-quarters of the world's energy needs by 2050 while reducing greenhouse gas emissions (IRENA, 2018). Researchers have made significant advancements in the development of renewable energy technologies, including solar photovoltaics, wind turbines, and energy storage systems Renewable energy is an essential area of green science and technology that aims to reduce greenhouse gas emissions and combat climate change. Researchers have explored new technologies and strategies to promote renewable energy, such as solar, wind, and hydroelectric power. Additionally, researchers have focused on improving energy storage and transmission systems to make renewable energy more reliable and cost-effective (International Energy Agency, 2020). Therefore, other studies have shown that renewable energy has the potential to provide a significant portion of global energy needs while reducing greenhouse gas emissions.

- **Sustainable Agriculture**

Sustainable agriculture practices aim to promote ecological balance, conserve biodiversity, and enhance soil health. In other words, sustainable agriculture aims to reduce environmental



impact and enhance food security. Researchers have focused on developing sustainable farming techniques such as organic farming, conservation agriculture, agroforestry, and precision agriculture. These practices have been found to improve crop yields, reduce soil erosion, and decrease the use of synthetic fertilizers and pesticides (Pretty et al., 2018). Additionally, researchers have focused on developing new approaches to soil health and nutrient management to improve crop yields and reduce greenhouse gas emissions (FAO, 2019).

- **Green Chemistry**

Green chemistry is a field that aims to design chemical products and processes that are safe, efficient, and environmentally sustainable. It employs alternative processes and reaction pathways, new materials and products are developed to meet our needs today, but with taking more care of the interests of future generations (Eilks & Rauch, 2012). Researchers have discovered new approaches to chemical synthesis, such as using renewable resources and designing chemicals with lower toxicity (green solvents), biodegradable plastics, and catalysts that reduce or eliminate the use of toxic chemicals and environmental impact (Anastas & Warner, 1998). For example, biodegradable plastics have the potential to reduce the amount of plastic waste in the environment, while green solvents can reduce the use of hazardous chemicals in industrial processes (Kerton & Marriott, 2013). Moreover, researchers have focused on improving chemical manufacturing processes to reduce waste and energy consumption (Anastas & Warner, 2018). Emerging green chemistry technologies, such as bio-based feedstocks and enzymatic catalysis, show promise in promoting sustainable chemical production.

- **Waste Management**

Waste management is an important aspect of sustainable development. Researchers have explored new methods for reducing, reusing, and recycling waste, including composting, anaerobic digestion, and waste-to-energy technologies. These methods can help reduce the amount of waste sent to landfills, conserve resources, and reduce greenhouse gas emissions (Tchobanoglous et al., 2014). For instance, waste-to-energy technologies can convert waste into electricity, reducing the reliance on fossil fuels (Jain & Baredar, 2018). Effective waste management is an essential area of green science and technology that aims to reduce waste and promote resource efficiency. Also, researchers have focused on improving waste collection and processing infrastructure to make waste management more efficient and cost-effective (European Commission, 2020).



- **Water Conservation**

Water conservation is another important area of green science and technology. Researchers have developed technologies such as drip irrigation, rainwater harvesting, and water recycling systems that help conserve water resources. These technologies can help reduce water waste, improve water quality, and ensure sustainable water management (Chandrashekara & Ravindranath, 2015). For instance, drip irrigation can reduce water consumption by up to 60% compared to traditional irrigation methods (FAO, 2020). Green science and technology can help promote clean water and air through technologies such as water treatment plants and air filtration systems. These technologies can reduce pollution and improve public health and environmental sustainability.

- **Ecosystem Restoration**

Ecosystem restoration is an essential area of green science and technology that aims to restore degraded ecosystems and enhance biodiversity. Green science is working to conserve and restore ecosystems that have been damaged by human activities, such as deforestation, overfishing, and pollution. Researchers have explored new technologies and strategies to promote ecosystem restoration, such as reforestation, wetland restoration, and coral reef restoration. Additionally, researchers have focused on improving monitoring and evaluation methods to track progress and inform restoration efforts (CBD, 2020).

Other green science initiatives include; *Green Transportation* whereby green science and technology can be used to promote transportation options such as electric cars, public transportation, and bike sharing programs. These options can reduce the emissions of greenhouse gases and other pollutants, which can promote a safer and healthier environment. Green science is promoting the development of *Green Infrastructure*, such as green roofs, rain gardens, and permeable pavement, to reduce the environmental impact of urban development and promote sustainability.

Emerging Issues on Green Science and Technology

As the field of green science and technology continues to evolve, several emerging issues have come to the forefront. The followings are highlight of some of the emerging issues on green science and technology:

1. **E-waste:** With the increasing emergence and use of electronic devices, the disposal of electronic waste has become a significant environmental concern. Green science and technology are needed to develop more efficient and sustainable methods of managing e-waste.



2. **Carbon Capture:** While renewable energy sources can reduce greenhouse gas emissions, they cannot eliminate them entirely. Carbon capture technologies are needed to capture and store carbon emissions from power plants and other industrial sources.
3. **Food Waste:** Food waste is a significant environmental and social issue. Green science and technology are needed to develop more efficient and sustainable methods of managing food waste and reducing the amount of food waste generated.
4. **Water Scarcity:** Water scarcity is becoming an increasingly pressing issue in many parts of the world. Green science and technology are needed to develop more efficient and sustainable methods of managing water resources and reducing water waste.
5. **Biodiversity Loss:** The loss of biodiversity is a significant environmental issue that can have long-term impacts on ecosystems and human well-being. Green science and technology are needed to develop more sustainable land use practices and promote biodiversity conservation.

6. **Policy Support and Implementation**

Government policies and regulations can have a significant impact on environmental sustainability. However, many policies and regulations do not support green science initiatives. Governments need to create policies and regulations that encourage and support green science research and development. On the other hand, even when green science research produces promising solutions, implementation can be challenging. There is a need for greater collaboration between green science researchers, policymakers, and industry leaders to facilitate the implementation of green technologies and practices.

Other emergent issues that decelerate the achievement of green science and technology include; *Lack of Funding* in research and development. Many green science projects require significant investments in technology, infrastructure, and human resources. Also, lack of *Interdisciplinary Collaboration* since green science involves a broad range of disciplines, including biology, chemistry, engineering, and social sciences. There is a need for greater interdisciplinary collaboration to address complex environmental challenges. Furthermore, *Lack of Public Awareness and Engagement*, because many people are not aware of the environmental challenges facing the world, or they may not understand the potential impact of their actions on the environment.

Prospects of Green Science and Technology

As a growing field of study that aims at providing solutions to the evolving problems due to unsustainable approaches of science and technologies. Researches are still being carried out from different part of the world and some possibilities were prospectively identified. These



include; energy storage, circular economy, sustainable transportation and consumption, green buildings, climate adaptation and digital technologies as detailed below:

- **Energy Storage**

The development of reliable and cost-effective energy storage technologies is crucial for the expansion of renewable energy sources. Emerging energy storage technologies such as flow batteries and solid-state batteries and other clean energy production and storage systems show promise in meeting this challenge.

- **Circular Economy**

The circular economy is a concept in green science and technology that aims to promote sustainable production and consumption by reducing waste, reusing materials, and recycling resources. Also, emerging technologies such as 3D printing and advanced materials science are driving the transition to a circular economy, which can promote environmental sustainability and economic growth. These approaches encourage the redesign of products and production processes to minimize waste and maximize resource efficiency (Kirchherr et al., 2018). Researchers have focused on developing new technologies and business models that support the circular economy, such as closed-loop manufacturing, product life extension, and sharing platforms (Ghisellini et al., 2016).

- **Sustainable Transportation**

The transportation sector is a significant source of greenhouse gas emissions, and researchers have explored new technologies to reduce emissions, such as electric vehicles, fuel-efficient engines, and alternative fuels. Furthermore, researchers have focused on improving transportation infrastructure, such as bike lanes and public transportation, to encourage sustainable transportation choices (Gössling & Scott, 2019). Therefore, the prospects for these technologies are promising, with the increasing availability of charging infrastructure and advancements in battery technology.

- **Green Buildings**

Green buildings are designed to reduce energy consumption, minimize environmental impact, and enhance indoor air quality. Researchers have explored new technologies and design approaches that promote sustainable buildings, such as energy-efficient lighting, renewable energy systems, and green roofs. Additionally, researchers have focused on improving building materials, such as low-emission insulation and non-toxic paints, to create healthier indoor environments (O'Brien & Pivo, 2019).



- **Sustainable Consumption**

Sustainable consumption is also a development in green science and technology that aims to promote sustainable lifestyles and reduce environmental impact. Scientists have discovered new approaches to promoting sustainable consumption, such as product-service systems, sharing platforms, and behavioral interventions. These approaches aim to encourage consumers to use resources more efficiently and reduce waste (Mont & Plepys, 2018).

- **Climate Adaptation**

Climate adaptation is becoming an increasingly important issue in green science and technology as the impacts of climate change become more apparent. Researchers have explored new technologies and strategies to help communities adapt to climate change, such as flood protection systems, drought-resistant crops, and heat mitigation strategies. Furthermore, researchers have focused on developing new approaches to climate modeling and risk assessment to help inform adaptation planning (UNEP, 2019). Emergent technologies such as precision agriculture and coastal zone management can help mitigate the impacts of climate change and promote environmental sustainability.

- **Digital Technologies**

Digital technologies have the potential to promote sustainability and reduce environmental impact. Investment is required in digital technologies, such as artificial intelligence, blockchain, and the internet of things, to promote energy efficiency, reduce waste, and enhance resource management.

Conclusion

It can be concluded that, green science is essential for achieving a green planet. By applying scientific principles and technology to environmental challenges, we can create a greener sustainable world for ourselves and future generations. From renewable energy and sustainable agriculture to waste reduction and conservation of ecosystems, green science has been a vital area of research that is essential for creating a more sustainable future. However, green science and technology has emerged as a critical area of research and development as the world continues to face environmental challenges. Therefore, addressing the issues facing green science will require a concerted effort from governments, businesses, researchers, and the public. Thus, by working together, we can develop innovative solutions that promote environmental sustainability and create a green planet for our future generation.



Critical Suggestions

Based on the Goals, Issues and Prospects of Green Science and Technology in achieving greener planet, Governments, Businesses, and Individuals need to:

1. Increase focus on climate change mitigation by adopting strategies and measures that can reduce carbon footprints, promote renewable energy, and reduce reliance on fossil fuels.
2. Focus on reducing waste and using resources more efficiently through adoption of circular economy principles, such as recycling and repurposing materials, and reducing energy and water consumption.
3. Invest in sustainable infrastructure, such as public transportation systems, green buildings, and renewable energy infrastructure, to reduce greenhouse gas emissions and promote sustainable development to ensuring a green planet.
4. Invest in research and development of green technologies, such as renewable energy, energy storage, and green chemistry, to accelerate the transition to a sustainable future.
5. Invest in education and awareness programs that promote sustainable practices and raise awareness about environmental issues.



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CHEMICAL COMPOSITION OF *Heracleum pastinacifolium* subsp. *incanum* ESSENTIAL OIL FROM EASTERN ANATOLIA REGION

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ABSTRACT

Since ancient times, people have used medicinal plants in various fields, such as nutrition, treatment and industrial purposes. Medicinal plants are composed of different kinds of bioactive compounds and secondary metabolites. These compounds and metabolites are frequently used in the pharmaceutical and industrial. Considering the endemic plant diversity of our country, it has an unlimited variety of plant flora that we can use as drug-active ingredients. *Heracleum pastinacifolium*, a perennial herbaceous structure belonging to the *Apiaceae* family and popularly known as “Baldırgan”. *Heracleum pastinacifolium* is widely used in the food industry and traditional medicine as a spice and flavouring. The essential oil composition can vary significantly according to different ecological conditions. In our study, we report the essential oil yield and components obtained from the aerial parts of *H. pastinacifolium* during the flowering period in 2022 in Erzurum province. *H. pastinacifolium* essential oil was obtained by cleveger distillation apparatus, and their chemical composition was determined by GC-MS analysis. Forty-one components representing 94.08% of the oil were detected in the essential oil of *Heracleum pastinacifolium*. The major components were β -caryophyllene (10.37%), (Z)-p-menth-2-en-1-ol (7.52%), Elemicin (5.82%), (E)-Isocroweacin N (5.62%), α -Terpinyl acetate (4.53%), Limonene (4.49%) respectively.

Keywords: *Heracleum pastinacifolium*, essential oil, *Apiaceae*, GC-MS



1. INTRODUCTION

Since ancient times, people have used medicinal plants in various fields such as nutrition, therapeutic and industrial purposes (Sirmomuza *et al.* 1997; Uğuz *et al.* 2022; Palabıyık *et al.* 2022). Medicinal plants contain different bioactive compounds and secondary metabolites (Mammadov, 2014). These compounds and metabolites are frequently used in the pharmaceutical and industrial industries. Although the interest in medicinal plants decreased with the production of synthetic drugs in the 20th century, the importance given to medicinal plants began to increase again towards the end of the 20th century, considering the difficulties and disadvantages of synthetic drug production.

Thanks to the secondary metabolites produced by medicinal and aromatic plants, it has many activities such as antioxidant, antimicrobial (Gülser *et al.*, 2020), anthelmintic, radioprotective (Kandikattu *et al.*, 2015), sedative, and analgesic. Considering the endemic plant diversity of our country, it has an unlimited variety of plant flora that we can use as active pharmaceutical ingredients. One of them, Apiaceae, is one of the most prominent families of flowering plants, and the genus *Heracleum* L. belonging to this family includes more than 120 species (Bahadori *et al.*, 2016). The genus is represented by 22 taxa (17 species) in Turkey, and 7 of them are endemic (Hacıoğlu, 2006). Many *Heracleum* species are consumed worldwide for medicinal purposes: antioxidant, antimicrobial, anti-inflammatory, antiviral (Tkachenko, 2006), anticarcinogenic, immunostimulatory and food (Bahadori *et al.*, 2016; Son *et al.*, 2020; Akbaribazm *et al.*, 2021).

H. pastinacifolium is a perennial herbaceous plant that grows in the Northern and Eastern Anatolia regions of our country at an altitude of 1800-3500, on rocky slopes, flood beds and peaks. There is only one study in the literature on the essential oil content of *Heracleum pastinacifolium* subsp. *incanum* (Firuzi *et al.*, 2010). However, no studies have been conducted in our country so far. Therefore, this study is the first scientific report published in our country in terms of the essential oil profile of the *H. pastinacifolium* plant, which grows endemic in our country.

2. Material and Methods

The aerial parts of *Heracleum pastinacifolium* C. KOCH subsp. *incanum* plants were collected during the flowering season in August 2022 at an altitude of 1990 m from Palandöken Mountain in Erzurum, Turkey, located in the Iran-Turan (Eastern Anatolia) floristic regions.

The collected plant materials were dried in the shade in a dry, sunless area in the laboratory of the Field Crops Department of the Faculty of Agriculture of Atatürk University. The dried plant



materials were pulverized with a 2 mm mesh diameter grinder. The collected plant materials were dried in the shade in a dry, sunless area in the laboratory of the Field Crops Department of the Faculty of Agriculture of Atatürk University. 100 mg of powdered plant sample was taken and placed in the Clevenger balloon on the heater. dH₂O added 3 times of the plant sample. The balloon was boiled with the help of a mantle heater. The essential oils, evaporated with water vapour, dragged to the finger-shaped condenser mounted on the balloon, and cooled by the cold water circulation. Moreover, essential oils, lighter than water, were collected here. This process took three hours. Obtained essential oils were collected by separating them from water. They were dried over anhydrous sodium sulfate. After drying, the filtered material was stored at +4 °C until GC/MS analysis.

The essential oil (EO) was analysed using a Thermo Finnigan Trace GC/A1300 (E.I.) equipped with an SGE/BPX5 MS capillary column (30 m x 0.25 mm i.d., 0.25 µm). Helium is the carrier gas at a rate of 1 mL min⁻¹. The injector temperature was set to 220 °C. The oven temperature was 50–150 °C at a rate of 3 °C min⁻¹, then isothermal at 150 °C for 10 minutes and finally increased to 250 °C at 10°C min⁻¹. Diluted samples (1/100, v/v, in methylene chloride) of 1.0 µL were injected manually and in the splitless mode. Quantitative data were obtained from FID area percentage data.



Figure 1. *Heracleum pastinacifolium* subsp. *incanum*



Also, GC-MS analyses of the EO's were carried out using a Thermofinnigan Trace GC/Trace DSQ /A1300, (E.I Quadrupole) (Thermo Finnigan, CA, USA) equipped with a SGE-BPX5 MS capillary column (Scientific Instrument Services Inc., NJ. USA) (30 m x 0.25 mm i.d., 0.25 μ m). An electron ionization system with an ionization energy of 70 eV was used for GC-MS detection. Helium was the carrier gas at a flow rate of 1 mL/min. Injection and MS transfer line temperatures, were set at 220 °C and 290 °C, respectively. The programme used was 50-150 °C at a rate of 3 °C /min, held isothermal for 10 minutes and finally raised to 250 °C at 10 °C /min. Diluted samples (1/100, v/v, in methylene chloride) of 1.0 μ L were injected manually and in the splitless mode. The components were identified by comparing their relative retention time and mass spectra with those of standards, Wiley7N, TRLIB library data of the GC-MS system and literature data. The results were also confirmed by comparing the compound's elution order with their relative retention indices on non-polar phases reported in the literature (Adams, 2007).

3. Results And Discussion

H.pastinacfolium subsp. *incanum* GC-MS analysis was performed to determine the essential oil content. During the analysis period of 71.37 minutes, components between 9 and 71 mins began to emerge. Component analysis of the plant's essential oil resulted in the detection of 41 components corresponding to 94.08 % of the total oil. Essential oil components and ratios are given in table 1 (main components are indicated in bold). In addition, the chromatogram graph obtained from the GC-MS device with the peak points is given in figure 2.

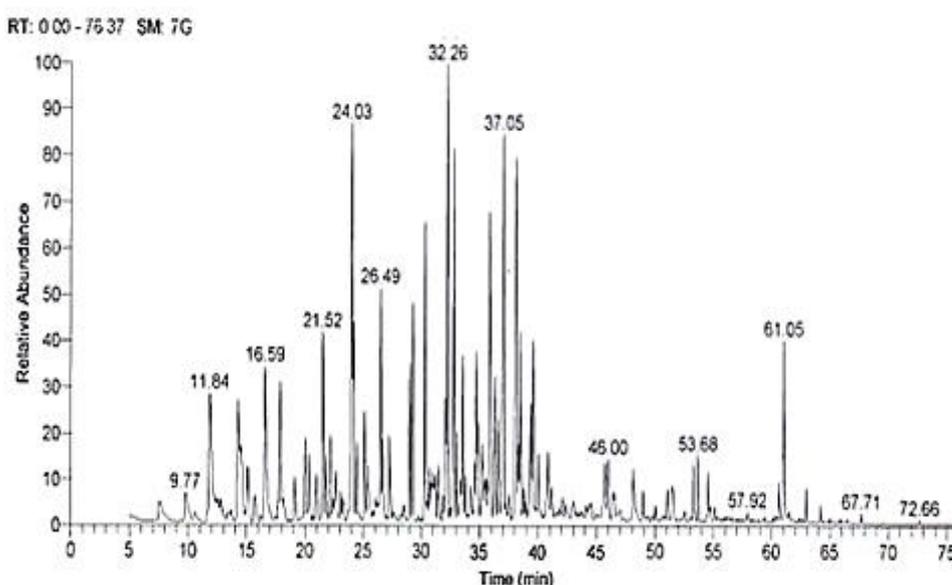


Figure 2. The chromatogram graph of *Heracleum pastinacfolium* subsp. *incanum* essential oil.



As can be seen from Table 1, the major components of the essential oil obtained using the above-ground part of *H. pastinacfolium* plant are β -Caryophyllene (10.37 %), (Z)-p- menth-2-en-1-ol (7.52%), Elemicin (5.82%), (E)-Isocroweacin N (5.62%), α -Terpinyl acetate (4.53%), Limonene (4.49%).

Table 1. *Heracleum pastinacfolium* subsp. *incanum* essential oil components of the plant

Constituents	RT*	Composition (%)
α -pinene	9.80	0.95
β -pinene	11.86	3.80
Limonene	14.30	4.49
(E)- β - ocimene	15.12	1.30
Terpinene	15.72	0.59
n-octanol	16.61	3.26
Linalool	17.88	2.85
(Z)-p- menth-2-en-1-ol	19.12	0.70
Camphor	20.36	0.94
Lavandulol	20.96	0.64
Borneal	21.52	2.40
Terpinen-4-ol	21.83	1.38
α -Terpineol	22.63	0.61
β -citronellol	24.03	7.52
Hexyl isovlerate	24.45	0.88
Geraniol	25.09	1.23
(4Z)-decen-1-ol	25.38	0.90
Bornyl acetate	26.49	3.25
Carvacrol	27.27	1.13
α -Terpinyl acetat	29.26	4.53
α -Copaene	30.31	3.11
β -Bourbonene	30.64	0.33
Isocaryophyllene	31.50	0.76
β -Caryophyllene	32.24	10.37
(Z)- β -Fornesene	33.55	2.75
7-epi-1,2-dehidrosesquicineole	34.23	0.31
Citronellyl isobutyrate	34.74	3.76
Lavandully isovalerate	35.88	4.40
γ -Cadinene	36.30	1.39
(E)- γ -Bisobolene	36.61	0.86
(E)-Isocroweacin	37.03	5.60
Elemicin	38.12	5.82
(E)- Nerolidol	38.47	2.34
Spathulenol	39.36	1.50
Caryophyllene oxide	39.56	2.58
Neryl isovalerate	40.03	1.86
Apiole	46.00	1.78
Geranyl tiglate	48.13	1.15
Total		94.08
EO yield (%)		0.22

*RT, retention time: Compounds listed in order of elution from a BPX5 MS column.



When previous study was examined, Firuzi *et al.* (2010) determined 26 components in the essential oil obtained from *H. pastinacifolium*, and 97.7% of the content was identified. The significant components are myristicin (53.6%), (Z)-trans-a-bergamot (10.6%) and limonene (7.3%). This study was the first to describe the content of *H. pastinacifolium* essential oil (Firuze *et. al.*, 2010). When the essential oil composition obtained in our study is compared with the other study, there are serious differences in terms of both the number of chemical compositions and the ratios of common chemical components. In our study, the major component was β -Caryophyllene (10.37%), and in the other study, Myristicin (53.6%) was the major component.

There are differences in the amount of Limonene component common in both studies. The results were observed to differ in many respects with the study in the literature. The active ingredient content and composition in essential oils can vary according to the genetic structure of the plants, the region where they grow, their developmental periods (ontogenetic variability), climatic and environmental factors, and temperature changes during the day (diurnal variability). Therefore, the fact that the active ingredients obtained in this study differ according to the literature is a situation that can be detected in many medicinal and aromatic plant studies.

4. Conclusion

As a result of the essential oil composition analysis of the *H. pastinacifolium*, β -Caryophyllene, (Z)-p- menth-2-en-1-ol, elemicin, (E)-isocrovecin, α -terpinyl acetate, limonene as major components were determined. *H. pastinacifolium* shows significant differences in phenological and morphological characteristics due to its existence in different environmental conditions. This situation can also influence the essential oil composition of *H. pastinacifolium*. The results from the present study support the concept that *H. pastinacifolium* can indicate considerable variations in essential oil composition due to varying ecological conditions. This information can benefit the essential oil industry and researchers who want standard quality in aromatic plants.



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BAZI KIRSAL ALANLARDA SORULAN BAZI MATEMATİK SORULARI

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ÖZET

1960-1970 li yıllarda “Doğrusal programlama”, üretim yönetimi, imalat planlama, portföy yönetimi, kentsel planlama gibi çeşitli alanlarda uygulaması olan bir matematiksel modelleme yöntemi (1) ni geometri, cebir ve analiz bilmeyen, hatta okuma yazmayı askere gidince biraz öğrenen, yaşamları tamamen organik tarım ve hayvancılığa dayalı olan Erzurum ilinin Karayazı ilçesinin Alemdağ Köyünün 3 hanelik Hacı Mahmut mezarında yaşayan ve Onlara misafir olarak gelenlerin, çevrede çok az bulunan öğrencilere sordukları matematik sorularının bir kısmını size ifade etmek istiyorum. Biri kazları otlatan adamı görünce; selamlar ey yüz kaz sahibi diyor. Kaz sahibi de bu kazlar kadar, bu kazların yarısı, bu kazların yarılarının yarısı kadar ve total kaz ile beraber 100 kaz eder. Acaba bu kazlar kaç tanedir? Üç çeşmeden üç eve su bağlanmak isteniyor. Borular üst üste geçmeyecek şartı ile her çeşmeden her eve su bağlayabilir misiniz? Adamın biri bir köyden geçince, üç kardeşin kavga ettiğini görür. Kavga sebebini sorar. Bunlara babalarından 17 koyun miras kaldığını söylerler. Babanın vasiyeti şu şekilde: Büyük oğlana koyunların yarısını, ortanca oğlana koyunların üçte birini ve küçük oğlana da 2 tane koyun verin diyor. Arabulucu bunların hakkını vasiyet doğrultusunda dağıtıyor. Herkes hissesine razı oluyor. Hiç kimse zarara uğratılmıyor. Acaba arabulucu nasıl bir taksimat yapmış? Daha nice sorular cevapları ile birlikte 11. Uluslararası Tarım, Hayvancılık ve Kırsal Kalkınma Kongresi 03-05 Mart 2023 te... Bu şekilde bir çalışmamın nedeni, elbetteki geçmişte yapılan tarım ve hayvancılık ile günümüzde bilimsel verilere dayalı olarak yapılan tarım ve hayvancılık arasındaki farkı mukayese etmektir.

Anahtar Kelimeler: Erzurum, Kültürel Matematik, Geleneksel Sorular



SOME MATHEMATICS QUESTIONS ASKED IN SOME RURAL AREAS

ABSTRACT

In the 1960s-1970s, "Linear programming", a mathematical modeling method that had applications in various fields such as production management, manufacturing planning, portfolio management, and urban planning (1), did not know geometry, algebra and analysis, and even learned to read and write a little when they went to the military. I would like to express to you some of the mathematical questions asked by those who live in the 3-household Hacı Mahmut hamlet of Alemdağ Village in the Karayazı district of Erzurum, which is completely based on organic agriculture and animal husbandry, and who come to them as guests, to the students who are very few in the surrounding area. When someone saw the man grazing the geese; Greetings, O owner of a hundred geese, he says. The owner of the goose is as much as these geese, half of these geese, half of these geese and 100 geese together with the lame goose. How many are these geese? It is desired to connect water from three fountains to three houses. Can you connect water from every fountain to every house on the condition that the pipes do not overlap? When a man passes through a village, he sees three brothers fighting. He asks the reason for the fight. They tell them that they inherited 17 sheep from their father. The father's will is as follows: Give half of the sheep to the older son, one-third of the sheep to the middle boy, and 2 sheep to the younger boy. The mediator distributes their rights in accordance with the will. Everyone agrees to their share. No one is harmed. How did the mediator make a division? 11th International Agriculture, Livestock and Rural Development Congress with answers to many more questions, on March 03-05, 2023... The reason for my work in this way is of course to compare the difference between agriculture and animal husbandry in the past and agriculture and animal husbandry based on scientific data today.

Keywords: Erzurum, Cultural Mathematics, Traditional Questions



1. Giriş

1960-1970 li yıllarda geometri, topoloji, cebir ve analiz bilmeyen, hatta okuma yazmayı askere gidince biraz öğrenen, yaşamları tamamen organik tarım ve hayvancılığa dayalı olan Erzurum ilinin Karayazı ilçesinin Alemdağ Köyünün 3 hanelik Hacı Mahmut mezarında yaşayan ve Onlara misafir olarak gelenlerin, çevrede çok az bulunan öğrencilere sordukları matematik sorularının bir kısmını size ifade etmek istiyorum. Matematiğin bilimsel olarak tarımda da uygulama alanı olduğu aşikârdır. Bilgi Üniversitesi'nin 2012 de “Oyun Teorisi Dünya Kongresi” ne katılmak üzere İstanbul'a gelen ünlü matematikçi John Nash, Türkiye'nin matematikte çok iyi olmadığını öğrenince büyük tepki gösterdi. “Bu durumda çocukları hiç okula göndermemek, evde matematik öğretmek daha iyi sonuçlar verebilir” demiş. Herkes yaşadığı şartlar çerçevesinde kendisine yetecek kadar matematik bilmesi kaçınılmazdır. Doğada bütün bilime temel oluşturacak bilgiler mevcuttur. Suyun kaldırma kuvveti ve yerin çekim kuvveti Dünya ilk kurulduğunda beri vardı. Bütün tabiat olayları formülleştiği andan itibaren; yani matematikselleştiği zaman varlığından haberdar olundu. Bilimde matematiğin öneminin çok büyük ölçüde olduğu bilinen bir gerçekliktir. Bunun üzerinde durmak istemiyorum. Amacım şu, bilimsel gelişmeler sonucu hayatımızı kolaylaştıran makineleşmeye evet. Tarım ve hayvancılıkta verimi artırmak için kullanılan kimyasallara, doğanın dengesini bozucu zararlı öldürücülere ve tabii gelişimi bozucu hormonal bozukluklara hayır demek istiyorum. Geçmiş zamanlarda olduğu gibi tabii yiyeceklerimize ulaşmak için ne yapılabilir?

Kırsalda Matematik Soruları

“Doğrusal programlama” ile üretme metodu, üretim planlaması, tasarruf araçları, şehirleşme planı gibi çeşitli alanlarda uygulaması olan bir matematiksel modelleme metodudur. Önemli olan modellenen durumun lineer ilişkiler kapsamasıdır. Tarımda genellikle çeşitli lineer ilişkileri gözlemlemek olasıdır[1].

Dent ve arkadaşları ile Moss tarımsal planlama, sayısız doğrusal programlama çalışması bu yöntemin doğal uygulama alanlarından biri olagelmıştır [2-3].

Biri kazları otlatan adamı görünce; selamlar ey yüz kaz sahibi diyor. Kaz sahibi de bu kazlar kadar, bu kazların yarısı, bu kazların yarılarının yarısı kadar ve topal kaz ile beraber 100 kaz eder. Acaba bu kazlar kaç tanedir?

Tarımsal aletler fazla yaygın olmadığından, samanından temizlenmiş buğdayı topraktan ve diğer yabancı maddelerden ayırmak için yıkıyorlardı. Yıkanmış buğdayı kurutmak için hasırların, kilimlerin, bezlerin ve bulurlarsa naylon bezlerin üzerine seriyorlardı. Dolayısıyla kuşlar buğdayı yemeye gelirdi. Adamın biri diyordu ki 10 teneke buğdayımı yıkadıktan sonra



kuruması için serdim. Kuşlar serili buğdayımın üzerini kondu. Kuşları kovalamak için bir taş fırlattım. Bir kuşun öldüğünü gördüm. Kuşun karnını yardım. Taşlığında 200 gram buğday çıktı. Ben müdahale edinceye kadar 5 teneke buğdayımı yemişlerdi. Acaba kaç kuş bu 5 teneke buğdayımı yemiş?

Üç çeşmeden üç eve su bağlanmak isteniyor. Borular üst üste geçmeyecek şartı ile her çeşmeden her eve su bağlayabilir misiniz? Bu soruyu kâğıt üzerinde yani iki boyutlu uzayda çözmek imkânsızdır. Borulardan sonuncusu daha önceden çizdiklerimizin bir tanesi ile kesişecektir. Bu problemin çözümü üç boyutlu uzayda topolojik yüzeyler üzerinde çözümü imkân dâhilindedir.

Adamın biri bir köyden geçince, üç kardeşin kavga ettiğini görür. Kavga sebebini sorar. Bunlara babalarından 17 koyun miras kaldığını söylerler. Babanın vasiyeti şu şekilde: Büyük oğlana koyunların yarısını, ortanca oğlana koyunların üçte birini ve küçük oğlana da 2 tane koyun verir diyor. Arabulucu bunların hakkını vasiyet doğrultusunda dağıtıyor. Herkes hissesine razı oluyor. Hiç kimse zarara uğratılmıyor. Acaba arabulucu nasıl bir taksimat yapmış?

İki kardeşin numaralı olan 30 adet ineği var. 1 numaralı inek 1 kg süt, 2 numaralı inek 2 kg süt, ..., 30 numaralı inek 30 kg süt vermektedir. Bu inekleri iki kardeş arasında eşit şekilde olacak şekilde dağılımını yapabilir misiniz?

10 litrelik bir pekmez kabı dolu. 7 litrelik ve 3 litrelik boş kap var. İki kişi arasında adilane olarak bu 10 litrelik pekmezi paylaşırabilir misiniz?

Birinin 100 lirası var. Bununla kilosu 60 kuruş olan elman kilosu 1 lira olan portakaldan ve kilosu 2 lira olan limondan toplam 100 kilogram almak isterse her birinden kaç kilogram almalı?

Bu çeşit sorulara benzer yüzlerce soruyu sayıları çok az olan öğrencilere soruyorlardı. Tarım ile alakalı da bir tarlanın ölçümünün nasıl yapılacağı, bir dönüm tarlaya ne kadar hububatın ekileceği gibi konularda da uğraştıklarını hatırlıyorum. Hayvancılık konusunda da çok ince hesaplar yaptıklarını biliyorum. Canlı bir hayvanın kaç kilo gelebileceğini, kesildikten sonra ne kadar et vereceğini bir iki kilo sapma ile neredeyse tam tahmin edebiliyorlardı. Aslında bunlar kendilerine yetecek kadar matematik biliyorlardı. Tarım ve hayvancılıkta iyidiler. Herkes işi ile ilgiliydi. Uzun denemeler ve tecrübeler sonucu tarım ve hayvancılıkta ne çeşit yöntemlerin kullanılacağını biliyorlardı. Belki yaptıkları tarım ve yetiştirdikleri hayvanlar bilimsel bilgilere dayanmıyordu, fakat ürettikleri doğal besinler fevkalade kendilerine yetiyor artıyordu bile. Bir ailede herkes çalışmak zorundaydı. Bir aile her çeşit hayvana sahipti. Çeşit çeşit tarımsal ürünler yetiştiriyorlardı. Kendi ihtiyaçlarından fazlasını satarak, bununla ihtiyaçları olan diğer



besin maddelerini ya da giysi alıyorlardı. Doğal beslenme ve toprakla buluşma sonucu hastalıklar çok yaygın değildi. İnsanların yaşama yaş ortalaması uzundu. Yüz yaş üstü çok insan gördüm. Bu gün neredeyse 90 yaşında insan göremiyorum.

1990 da ülkemizde çalışanların %45'i tarımda işçi olarak çalışırken, günümüzde bu oran 2019 TÜİK verilerine göre % 17 olmuştur. Yani tarım sektöründe son 29 yılda yaklaşık % 61 azaldı. Buna bağlı olarak da tarım alanlarında % 25 lik bir azalma olmuştur.

Çölleşmeyle Mücadele Ulusal Stratejisi ve Eylem Planı 2019-2030 Tarım ve Orman Bakanlığı Çölleşme ve Erozyonla Mücadele Genel Müdürlüğü Yayınlarından almış olduğum bazı bilgileri sizinle paylaşmak istiyorum.

Toprak; bitkilerin, hayvanların ve mikrobiyolojik canlıların üretkenliğini sağlar. Kayaçların kopup bir avuç toprağa dönüşmesi bile yıllar süren ve meşakkatli bir süreçtir. Oysa her geçen gün erozyon nedeniyle fiziksel olarak toprak kaybederken; kullanılan kimyasal girdiler nedeniyle de topraktaki biyolojik canlılığı kaybediyoruz. Türkiye'de yaklaşık 5 milyon hektar tarıma elverişli arazi, kapsamının dışında değerlendirilirken; yaklaşık 5 milyon hektar arazi de tarıma elverişli olmadığı halde tarımsal üretim amaçlı kullanılması sonucu erozyona uğruyor. Ayrıca sağlıklı bir toprağın en önemli göstergelerinden olan organik madde miktarının; Türkiye topraklarının yaklaşık %88'inde az ya da çok az seviyede olması, topraklarımız için alarm zillerinin çaldığını gösteriyor. Topraktaki canlılığa ihtiyacımız var! Toprak, ancak sağlıklı ve üretken ise sürdürülebilirdir. Çok uzun zamandır yanlış tarım yöntemleri ile zarar verdiğimiz toprakların, gelecek nesilleri de besleyebilmesi için toprağı sadece fiziksel olarak korumak artık yeterli değil. İçindeki canlılığı da koruyarak toprağımızı iyileştirmemiz gerekiyor. Yer altında bulunan bitkilerin kökleri ile toprağın içindeki organizmalar arasındaki ilişkilere dair her geçen gün yeni bilgiler keşfedilmektedir. Sağlıklı toprak, birbirleriyle karmaşık bir beslenme ağı dâhilinde ilişkide olan organizmalarla dolu, canlı bir ekosistemdir. Mineral, organik madde, su ve hava açısından dengeli; bitki besin maddeleri açısından zengindir. Bu özellikleriyle toprak, bitkilerin sağlıklı kök gelişimi için uygun ve hastalıklara karşı dirençlidir (Orgiazzi vd., 2016). Sağlıklı toprak, sağlıklı mahsul verir. Son 40 yıldır toprak canlılığı ve besin ağı ile ilgili çalışmalar artıkça, aslında ne kadar çok şeyi yanlış bildiğimizi ve yanlış tarım yöntemleri ile topraktaki canlılığı öldürerek verimsizleştirdiğimizi de anlamaya başlamış durumdayız. Bu nedenle, dünyanın pek çok yerinde koruyucu tarımın yanı sıra biyolojik toprak düzenleyici ve iyileştiriciler, perma kültür, onarıcı tarım, bütüncül planlı otlatma gibi yenilikçi uygulama yaklaşımları da hızla yaygınlaşmaktadır. Türkiye'de çölleşmenin ve kuraklığın yaklaşan ayak sesleri! Türkiye'de, toprak örtüsünün yok edilmesi ve yapılarına uygun kullanılmaması



sonucunda ortaya çıkan en önemli sorunlar arasında tarım arazilerindeki tahribat, çölleşme ve tuzlanma yer alıyor. Bitki örtüsünün tahrip edildiği, yoğun toprak işleme ve nadaslı buğday tarımının yapıldığı İç Anadolu Bölgesi, aynı zamanda rüzgar erozyonu şiddetinin de en yüksek olduğu bölgedir. Ayrıca, özellikle Konya bölgesinde su ve rüzgar erozyonlarının yanı sıra jeolojik faktörler ve yer altı sularının kontrolsüz kullanımı sonucu ortaya çıkan büyük toprak çöküntüleri (obruklar) son yıllarda giderek artmaktadır. Dünyada buğday üretiminde onuncu sırada olan ülkemiz için buğday önemli bir tarımsal üründür (TMO, 2019). Bu nedenle, hazırladığımız rapor kapsamında tarım topraklarımızı iyileştirmek için buğday üretiminde uygulanan koruyucu tarım uygulamalarına ait deneyimlere ve uygulamaların yaygınlaştırılması için önerilere ayrıca değinilmiştir.

İklim değişikliğinin etkisi sonucu, ülkemizin de içinde yer aldığı Akdeniz Bölgesi'nde artan sıcaklıklar nedeniyle; orta, güney ve güneydoğu bölgelerimiz şu an için bile yarı kurak iklim kuşağı içerisinde ve çölleşme riski ile karşı karşıya bulunmaktadır (Şahin ve Kurnaz, 2014). Etkisini hızlanarak gösterecek olan iklim değişikliği nedeniyle güney bölgelerimizdeki iklim, Suriye ve Irak ile benzerlik gösterecek; orta ve kuzey bölgelerimiz de şu an güney bölgelerimizdeki iklim yapısına sahip olacaktır. Kısacası, iklim değişikliği nedeniyle tüm bölgelerimizde kuraklık ve çölleşme riski artacaktır (Şahin ve Kurnaz, 2014). Koruyucu tarım ise toprağın karbon tutma kapasitesini artırarak; gıda güvenliği ile ilgili de pek çok sorunu beraberinde getirecek olan iklim krizine karşı bir mücadele aracı sağlamaktadır. Raporda derlenen, Türkiye'de tarım topraklarının sorunları ve koruyucu tarım uygulamalarına ait verilerden bazıları şu şekildedir:

1. Toprakta yaşayan 360 bin tür hayvan olduğu tahmin edilmekte ve 10 gram sağlıklı bir toprakta bile 106 farklı türe ait 1010 bakteri hücresi görülebilmektedir.
2. Türkiye toprakların yaklaşık %88'inin organik madde miktarı, az ya da çok az olarak nitelendirilen %2 oranının altındadır.
3. Ülkemizde 4,2 milyon hektar alan, değişen oranlardaki tuzlanma nedeniyle verimliliğini ve üretkenliğini kısmen ya da tamamen yitirmiştir.
4. Türkiye, dünya ortalamasının 2 katı kadar fazla erozyona maruz kalmaktadır.
5. Yaygın olarak uygulanan toprak işleme yöntemleri; toprağın kalitesini azaltarak fiziksel, kimyasal ve biyolojik özelliğini yitirmesine, verimliliğin düşmesine neden olmuştur.
6. Çölleşme Hassasiyet Haritası'na göre, Türkiye'nin %22,5'i yüksek çölleşme hassasiyetine, %50,9'u ise orta düzeyde çölleşme hassasiyetine sahiptir.
7. stihdam edilen yaşlı nüfusun (65 yaş ve üzeri) %65,5'i, tarım sektöründe çalışmaktadır.



8. Sahip olduğumuz tatlı su potansiyelinin % 70'den fazlasına yakını, tarımsal sulamada kullanılmaktadır.

9. 2015 yılı itibarıyla Türkiye'de doğrudan ekim yapılan alanların, toplam işlenebilir tarım alanlarının % 1'i kadar olduğu tahmin edilmektedir.

Bilinçli tarım yapmakla toprağı iyileştirmek mümkündür. Yıllardan beri toprağı işlemek gibi bazı metotların, topraklarımızı öldürdüğünü biliyoruz. Ancak iklim değişikliğinin hem çevreyle ilgili hem de ekonomik olarak yıkıcı etkilerini her geçen gün daha fazla görmeye başladığımız bu dönemde fazla zamanımız kalmadı. Değişmek ve değiştirmek zorundayız. Yıllardan beri bizleri besleyen bu yorgun toprakları korumak ve iyileştirmek için doğanın çalışma ilkelerini kavrayarak onunla uyumlu sistemler kurmaktan başka çaremiz yok. Bu çalışmanın amaçlarından birisi de kimyasal girdi kullanımı, pullukla sürme ve anızın yakılması gibi yanlış uygulamalar sonucu, fiziksel ve biyolojik olarak neredeyse vasfını yitirme noktasına gelmiş topraklarımızı korumak ve iyileştirmek için; dünyada ve ülkemizde yapılan uygulamaları derlemektir. Türkiye'de 90'lı yıllardan itibaren, buğday üretiminde Konya'da başlayan pulluksuz tarım uygulamaları, zamanla Marmara, İç Anadolu ve Doğu Anadolu bölgelerine de yayılan bir birikime sahiptir. Raporun son bölümlerinde, toprağın iyileştirilmesinin yanı sıra her bölgenin sosyolojik, çevreyle ilgili ve iklimsel yapısına göre uyarlanması gereken buğday üretiminde, koruyucu tarım yöntemlerine dair deneyimler de ele alınmış ve yöntemlerin yaygınlaşması için öneriler sunulmuştur.

Toprak, ancak sağlıklı ve üretken ise sürdürülebilir. Uzun zamandır yanlış tarım yöntemleri ile zarar verdiğimiz toprakların, gelecek nesilleri de besleyebilmesi için toprağı sadece fiziksel olarak korumak artık yeterli değil. Topraktaki canlılığı da koruyarak iyileştirmemiz gerekiyor. Koruyucu tarım, toprağın karbon tutma kapasitesini artırarak; toprağı iyileştirmenin yanı sıra, gıda güvenliği ile ilgili de pek çok sorunu beraberinde getirecek olan iklim krizine karşı da bir mücadele aracı sağlamaktadır. Akademi dünyasından, kamu ve özel sektörden 13 uzmanın katkı sunduğu "Türkiye'de Tarım Topraklarının Dünü, Bugünü ve Geleceği" başlıklı raporda toprakla ilgili temel bilgiler verilerek, dünyada ve Türkiye'de toprağın karşı karşıya kaldığı sorunlar ele alınıyor. Raporda ayrıca toprak koruma ve iyileştirme yöntemlerine, buğday tarımı özelindeki koruyucu uygulamalardan, toprağın iyileşmesi için önerilere kadar uzanan önemli teorik ve pratik bilgiler aktarılıyor.

Rapordaki çözüm önerileri dört ana dört ana başlık altında toplanıyor:

- Tarım topraklarının amaç dışı kullanımının engellenmesi,
- Tarım arazilerinin tahribatına sebep olan tarım uygulamalarının durdurulması,



- Tarım toprağını korumayı amaçlayan uygulama ve politikaların teşvik edilmesi,
- Tahrip edilmiş tarım toprağını iyileştirecek ve toprak canlılığını artıracak yenilikçi uygulamaların yaygınlaştırılması[4].

Türkiye’de genel ekonomi içinde tarımın yerine bakıldığında uzun bir durağan dönemden sonra hızlı bir gerileme gözlemlenmektedir. 1920’li yılların başından 1960’lı yılların sonuna kadar Gayri Safi Milli Hasıla (G.S.M.H.)’nin yaklaşık % 45’i tarımdan elde edilirken 1980 yılına gelindiğinde; Tarımın GSMH içindeki payı % 26 seviyesine inmiştir. 1997 yılında ise % 14,5’e gerilemiştir. Süreç içinde bu gerileme eğilimi devam etmiştir. 2001 yılı itibariyle % 12,8 olan tarım sektörünün ekonomiye katkısı 2005 yılına geldiğinde % 11,9’a kadar düşmüştür[5].

Toprakla buluşan insanların bedenleri daha sağlıklı ve rahat uydukları bir gerçektir. Tarımı organik olarak işlemek bir doğa dengesidir. Aynı zamanda her canlının sağlıklı olması ve yeni tür canlıların oluşması demektir. Her işte uzman olan bireyler, çok ayrıntılı bir biçimde o alanla ilgili olumlu ya da olumsuz olayları açıklamaktadırlar. Küçüklüğümden beri tarım ve hayvancılıkla ilgili görmüş olduğum olumsuz yönleri kafamda canlandırmaya çalışıyordum. Bazı bilimsel araştırma makalelerini okuduğum da anladım ki; konu ile ilgili araştırmacılar daha ayrıntılı biçimde olumsuzluklardan haberdar olup çözüm önerilerini sunmaktalar. Bu araştırmacıların duyarlılığı ve konu ile alakalı bilinçlenmeyi halkımıza da ulaştırmalıyız. Tarım ve hayvancılık sektörüne bilinçli bir şekilde girmelerini teşvik etmeliyiz.

6 Şubat 2023 günü ülkemizi derinden üzen, hepimizi yasa boğan ve yüreğimize bir ok gibi saplanan deprem felaketi ile ilgili, bilimsel bilgi verilerinin kötüye kullanımına dur demenin zamanı geçmektedir. Matematik öğrenenler kendi menfaatleri doğrultusunda hile yaparak ceplerini doldurmak için kullanmamalıdır. Toplumun yüksek menfaatleri doğrultusunda maksimum yarar sağlamak için kullanılmalıdır. Mesela matematik bir binanın yapımının en sağlam ne şekilde inşa edileceği hesabında kullanılmalıdır. Benzer durumlar tarım ve hayvancılık sektöründe yetiştiricilik için de söz konusudur. Bitkiler ve hayvanları doğasından koparıp, hormonal bir yetiştiricilik şeklindeki matematiksel hesaplamaları karlıları için kullanmamalıdır. En ince hesaplamaları çevre sağlığı ve insan sağlığı için yapmalıdır. Bu da ancak ve ancak sağlıklı doğal üretimi gerçekleştirmek ile mümkündür.



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IMPACTS OF URBANIZATION ON LIVELIHOODS: CASE STUDY IN LONG HOA WARD, CAN THO CITY, VIETNAM

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ABSTRACT

The process of urbanization is taking place rapidly in Can Tho city, having a direct impact on the lives of people in the suburban. A study on a suburban agricultural ward of Binh Thuy district, Can Tho City was surveyed with a random sample of 200 households, to understand the impacts on people's livelihoods in the process of urbanization. The results show that: Long Hoa suburban ward but has a high population density, the average land area per household is 0.45 ha low and most of it is for cultivation of different crops . The education level of the household head is still low, the average is grade 6. There have been significant changes in the structure of economic activities of the household. At present, most of the farmers are engaged in both agricultural production and other commercial and service activities to increase their income. Although the income from non-agricultural occupations is not high, it has gradually increased in the past 7 years (2015-2022) from 30.5 to 40.4 million VND/person/year, of which workers work in different industries. neighboring factories and enterprises have the most stable income. Most of the farmers are focusing on the cultivation of crops with high economic value, intensive animal husbandry and aquaculture. However, at present, there is still a large proportion of unemployed/ underemployed people. Farmers are developing in two strategic directions for their livelihood: (a) still producing high-quality agriculture and seeking the domestic market, especially linking with the market of the inner city of Can Tho in the consumption of agricultural products, (b) increasing non-agricultural activities and services. Both of these strategies need the support of technical transfer of agricultural extension, industrial extension and vocational training by the state to avoid injury to the poor due to the impact of urbanization.

Keywords: Urbanization, Non-agricultural activities, Livelihood strategies, Technology transfer, Vocational training.



1. RATIONALE

Urbanization in rural area is part of government's strategy of industrialization and modernization. Over last decade the urbanization has grown about 8 percent annually (Vietnam Economic Time Online, 24/11/2020). As the other regions in the country, urbanization in the Mekong Delta of Vietnam has been occurred rapidly in several provinces and cities.

At Can Tho city, which it is recognized as a city directly governed by central government, urbanization trend is obviously occurred. At present, the city has five urban districts of Ninh Kieu, Binh Thuy, Cai Rang, O Mon and Thot Not. And the other four rural districts of Phong Dien, Co Do, Thoi Lai and Vinh Thanh. Long Hoa ward belonging to Binh Thuy district is considered as a suburban area, where its high proportion of agricultural land and population is still remained. However, the urbanization is being occurred in the ward. Therefore, Long Hoa ward is selected for study the impact of urbanization on rural livelihood and agriculture.

Urbanization in Can Tho city, particularly in its suburban area is growing rapidly. Nevertheless, the urbanization still needs a long time for its completely process. It needs a huge investment on infrastructure, industrial, and service development, and especially on preparation of profession and employment for labor force. Urbanization process has brought several impacts on rural's livelihood, particularly on agricultural transition and labor force's professional.

Due to several reasons stated above, a research on impact of urbanization on rural's livelihood and agricultural transition has been carried out in Long Hoa ward in the year 2015-2022. This research expects to gain a good experience for policy makers in order to develop sustainable agriculture and profession for labor force in the urbanization process.

Objective

The objective of this research is to analyze the impact of urbanization on livelihood's strategy of rural people, especially impact on agricultural and employment transition. At the meantime, the research would figure out policy and solution for agricultural development and employment transition of suburban area under urbanization process.

2. RESEARCH METHODS

Several methods were used to satisfy the objective as followings:

- Collection of data and information related to urbanization at city and ward levels.
- Investigation of PRA (Participatory Rapid Appraisal) at Long Hoa ward for local officers and farmer groups whom preventatives for their agricultural and business patterns.
- Investigation of intensive survey on randomly 200 households in several typical farmer groups. The information over the period of 2015-2022 is collected and analyzed.



3. RESULTS AND DISCUSSION

3.1. Social economic conditions and development strategy of Can Tho city

Can Tho city situates in the central Mekong Delta, which is boundary with An Giang province in the North, Hau Giang province in the South, Kien Giang in the West and Vinh Long and Dong Thap provinces in the East.

The city is just being separated in early 2004, and it is recognized as type I city governed by central government. The city has 5 districts in urban area and 4 other districts in rural area.

Total natural area of the city is 1,410 ha, accounting for 3.49% of the whole Mekong Delta area. The population in the year 2022 is 1,246,993 people, in which there are 619,115 male and 627,878 female. Most population is Kinh of 1,205,725 people, and followed by Chinese of 20,458 people and Khmer people of 20,810 and some other minors. There are 876,923 inhabitants in urban area and 370,070 people in rural area. An average density of 884 people per km² is recorded, at which the highest density is felled into Ninh Kieu district, and the lowest is found in Vinh Thanh district.

There are about 696,973 people in the labor force, in which 584,330 people are in active labor force, and the rest is reserved labors.

Overall objective is to build the city into modem, civilization city and it plays as a central of the delta in all aspects. It goals until the year of 2022 should be:

GDP growth is averaged of 18.5 % for the period of 2015-2022, especially is about 20-27% in the years 2017-2022. GDP structure would be 9.4% - 43.9% - 46.7% for sector 1, 2 and 3 in 2022, respectively. The GDP per capita should be 3,500 to 3,750 USD in the year 2022. Annual birth rate would be declined 0.2 - 0.4%. Almost households in the city should be supplied clean water and electricity.

Investment capital will be 325,000 - 630,000 billion VND over the year 2015 to 2022, in which 567,000-675,000 billion VND in the year 2017-2022. Export value would gain 1,240 million to 1,570 billion US dollars while the import value would be 745 to 1,235 million US dollars in the year 2022. Especially the urbanization index would reach 68% in the year 2022. This indicator is very important and will affect all aspects of the livelihood.

3.2. Social economic condition of Long Hoa ward

Long Hoa is one of suburban wards of Can Tho city, which is 1,395 ha of natural area and covers 6 separated areas. The ward has 2,826 households with a population of 14,385 people. Population density of 1,031 people per km² is found. There are 9,957 people in working age,



accounts for about 69.2 percent as compared with total population. In which, there are 89.6 percent who have stable employment (Long Hoa Ward's annual report, 2022).

The ward is characterized as an agricultural site, which has 1,119 ha of agricultural land, accounts for 86 percent of total land. Land of fruit tree is 595 ha, which has a large share of more than 53 percent of agricultural land. In which 452 ha are just shifted into special and high value fruit trees such as durian, jackfruit, mango, oranges, citric fruit, etc. Land for rice is of 485 ha, occupies less than 43,3 percent of total agricultural land. Three rice crop patterns are found in this ward. Cash crop as vegetables and high valued upland crops are developing in the site, which mostly rotates with rice crop, intercrops in garden land and in some other lands. Profit from these cash crops would be 6 times higher than that of rice. Fish culture of high profitable species such as hybrid catfish is also being developed recently. It is about 12 ha of water surface in the site.

The ward has been changed its title from the village formerly. This would affect development strategy of the ward, which is tending to develop industrial, light industrial and service sectors. There are around 65 small business units and more than 265 commercial business bases in the ward at the present time. Moreover, there are another 9 state and private enterprises in the ward. Infrastructure in the ward is much developed, recently. There are 6 main roads, which have been built and upgraded over the period 2010-2022. The local main market in the ward has been promoted and another five local markets in this site are formed recently. In the near future a new center of business and commerce will be built. Schools in the ward have been upgraded and the noon classes are not remained anymore. Former clinic in the ward is also promoted into a region hospital since 1999. Electricity line in the ward is mostly completed, and there are more than 98% of household can be accessed. Around 97% of households in the ward are using clean water, in which more than 2,100 households is accessed pipe water supply.

3.3. Social characteristics of surveyed households

Result of 200 households survey shows that average age of household head is 54, and there is not much variation of age among household groups. Average education in grade of the households is 5.8. The highest grade of 7.2 is found in rich group, and following by 5.5 and 4.6 grade for medium and poor group, respectively. Number of member per household is varied from 5 people in the year 2015 to 5.3 in the year 2022 (Table 1).



Table 1. Characteristics of household head and family by household group

	Unit	Group			Overall
		Rich	Medium	Poor	
Sample size	Household	60	100	40	200
Household head's age	Year	52.2	54.5	56.1	54.1
Education level of household head	Grade	7.2	5.5	4.6	5.8
Family size in 2015	Person	4.5	5.3	4.8	5.0
Family size in 2022	Person	4.6	5.7	5.4	5.3

Average size of house of all group is 121 m² per house, in which the rich group has a biggest house of 150 m², and it is significant different with medium and poor group (120 and 80 m²). However, house's value is much varied between them. The rich group has a house value of 250 million while that of the medium and the poor is 135 and 80 million, respectively (Table 2).

Table 2. House's characteristics and its value by wealthy status group

	Unit	Group			Overall
		Rich	Medium	Poor	
Sample size	Household	60	100	40	200
House's size	m ² /house	150	120	80	121.0
House's value	Million VND/house	250	135	80	158,5

Long Hoa is suburban ward of Can Tho city. It has a high density of population, and as a result the farm size is very small. Average farm size of 0.45 ha per household is found. Among group, the rich is owned a biggest farm size of 0.69 ha per household, while that of the medium and the poor is 0.41 and 0.19 ha per household, respectively (Table 3). For all group, most land is devoted for the garden.

Table 3. Land owning by household group at present time

	Unit	Group			Overall
		Rich	Medium	Poor	
Sample size	Household	60	100	40	200
Total land owned	ha/household	0.69	0.41	0.19	0.45
Homestead area	ha/household	0.07	0.03	0.02	0.04
Garden area	ha/household	0.44	0.24	0.10	0.27
Rice field area	ha/household	0.17	0.13	0.08	0.13
Other land	ha/household	0.02	0.01	0.00	0.01

In the households surveyed most their homestead area is inherited from their parents at same location. It is accounted for 72.5 percent of the total households. Another of 23.8 percent of household surveyed has their homestead from buying. This also meant that they are just resettled in the ward recently. The statement of resettlement shows that there are 40.7 percent



of household buying homestead just come to the ward during the period of 2010- 2015, and 25.9 percent of them come to the ward after the year 2015.

Most of household (89%) has their owned gardens by inheritance, and another of 11 percent of households bought their garden after renovation period. A similar situation is found for rice field ownership ..

3.4. Impact of urbanization on livelihood and production

(a) Transition of employment

The ward has totally about 2,826 households. Transition of household's employment for the period 2015-2022 is clearly reflected. According to PRA's result, most households formerly involves purely in agricultural activities for their income generation, while at the present, this figure is much declined. In the other hand, most households now work not only in agriculture but also in commercial and service activities for their income. Another proportion working in factories and Non-agricultural labors are found recently.

Results from 200 households surveyed have indicated a change of employment between the year 2015 and 2022. Table 4 below presents such a change. It is clearly to see the share of agricultural job reduced from 33.5 percent in 2015 to 25.0 percent in 2022. This would be explained by a decline of agricultural land and low profitability from agriculture. However, proportion of Agricultural hired labor of household is also lightly reduced during the same period, from 5.8 percent to 1.2 percent. This figure is seemly not much consistent with the urbanization process. It would make us to think about difficult and challenge of this reduction. They would expect to study further in next phase of the project.

Table 4. Change of major employments in the period 2015-2022

Major employment	Year 2015		Year 2022	
	Frequency	Rate (%)	Frequency	Rate (%)
Farmer	185	33.5	173	25.0
Small grocery store	68	12.3	85	12.3
Industrial factory worker	48	8.7	75	10.8
State officials	40	7.2	60	8.7
Commercial service	43	7.8	58	8.4
Construction workers	35	6.3	48	6.9
Teaching staff	26	4.7	43	6.2
handicraft labor	12	2.2	35	5.1
Aquaculture and fishing	8	1.4	12	1.7
Motorcycle repair	6	1.1	12	1.7
nurse/doctor	6	1.1	12	1.7
Bank staff	7	1.3	12	1.7
Agricultural hired labor	32	5.8	8	1.2
Carpenter	3	0.5	7	1.0
Repair of engines for cars and trucks	2	0.4	6	0.9
Electronic repair	4	0.7	6	0.9
silversmith	3	0.5	3	0.4
Other trades	25	4.5	37	5.3
Total	553	100.0	692	100.0



The urbanization process occurring at this ward and other adjacent area; would create conditions for labors force to work in factories and enterprises. As a result, this figure is increased from 8.7 percent in 2015 to 10.5 percent in 2022. Labors that are worked for government offices are also tending to increase in the same period, from 7.2 percent in 2015 to 8.7 percent in 2022. Labors worked in commercial and business is also sharply increased from 7.8 percent in 2015 to 8.4 percent in 2022. Carpenter and construction workers are also increased in the same period.

The results of Table 5 on change in income sources in the period 2015-2022 show high conversion, from State officials (129.5 percent) and from Commercial service (241.8 percent). The highest household income in 2022 from Commercial service is 78.6 million VND/year, followed by Aquaculture and fishing, Industrial factory worker, State officials with income of 67.5, 66.4, 62.4 million VND, corresponding. In addition, to increase family income, occupations such as Construction workers, Agricultural hired labor, handicraft labor, Small grocery store are also performed by households.

Table 5. Income/year/household member changes by type of employment in the period 2015-2022

Type of employment	Income in 2015 (million VND)	Income in 2022 (million VND)	Change (%) (in 2015-2022)
Commercial service	32.5	78.6	241.8
Aquaculture and fishing	35.6	67.5	189.6
Industrial factory worker	34.4	66.4	193.0
State officials	48.2	62.4	129.5
Teaching staff	34.8	49.8	143.1
Construction workers	28.5	47.8	167.7
Agricultural hired labor	28.9	44.8	155.0
handicraft labor	18.7	34.9	186.6
Small grocery store	12.5	29.7	237.6
Others	31.7	55.6	175.4

(b) Employment shortage and underemployment

High population and recently reduction of agricultural land associated with less development of light industrial and service and fast growth of labor force, have caused unemployment and under employment especially for the poor and above the poor groups. This situation is obviously seen in aged women and non-professional groups. Interviewing poor households in the ward shows that:

They have no land for agricultural cultivation. Their livelihood is essentially relied on selling their labors, small buy and sell but the incomes are unstable daily. Finding a job for these groups, particularly job in industrial factories and enterprise is much difficulty. These are because they are rather old, low educated level, non-profession and improper gender.



According to annual report of the ward, only 850 people have been professional trained for the last 7 years, averaged of 120 people per year. These training course are paid much more in agricultural extension, while those in non-agricultural are shortage. Therefore the number of labors found their jobs in ward's factories as well as enterprises is low, and the others labor have to find their job in other provinces with a low professional job.

(c) Development of fruit tree and aquaculture

Land devoted for fruit tree is 595 ha accounted for more than 50 percent of agricultural land. Formerly the ward's fruit tree is dominated by orange and citric species, however, this fruit trees have been decline due to greening disease recently and unstable price. The fruit trees tending to grow with higher value varieties and low labor input. So far, there is 352 households have shifted to durian tree, jack fruit, mango, special orange, and lemon.

Aquaculture is developing recently. It is of 12 ha of fishpond in the ward. Formerly the purpose of raising fish is to use by-product at household scale and therefore the fish is low market valued. Now it is changing to raise higher value of fish such as hybrid catfish, red tilapia and so on ... Feed for fish is by- product come from food processing factory in adjacent wards.

(d) Sell and buy of land

Due to urbanization process recently, transportation system has been improved. This is to lead a rapid increase of land price. As a result land along the main roads have been sold and bought. There are about hundred cases of buy and sell their lands with an area of about 50 to 70 hectare of homestead a year.

The seller has sold their land partly to earn money for their better incomes, while the buyers are from outside the ward. Land bought is not used for resettlement but for resell again to another buyers when a higher price of land coming. The other cases are not being sold their land but they are waiting for a higher price of land to sell. This is leading to a bad situation that land is not for agricultural production.

Table 6. Sale and buying land in surveyed households in the last 7 years

	Rich group	Medium group	Poor group	Overall
Number of seller	15	42	24	81
Land sold (m ² /household)	2675	3157	2345	2827
Number of buyer	18	25	2	45
Land bought (m ² /household)	5318	3285	1285	4009

(e) Contract or consumption of valuable vegetables

Around 5 hectares out of 72 hectares of vegetable cropped in the ward has been planned to grow clean and valuable vegetables. This area is being contracted with the super market in the city



for consumption. These are new and good phenomena of marketing. However, this is still limited at a small scale. Growers in the ward are expected to expand the area contracted under this marketing channel.

(f) Variation of household income

Table 7 below present the level and sources of income of household surveyed. Income earned from agriculture is gradually increased in the fast seven years, in which income from fruit tree from 46.5 to 71 million VND/household. While the income from rice did not change much (23 to 23.7 million VND/household) . This is because the fanners to grow other kinds of fruit tree with higher economic value. In the other hand, rice is declined in area associated with small scale and poor irrigation system supported. In contrary, income from vegetables, livestock and aquaculture is grown during the past seven years. These sources of income are growing consistently with the trend of agricultural development under urbanization. Within this trend, fanners are tending to invest their capitals , material, and labor for developing the valuable vegetable, livestock and fishery.

Table 7. Household incomes from agriculture in 2015 and 2022 (million VND/household)

Incomes source	2015		2022	
	No. household	Income	No. household	Income
- Fruit tree	145	46.5	173	71.0
- Rice	98	23.0	85	23.7
- Cash crop	43	6.3	47	10.0
- Livestock	52	5.8	42	7.6
- Fishery	18	3.1	15	7.2
- Other	184	6.4	758	10.5
Total		91.1		130.0

(g) Variation of total household's income structure

Table 8 indicates the total household income and the share of agriculture and non-agriculture's income in the context. Total household's income is increased from 154.6 million VND in the year 2015 up to 228.1 million VND in 2022. Among household groups, the rich group's income has increase of 75.5 million VND and followed by medium group of 76.2 million VND and the poor of 44.6 million VND.



Table 8. Total household's income and its structure in 2015 and 2022

Source of income	Unit	2015				2022			
		Rich	Medium	Poor	Overall	Rich	Medium	Poor	Overall
Agriculture	%	55,3	59,3	49,7	58,9	57,5	55,7	45,1	57,0
- Fruit tree	%	32,3	29,6	19,8	30,1	35,2	29,8	19,5	31,1
- Rice	%	12,2	18,3	7,3	14,9	10,5	11,7	4,3	10,4
- Cash crop	%	2,4	3,4	7,8	4,1	2,6	4,6	5,8	4,4
- Livestock	%	3,5	2,8	5,7	3,8	2,7	2,5	5,7	3,3
- Fishery	%	2,3	1,7	1,6	2,0	4,6	2,6	1,3	3,2
- Other	%	2,6	3,5	7,5	4,2	1,9	4,5	8,5	4,6
Non-agriculture	%	44,7	40,7	50,3	41,1	42,5	44,3	54,9	43,0
Total income	Million VND	185,4	141,6	94,7	154,6	260,9	217,9	139,1	228,1
Sample size	HHs	70	100	40	200	70	100	40	200

Share of agricultural income has been reduced from 58.9 percent in 2015 to 57.0 percent in 2022. All household groups have a similar situation that agricultural income gradually declined over the period. In the other hand, share of income from non-agricultural sources are fast grown up, from 41.1 percent in 2015 to 43.0 percent in 2022. Especially, the poor group has a highest share of non-agricultural income as compared with the other groups in the surveyed. It is varied from 50.3 percent in 2015 up to 54.9 percent in 2022.

3.5. Livelihood strategy

As the other wards in suburban circle of the Can Tho city, Long Hoa ward has been replied strongly in agricultural income. How to still remain agricultural activities and develop non-agricultural income to improve income generation under urbanization process is a livelihood strategy of the city. SWOT table below has been extracted from a PRA on the agricultural combined with non-agricultural households.

Table 9. SWOT analysis of agricultural and non-agricultural household groups

<p>Strength: having cultivated land have a good transportation and communication system having a good experience in agricultural production having family labor force</p>	<p>Weakness: : low profitability from agriculture : shortage of professional school shortage of linkage between production associations</p>
<p>Opportunity: having market, commercial system and service having good road system having chances for non-agricultural jobs land will be planned in logical way having good marketing system as super market, agency, restaurant</p>	<p>Threaten: hang up land planning effect agricultural production. low price of agricultural product due to shortage of marketing system high cost of material investment for agriculture</p>

From the analysis of SWOT above, some major livelihood strategy of Long Hoa' people such as follows:



Strategy 1 : S1 + S3 + 01 + O5: Still remaining the agricultural production, this has the local marketing channel for production consumption. To implement this strategy, it is necessary to establish fruit tree producers into production associations and to link them with the potential buyer for better production consumption. Achievement of this strategy will be a good opportunity to remain a green circle surrounding the city, the green production will supply for the city, and it will be a good linkage between producers and consumers within the city.

Strategy 2: S4 + 03 + W2: Promotion of non-agricultural activities. The local government, especially the city's government should improve and promote the professional training for your people in the city, particularly for those in suburban areas. The urbanization process will create more potential of non-farm activities. However, the young people still hard to find job for their income generation as well as finding the professional jobs. Therefore at the present situation, young people still shortage job and unstable in their income.

Strategy 3: S1 + S3 + 04: Selection and planning the production zone for a sustainable production.

4. CONCLUSION AND POLICY IMPLICATION

4.1 Conclusion

Urbanization process is an actual trend that has been occurred in Can Tho city. Due to urbanization process the agricultural sector becomes less important in the city's economy, while the industrial and service sectors gradually are more important.

Long Hoa is a suburban ward of the city, its population is higher than average figure of the city. The agriculture is still remaining a relative importance in it economic structure regardless the light industry and service sectors are being developed. Average cultivated land for each household in the ward is small.

Therefore the fruit tree which are relatively valuable and less sensitive to disease and low labor input, are much more planted in the ward. High profitability of livestock and aquaculture are growing in the present time.

Income generated from agriculture is relatively low as compared with the total household's income. It is also tending to reduce over the past five year. In the other hand income from non-agricultural sector is tending to grow in the same period.

Employment structure is vained, in which agricultural labor and selling labor in agriculture is declined. In contrary, labor working in factory and enterprise as well as governmental servant is sharply increased over the same period. Moreover, private workers having professional skill



such as carpenter and construction worker are gradually increased in response with the urbanization.

Although having no exactly information and data, but unemployment and underemployment are sharing a large proportion of the labor force, especially for the women. This is essential to study further in the future.

Tow livelihood strategy of local people to response with urbanization of (1) developing high technological and sustainable agriculture associating with linkage of marketing channel, and (2) developing of non-agricultural employment are priority to develop in the near future.

4.2 Policy implication

City's extension department has to improve and increase their activities for their producers. This will lead to a better and faster transition of existing agriculture into high valuable and sustainable sector in the near future. In addition, the credit service has to fully meet the production's need in order to speed up the agriculture transition.

The local government has to be well land planning as well as agricultural land zoning and improving of irrigation system for a better production. These actions will lead the producers having a good strategy for their investment.

Establishing and strengthening the market system for agricultural production consumption in the suburban area. This is especially for fruit tree and short and valuable vegetables.

The local government has to improve and promote the professional training for people in the area, who are having a relatively high education level. These people therefore would supply for a better labor force in urbanization process.



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KISINTILI SULAMA REJİMİ ALTINDA FARKLI ORANLARDA FINDIK ZURUFU KOMPOSTU UYGULANMIŞ TOPRAĞIN SICAKLIĞI İLE H₂O VE CO₂ SALINIMLARI

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ÖZET

Toprak yeryüzündeki tüm canlılar için hayati önem taşıyan ekosistem dinamiklerine önemli katkıda bulunduğu için çok fonksiyonlu bir kaynak olarak yönetilmelidir. Bu nedenle tarımsal üretimde ekonomik ve çevresel stratejilerin benimsenmesi toprakların sürdürülebilirliği açısından oldukça önemlidir. Ayrıca toprağın verimlilik döngüsünde yer alan toprak suyunun etkin kullanılması ve küresel karbon döngüsünün daha iyi yönetilmesi için arazi yönetimi uygulamalarında karbon stoklarının uzun vadeli olarak korunması topraktan CO₂ ve H₂O salınımlarının azaltılmasıyla çevresel sürdürülebilirliği önemli ölçüde desteklemektedir. Tarımsal ekosistemleri çevresel olarak güvenli bir şekilde sürdürebilmek için toprağa compost uygulaması ve üretimde kısıntılı sulama uygulamaları sürdürülebilir bir strateji olarak kabul edilmektedir. Böylece 3 farklı oranda (0%, 1.5%, 3%) findık kabuğu kompostunun çıplak toprağa uygulanması ve 3 farklı seviyede sulanması (100%, 67%, 33%) koşullarında 3 tekerrürlü olarak yürütülmüş bu çalışma toplam 27 saksıda 1 ay süreyle laboratuvar koşullarında gerçekleştirilmiştir. Çalışmada farklı dozlarda findık zurufu kompostu uygulanmış toprağın değişen seviyelerde sulanmasının toprak sıcaklığına ve topraktan H₂O ve CO₂ salınımlarına etkilerinin incelenmesi amaçlanmıştır. Çalışma sonucunda tam sulama koşullarında toprak sıcaklığının azaldığı ve topraktan H₂O salınımının arttığı buna karşın artan findık zurufu kompostu uygulamasıyla topraktan H₂O salınım miktarının azaldığı ve CO₂ salınımının arttığı ancak CO₂ salınımının kısıntılı sulama uygulamasıyla azaltılabileceği belirlenmiştir. Bu çalışmanın bulguları ile kısıntılı sulama rejimi altında toprağa compost uygulamasının salınımları azaltıcı bir yaklaşım olarak kullanılması ve toprak neminin kontrol altına alınması konusunda çevreci bir tarımsal faaliyet programı olarak önerilebileceği sonucuna ulaşılmıştır.

Anahtar Kelimeler: CO₂ salınımı, findık zurufu kompostu, H₂O salınımı, kısıntılı sulama, toprak sıcaklığı



SOIL TEMPERATURE AND H₂O AND CO₂ RELEASES FROM SOIL TREATED WITH HAZELNUT HUSK COMPOST AT DIFFERENT RATES UNDER DEFICIT IRRIGATION REGIME

ABSTRACT

Soil should be managed as a multifunctional resource as it contributes significantly to ecosystem dynamics that are vital for all living things on earth. Therefore, the adoption of economic and environmental strategies in agricultural production is very important for the sustainability of soils. In addition, long-term protection of carbon stocks in land management practices for the effective use of soil water in the soil fertility cycle and better management of the global carbon cycle significantly supports environmental sustainability by reducing CO₂ and H₂O releases from the soil. To sustain agricultural ecosystems in an environmentally safe manner, compost application to the soil and deficit irrigation practices in production is accepted as sustainable strategy. Thus, this study, which was conducted in 3 replications under different ratios of hazelnut husk compost (0%, 1.5%, 3%) applied to bare soil and irrigated at 3 different levels (100%, 67%, 33%), was carried out in a total of 27 pots for 1 month under laboratory conditions. In this study, it was aimed to examine the effects of varying levels of irrigation of the soil applied with different doses of hazelnut husk compost on soil temperature and H₂O and CO₂ releases from the soil. As a result of the study, it was determined that the soil temperature decreased and the H₂O release from the soil increased under full irrigation conditions, however, the amount of H₂O release from the soil decreased with the application of increased hazelnut husk compost, and the CO₂ release increased, but the CO₂ release could be reduced with the deficit irrigation application. With the findings of this study, it was concluded that the application of compost to the soil under the deficit irrigation regime can be recommended as an environmentally friendly agricultural activity program for the use of an approach to reduce the releases and to control soil moisture.

Keywords: CO₂ release, deficit irrigation, H₂O release, hazelnut husk compost, soil temperature



1. INTRODUCTION

Soil must be managed as a multifunctional resource, not only to provide food for the increasing population, but also to contribute to vital ecosystem dynamics such as regulating the climate through carbon storage, filtering water, cycling of plant nutrients, and creating a habitat for many living things. When this multi-management model is taken into consideration, besides the productivity parameters, the environmental management approach should be taken into consideration and should not be ignored.

Terrestrial ecosystem dynamics are significantly affected by the amount of organic matter in the soil. The organic matter added to the soil with various organic materials regulates the soil pH, provides a buffer feature to the soil and has significant positive effects on regulating the biological properties of the soil, water holding capacity, aeration capacity, cation exchange capacity and the availability of plant nutrients (Cooper et al., 2020; Kranz et al., 2020). With these important effects of organic matter on the physical, chemical and biological properties of the soil, it has become a necessity to add organic materials to soils as a source of organic matter. While planning agricultural activities with this target, organic wastes should be applied directly or by composting to the soil in soil management. Composting is recognized as a sustainable strategy to manage agro-ecosystems in an environmentally safe manner (Jiang et al., 2015). The use of harvest residues as a soil conditioner in agricultural production has an economically and environmentally important strategy in the approach of evaluating waste as a resource.

Hazelnut husk, which is the harvest residue created by hazelnut, which is one of the most important agricultural products for Turkey, in which Turkey ranks first in world production, has a great waste potential. Hazelnuts release a mean of 500 000-tons of dry hazelnut husk at the end of the harvest each year, and the physical and chemical properties of this husk are evaluated in agricultural areas as an organic matter source (Ozenc Bender and Sahin, 2018). Although hazelnut husk has a very rich content of organic matter as a good carbon source, it has been stated that hazelnut husk should be used by composting rather than directly in the soil due to its high organic matter/nitrogen ratio (Caliskan et al., 1996). The application of hazelnut husk to the soil improves the physical, chemical and biological properties of the soil by increasing the organic matter of the soil (Caliskan et al., 1996; Ozenc Bender and Sahin, 2018). However, increasing soil organic matter has the risk of increasing CO₂ release from the soil as well as improving soil properties.

Soils are the largest carbon pool indicative of organic matter, containing more than three times the carbon of the atmosphere (Schlesinger and Andrews, 2000; Leinweber et al., 2008). Small



changes in the rate of mineralization of soil organic carbon can significantly affect the atmospheric CO₂ concentration and also reduce soil fertility (Coban et al., 2015). CO₂ releases from agricultural production account for 12% of global anthropogenic releases (Hou et al., 2019).

To better manage the global carbon cycle, land management practices aim to limit the impact on CO₂ losses from soils through long-term conservation of carbon stocks. The impact of agricultural practices on the global carbon cycle should be not only mitigating against climate change, but also increasing the sequestration of atmospheric carbon in the soil to improve food and biomass production, water quality and sustainability (Chaplot et al., 2019). Water management is positioned as one of the important factors affecting soil CO₂ releases (Li et al., 2019), and when compared to full irrigation, deficit irrigation can change mineralization and CO₂ releases from the soil by reducing soil moisture content in agricultural lands (Yerli et al., 2022). Changes in soil temperature can also cause changes in soil microbial species and activity, which inevitably leads to differences in soil CO₂ releases (Hou et al., 2019).

Previous studies have focused on the usefulness of hazelnut husk compost for soil and plants, or the effect of different organic materials applied to the soil on CO₂ release from the soil. However, this study aimed to bring a different perspective to the literature by examining the effects of irrigating the soil applied with different doses of hazelnut husk compost at varying irrigation water levels on soil temperature and CO₂ and H₂O releases from the soil. This study hypothesized that increasing amounts of hazelnut husk compost would increase CO₂ release from the soil while reducing H₂O release from the soil, and soil CO₂ releases could be controlled with a deficit irrigation regime.

2. MATERIAL AND METHOD

The study was carried out in the laboratory of Van Yuzuncu Yil University, Faculty of Agriculture, Department of Biosystems Engineering in a total of 27 pots (V: 1.5 liters, R: 13 cm, H: 11 cm) according to a completely randomized factorial experimental design with 3 replications under the conditions of applying 3 different ratios of hazelnut husk compost (0%, 1.5%, 3%) to bare soil on a weight basis and irrigating at 3 different levels (100%: full irrigation, 67%: deficit irrigation at 33% level, 33%: deficit irrigation at 67% level). During the study period, the mean daily temperature and humidity of the laboratory measured by the automatic weather station (HOBO, Campbell Scientific, USA) were 23.7±2.6°C and 39.3±5.1%. To fix the influence factors of the pots from the external environment, the position of the pots was randomly changed in each wetting-drying cycle.



According to the analyzes made on the soil before the experiment, it was determined that the texture of the soil was sandy loam (sand: 66.3%, silt: 15.6%, clay: 18.1%) in the USDA classification. In addition, it was observed that the soil did not have salinity problems (0.615 dS m⁻¹), had an acidic character close to neutral (7.17), and organic matter (0.81%), carbon (0.47%) and nitrogen (0.040%) contents of the soil were low. In addition, the same analyzes were carried out to determine some properties of hazelnut husk compost and the EC, pH, organic matter, organic carbon and total N values of hazelnut husk compost were determined as 2.314 dS m⁻¹, 6.31, 75.7%, 43.9% and 1.35%, respectively.

Hazelnut husk compost at the rates of 0%, 1.5% and 3% was mixed homogeneously into the air-dry soils passed through a 4 mm sieve on a weight basis and transferred to the pots. The field capacity of the pots without hazelnut husk compost (0%) was determined as the pot capacity and all pots were irrigated with equal irrigation water level to complete the pot capacity and left for incubation for 1 month. After incubation, the determined current moisture of each pot was completed to the pot capacity and in subsequent irrigations, each wetting-drying cycle was repeated for a total of 6 times for 1 month, completing every 5 days. Irrigation in the wetting-drying cycle was carried out until the end of the study period, taking into account the irrigation water levels (100%, 67% 33%) according to the current moisture determined for the control application, where no hazelnut husk compost (0%) and full irrigation (100%) were applied.

Soil temperature, H₂O and CO₂ releases were measured daily from each pot with an infrared gas analyzer (EGM 5, PPSsystem, Stotfold, UK) during the wetting-drying period. While the soil temperature values were obtained by immersing the soil temperature probe (STP 1, PPSsystem, Stotfold, UK) connected to an infrared gas analyzer device into the soil 5 cm deep, the dynamic closed room system (SRC 1, PPSsystem, Stotfold, UK) of the device was placed in the upper 1 cm depth of the potting soil to determine the H₂O and CO₂ release values (Yerli et al. 2022). Soil temperature, H₂O and CO₂ release data were automatically recorded on the USB memory connected to the EGM 5 device for each measurement, and these data were then processed in the PC.

The obtained soil temperature, H₂O, and CO₂ release data were statistically evaluated with the General Linear Model in the SPSS program (Version 21) and the significant means were separated at the 5% probability level with the Duncan Multiple Range Test (Duncan, 1955).



3. RESULTS AND DISCUSSION

While the effect of hazelnut husk compost doses on soil temperature was insignificant, the effect of different irrigation levels on soil temperature was found to be significant at $p < 0.01$ (Figure 1). It is thought that the increase in soil temperature as the irrigation water level decreases is related to the decrease in the thermal conductivity between the soil particles and the cooling effect of soil moisture on the soil. Longer preservation of soil moisture can significantly affect the heat capacity and thermal conductivity of the soil, resulting in a significant decrease in soil temperature (Yerli et al., 2022). Under wet conditions, the evaporation of water in the soil slows the warming of the soil as more soil heat capacity and more energy are used to heat the soil (Radke, 1982). The fact that soil particles have a lower heat capacity and higher thermal conductivity than water causes dry soils to potentially warm faster than wet soils (Licht and Kaisi, 2005). In addition, increased moisture in the soil reduces heat dissipation in the soil and weakens the potential heat absorption capacity, resulting in cooler soils (Lakshmi et al., 2003). Akbolat and Coskan (2020) stated that increasing soil moisture with the increase in the amount of water in the soil causes a decrease in soil temperature. Similarly, Zhang et al. (2019) also stated that increased moisture in the soil by precipitation or irrigation resulted in a decrease in soil temperature at a level greater than 1.5°C in the surface layer of the soil (5 cm).

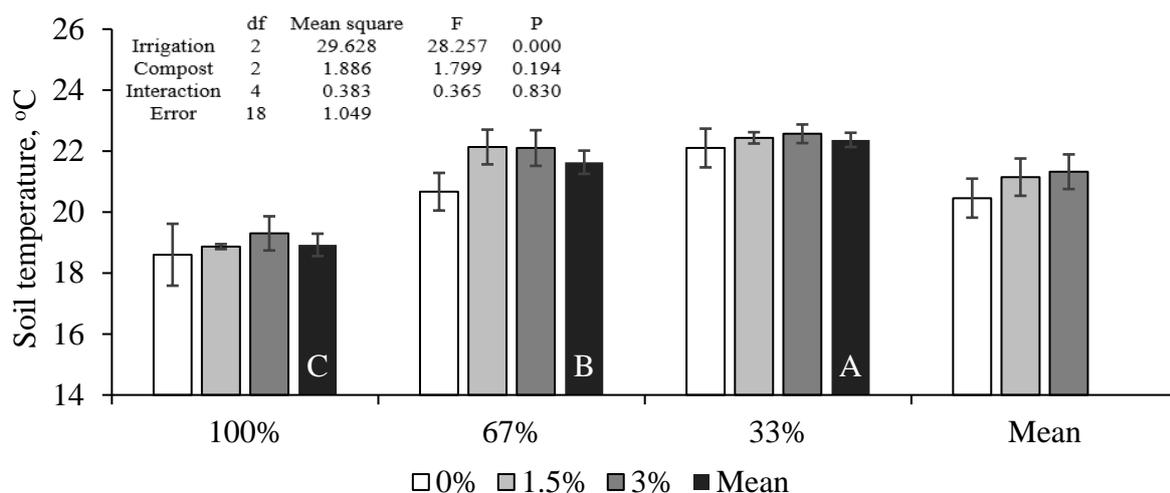


Figure 1. Soil temperature at different hazelnut husk compost doses and irrigation water levels (While 100%, 67%, 33% represent irrigation water levels, 0%, 1.5%, 3% indicate hazelnut husk compost doses)

The effect of hazelnut husk compost doses and different irrigation levels on H₂O release from the soil was found to be significant at $p < 0.01$ (Figure 2). It is thought that the decrease in H₂O



release from the soil as the dose of hazelnut husk compost increases is related to the increased organic matter in the soil with compost. Less H₂O may be released from the soil as a result of the improvement of the soil physical properties of the organic matter in favor of the soil's water retention. Increasing organic matter in the soil increases the pore structure, size and distribution of the soil in a way that improves the soil's more water retention, thus balancing the moisture retention in the soil and reducing water losses by evaporation from the soil (Devi et al., 2019). Ding et al. (2014) stated that the increase in soil organic matter content may prevent the evaporation of water. Similarly, in different studies, different organic matter inputs emerge with the potential to improve soil water, and organic matter applied to the soil reduces H₂O releases from the soil (Ouattara et al., 2006; Askin and Aygun, 2018; Devi et al., 2019). Kizilkaya et al. (2015) also stated that the water holding capacity of hazelnut husk compost is high and pointed out that hazelnut husk compost has an important effect on preserving soil water.

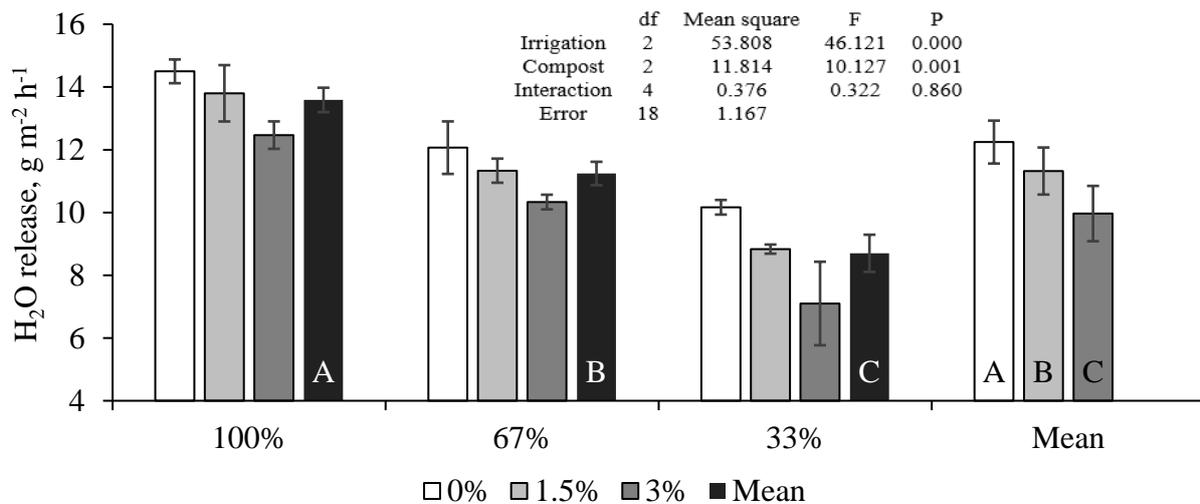


Figure 2. H₂O release at different hazelnut husk compost doses and irrigation water levels (While 100%, 67%, 33% represent irrigation water levels, 0%, 1.5%, 3% indicate hazelnut husk compost doses)

As the amount of irrigation water increases, the increase in H₂O release from the soil can be explained by the increase in evaporation losses due to the increase in moisture in the soil, an expected effect. Decreased moisture in the soil with a decrease in the amount of irrigation water results in a decrease in H₂O emissions due to the filling rate of the pores with water (Akbolat and Senyigit, 2012). As a result of a study examining the H₂O release from the soil under different irrigation methods, it was stated that the lowest H₂O release from the soil was obtained



from the drip irrigation method in which the least irrigation water was applied to soil (Senyigit and Akbolat, 2010).

The effect of hazelnut husk compost doses and different irrigation levels on CO₂ release from the soil was found to be significant at $p < 0.01$ level, and the interaction of hazelnut husk compost doses \times different irrigation levels was also significant at $p < 0.05$ (Figure 3). It is thought that the increase in CO₂ release from the soil as the dose of hazelnut husk compost increases is related to the increased organic matter in the soil with compost. Mineralization of more soil organic matter by soil microorganisms causes more CO₂ release from soil and organic matter loss from soil (Tang et al., 2018). Together with the organic matter added to the soil, high organic carbon increases the CO₂ release potential (Yerli et al., 2022). The application of compost to the soil increases the soil microbial population rate and size, resulting in more mineralization and more CO₂ release from the soil, and with the increasing compost applied to the soil, the rate of increase in CO₂ release increases (Bouajila and Sanaa, 2011). In addition, the increased amount of nitrogen in the soil along with organic matter increases the microorganism activity of the soil and accelerates the respiration in the soil due to the need for nitrogen by the microorganisms in the oxidation process, increasing CO₂ release (Tang et al., 2018). Even if sufficient organic matter level in the soil and conditions such as moisture and temperature of the soil is suitable for the oxidation of organic matter, nitrogen deficiency in the soil slows down mineralization (Navarro Pedreño et al., 2021). Thus, less mineralization causes less CO₂ release from the soil. Yu et al. (2014) stated that increasing nitrogen in the soil not only increases the release of N₂O, but also activates the mechanism of release of CO₂ from the soil.

The increase in CO₂ release from the soil as the amount of irrigation water increases can be explained by the fact that soil moisture stimulates soil microorganisms for oxidation and moisture creates a suitable environment for oxidation. Increasing soil moisture increases soil microorganisms, soil mineralization processes and CO₂ releases from the soil as a chain, respectively (Rey et al., 2002). The rising moisture level of the soil due to irrigation or precipitation results in the mineralization of more organic matter by soil microorganisms, resulting in increased CO₂ releases from the soil (Sainju et al., 2010). On the contrary, soil microbial respiration is reduced due to low soil moisture and therefore the amount of CO₂ release from the soil is also limited (Griffis et al., 2004). The changing moisture balance in the soil with irrigation changes the components of the soil carbon balance by affecting the microbial processes that regulate the carbon cycle of the soil (Karlawsky et al., 2018). Adequate moisture condition in the soil refers to the regular and stable state of microbial activities (Yu et al., 2014).



It has been stated that CO₂ release from the soil reaches its peak when the pores that provide water retention in the soil are completely filled with water (Hou et al., 2016). Akbolat and Senyigit (2012) in their study, which examined the CO₂ releases from the soil irrigated with different irrigation water levels, reported that the CO₂ release from the soil decreased with the decreasing irrigation water level and that this decrease was due to the limitation of soil microbial population growth with less soil moisture.

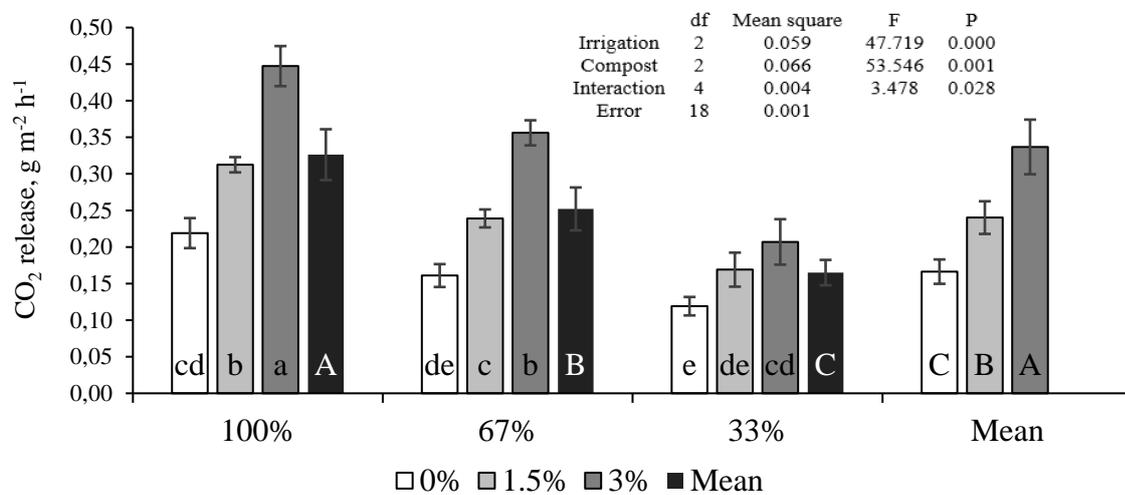


Figure 3. CO₂ release at different hazelnut husk compost doses and irrigation water levels (While 100%, 67%, 33% represent irrigation water levels, 0%, 1.5%, 3% indicate hazelnut husk compost doses)

4. CONCLUSION

This study investigated the effects of irrigating the soil with varying doses of hazelnut husk compost applied as an organic matter additive on soil temperature and H₂O and CO₂ releases from the soil by following the soil wetting-drying cycle. The results of the study showed that increasing doses of hazelnut husk compost decreased H₂O releases from the soil and increased CO₂ releases, but the effect of hazelnut husk compost applications on soil temperature was insignificant, and also, the deficit irrigation regime decreased the H₂O and CO₂ releases from the soil but increased the soil temperature.

Hazelnut husk compost contributes significantly to many physical, chemical and biological processes in the soil by increasing the water holding capacity of the soil with its organic matter content but due to the mineralization of the organic carbon it contains, it increases the threshold value of the global warming risk as a result of causing CO₂ release when combined with oxygen.



However, since it was determined as a result of this study that this negative effect can be reduced with deficit irrigation regimes, it was concluded that hazelnut husk compost application to the soil under the deficit irrigation regime can be used as an approach to reduce CO₂ releases and it could be recommended as an environmentally friendly agricultural activity program for controlling soil moisture.



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EXPLORING THE EFFICACY OF MACHINE LEARNING IN AGRICULTURE: AN EXPLICIT APPROACH

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ABSTRACT

The impact of computational intelligence on agriculture can in no way be under estimated. A subset of artificial intelligence, namely Machine learning (ML) is systematically unfolding its potentials in finding long lasting solutions to the multi-dimensional challenges in the sphere of agriculture. Machine learning is one of the dominant technology used for computational analysis of data obtained quantify, monitor and predicts agricultural products. This paper is a descriptive survey of efficacy of Machine Learning in the agriculture sector. The paper discussed is focused on machine learning and its applications. The paper also highlighted some of the importance of using machine learning techniques in agriculture. In order to collect useful data for the paper discussion, relevant questions were drafted and administered to respondents using online Google form questionnaire instrument. The responses collected were subjected to reliability analysis. Conclusively, the paper inferred that machine learning applications in agriculture have the potentials that provide more effective ways of managing agricultural products for improved data analysis and future predictions.

Keywords: Computational Intelligence, Machine Learning, Agriculture.



INTRODUCTION

Computational intelligence and machine learning techniques are now widely adopted to cope with the several challenges in modern agricultural. According to Lampridi, et al. (2019), the digitalization of agricultural practices has great potentials to assure maximal productivity, sustainability, and safe farming environment. Machine learning (ML) is systematically unfolding its potentials in finding long lasting solutions to the multi-dimensional challenges in the sphere of agriculture. It is one of the key technology used for the prediction of real time data and predictions in agriculture. (Oguntunde et al., 2018). Technology enhanced farming is generally based on four dominant pillars that could help deal with pending needs which includes i) conservation of the ecosystem, ii) optimal natural resources' management, iii) development of adequate services, and iv) utilization of modern technologies.

RELATED LITERATURE

Helm, et al. (2020), state that machine learning (ML) is a subset of artificial intelligence. Findings according to Evstatiev, et al. (2020), establish that the conventional data processing techniques are not meeting up with the increasingly growing demands of modern agriculture. The enumerable challenges of modern farming including natural resources depletion (Nassani, et al., 2019), climate changes (Thayer, et al., 2020), and alteration of dietary choices (Conrad, et al., 2018), safety and health concerns (Benos, et al., 2020). According to Goap et al., (2018), the technique in Machine Learning (ML) is a novel approach that have potentials that could reduce environmental pollution, reduce cost, minimal resources consumption and invariably improve crop production through Crop yield predictions. Khaki et al., 2020) further state that remote sensing could be done using drone air-born, picture, video and satellite multispectral scanning to enable efficient weed management in crop production.

Machine learning applications in agriculture

Modern technology including the use of computational intelligence based on remote monitoring and enhances predictions using Machine Learning (ML) technique could help improve agricultural practice in the unlisted areas:-

1. Soil Management:

Traditional soil assessment methods are considerably expensive and require a great deal of time and effort. However, soil mapping sensors and remote sensing can provide low cost and effortless solution for improved soil management.



2. Crop Management:

The use of advanced techniques to manage crops including weed detection, disease detection, crop quality, crop recognition and yield prediction can help increase farm productivity and returns.

3. Water Management:

Interestingly, the rapid depletion rate aquifers calls for more effective water management to ensure better conserving water for sustainable crop production. Precision agriculture offers the potential of variable rate irrigation so as to attain water savings and realizable irrigation implementation.

4. Livestock Management:

In precision livestock farming, models are developed that are capable of relying on causal relationships, defining the manner a biological system operates and exploiting the biological awareness towards generating predictions and suggestions. This is becoming an integral part of modern livestock farming.

Benefits of machine learning in agriculture

Some of the benefits of Machine learning in Agriculture are listed below:

Water and Irrigation:

Water management and irrigation are significantly essential in agriculture. Machine learning is very helpful in undermine the moisture requirement of crop farming.

1. Suitable time for crops:

Machine learning technique can help farmers to predict and forecast the right timing for cropping and the right season match for the planting of such crop.

2. Crop Yield Patterns:

Machine learning can aid cropping performance using computational gadgets to gather relevant data of past performance and appropriately apply precautions that can aid better crop production.

3. Farm animals:

Machine learning technique is very useful in keeping farm animals healthy through regular monitoring and estimating of the health condition of these animals.

4. Agribots:

The high cost of employment of laborers for harvest time and overall agricultural process is alarm. This cost can be reduced as agribots can be used to estimate the time when you will need labors on the field thereby minimizing the overhead cost.

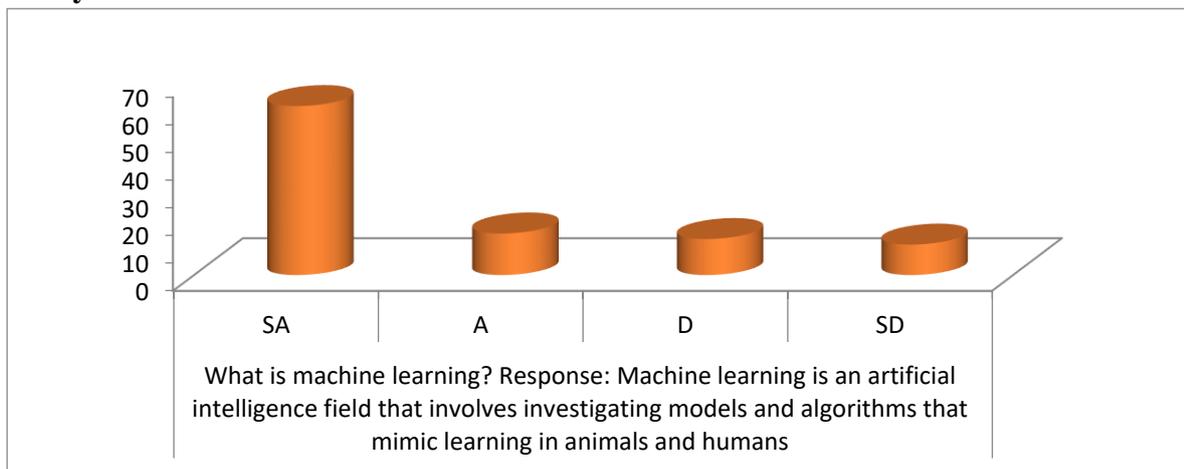


MATERIALS AND METHODS

This paper adopted a descriptive survey approach on machine learning and its applications. The paper discussion was based on selected Machine learning techniques. In order to be able to gather valid data that could be helpful in the paper discussion, drafted copies of questionnaires were administered to respondents using online Google form questionnaire instrument. The responses gathered were subjected to Cronbach's alpha reliability analysis. The result of 0.85 gave a good reliability index of the instrument. The entire exercise took place within 56 days before completion.

RESULT AND DISCUSSION

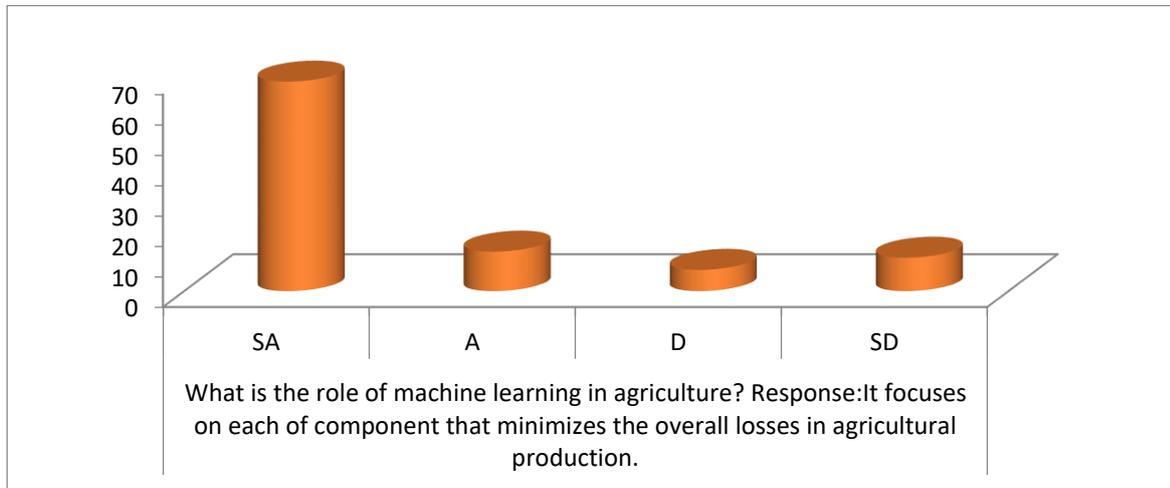
Analysis chart 1



The graph plotted in fig.1 clearly that a very high number of the correspondents denote that machine learning is a subset of Artificial intelligent that involves the use of models and sets of algorithms to mimic learning in animals and humans. The respondents explain that the technology make use of computer systems that are able to learn and adapt without explicit follow-up of specific instructions from any model or algorithms before drawing inferences.

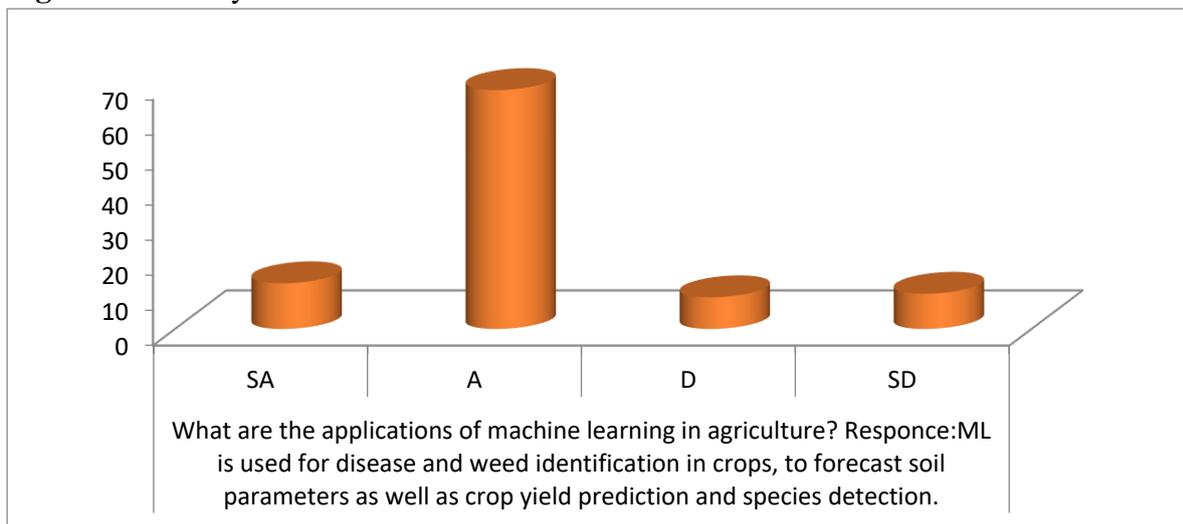


Fig. 2. Chat Analysis



The responses in fig. 2 depicts that a greater of the respondents concur with the statement that ML focuses on the agricultural component that minimizes the overall losses in agricultural production. The respondents explain further that machine learning is used In pre-harvesting to capture the parameters of soil, fertilizer application, seeds quality, pruning, irrigation, genetic and environmental conditions.

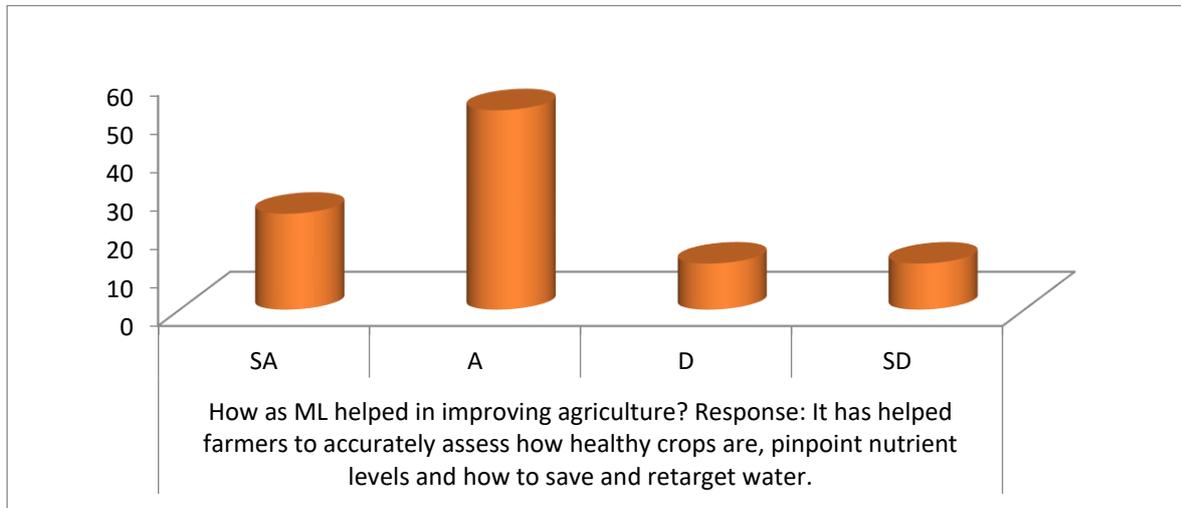
Fig. 3. Chat Analysis



The graph plotted in fig.3, shows that a significant number of the respondents denote that ML is used to forecast soil parameters, crop yield prediction and specimen detection. The respondents further outlined the applications of ML in agriculture to include: crop monitoring systems, automated irrigation systems and agricultural drones for field analysis.

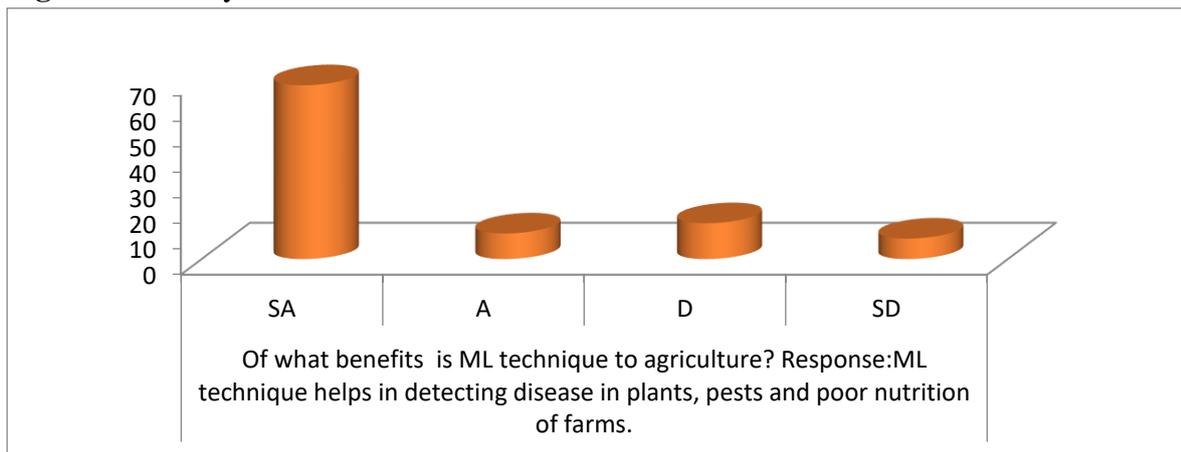


Fig.4. Chat Analysis



The chat analysis in fig. 4 shows that a higher number of the respondents agree with the statement that ML has helped farmers to accurately assessing the nutrients and health level of crops. It also help to save and retarget water usage level. According to the respondents, ML technology has helped in the detection of disease in plants, pests and poor nutrition of farms.

Fig.5. Chat Analysis



A larger number of the respondents in the graph plotted in fig.5 agree with the statement that ML technique helps in detecting disease in plants, pests and poor nutrition of farms. ML algorithms can be used to help detect weeds and then decide which herbicide to apply. The usage of herbicides is hereby reduced in this scenario and the money spent is also minimized.



CONCLUSION

This paper discussion is based on Machine learning concepts. The paper carefully examined how Machine learning techniques are applicable in Agriculture and some of the benefits of applying Machine learning in the sphere of Agriculture. The paper affirmed that machine learning applications in agriculture have the potentials that provide more effective ways of managing agricultural products for improved data analysis and future predictions.



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ÇİFTLİK HAYVANLARI YETİŞTİRİCİLİĞİNDE REFAH VE STRES KAVRAMI

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ÖZET

Çiftlik hayvanlarında refah kavramı 20.yüzyılın ikinci yarısından sonra endüstriyel hayvan üretimi hakkındaki bilimsel verilerden ve toplum kaygılarından ortaya çıkmıştır. Başlangıçta, refah kavramı hayvanlar üzerinde stresin varlığı veya yokluğu temeline dayandırılmıştır. Hayvan refahını, bir hayvanın doğal ortamında gösterdiği davranışları (otlama, beslenme, barınma güneşlenme, gölgelenme, gezinme, eşinme, yüzme, eşe kur yapma, yavru emzirme, yavruyu koklama, yalama, çiftleşme, sürü halinde bulunma vb.) özgürce yapabildiği, hislerini, duygularını özgürce yaşayabildiği, ağrısız, acısız (sağlıklı), midesini metabolizmasına uygun türden besinlerle doyurabildiği, susuzluğunu temiz ve kolayca giderebildiği bir yaşam sürdürülebilirliği durumu olarak tanımlamak mümkündür. Bununla birlikte hayvan refahının içeriği hakkında, özellikle hayvanın hisleri ve duyguları ile ilgili kesin veriler elde etmek mümkün olmadığından üzerinde mutabakat sağlanmış bir tanım bulunmamaktadır. Aynı durum stres için de söylenebilir. Stres, başlangıçta bir canlının hastalanması veya ölümüne neden olan çevresel ajanları ifade ederken, günümüzde canlının refahını etkileyen her türlü etmeni içeren bir anlam genişlemesi kazanmıştır. Bir hayvan, stres koşullarına maruz kalmadıkça veya refahını artırıcı şartlar sağlandıkça daha fazla ve daha kaliteli ürünler üretmektedir. Günlük besin kaynaklarımızın önemli bir kısmını temin ettiğimiz çiftlik hayvanlarının refah koşullarına ve etik değerleri göz önünde bulundurarak en ideal koşullarda barındırılıp, beslenmesi ve çoğaltılması ekolojik dengenin ve döngünün sürdürülebilmesi için de katkı sağlamaktadır. Hayvan refahı ile ilgili hassasiyette hayvan hakları savunucularının, küresel ısınmada çiftlik hayvanlarının atmosfere saldığı metan vb. gazların etkileri öne sürülerek oluşturulan baskılar, hayvansal ürünlerin biyoteknolojik olarak üretilme gayretleri refah, stres ve sera gazı üretimi gibi kavramların hayvansal ürünlerin yerine ikame edilmeye çalışılan ürünler için bir pazar payı oluşturma kaygısı taşıyıp taşımadığı endişesini beraberinde getirmektedir. Hayvan refahı üzerindeki hassasiyette, insanın kendi türü hakkındaki hassasiyetinden daha fazla önem kazandığı bir dönemde yaşamaktayız. Yakın gelecekte çiftlik hayvanı yetiştiriciliğinde refahla ilgili standartların ve etik kuralların yerine getirilmesi için, işletme sahiplerinin üretim koşullarında önemli değişiklikler yapması gerekeceği öngörülmektedir. Çiftlik hayvanlarının yer aldığı çalışmaların sonuçlarının yayımlanmasında da etik raporların gerekliliği bu konudaki duyarlılığa dayanmaktadır. Bu çalışmada hayvan refahını etkileyen faktörler ve refah koşullarını belirleyen yöntemlerin güncel gelişmeler ışığında ele alınması amaçlanmıştır.

Anahtar Kelimeler: Hayvan Refahı, Stres, Hayvansal Gıda, Üreme, Kalite



THE CONCEPT OF WELFARE AND STRESS IN FARM ANIMAL RAISING

ABSTRACT

The concept of welfare for farm animals emerged from scientific data and social concerns about industrial animal production after the second half of the 20th century. The concept of welfare was initially based on the presence or absence of stress on animals. Animal welfare is an animal's behaviour in its natural environment (grazing, feeding, sheltering, sunbathing, shading, walking, petting, swimming, courting the mate, suckling the cub, smelling the baby, licking, mating, being in a herd, etc.), and a state of being able to live a life in which can live freely, without wound, without pain (healthy), saturate his stomach with foods suitable for his metabolism, and quench his thirst cleanly and efficiently. However, since it is impossible to obtain precise data on animal welfare content, especially animal feelings, and emotions, there is no agreed definition. The same can be said for stress. While stress was initially meant to refer to environmental agents that cause illness or death of a living thing, today, it has gained an expansion of meaning that includes all factors that affect the welfare of the living thing. An animal produces more and better-quality products as long as it is not exposed to stress or conditions that increase its well-being. Considering the welfare conditions and ethical values of the farm animals, from which we provide a significant part of our daily food resources, they are housed, fed, and reproduced in the ideal conditions, contributing to the sustainability of the ecological balance and cycle. The pressures created by animal rights defenders in sensitivity to animal welfare, the effects of gases such as methane released into the atmosphere by farm animals in global warming, the efforts to produce animal products biotechnologically, the concepts such as welfare, stress, and greenhouse gas production create a market share for products that are tried to be substituted for animal products. It brings with it whether there is a concern to create or not. We live in a time when sensitivity to animal welfare is more important than human sensitivity to his species. It is foreseen that in the near future, business owners will have to make significant changes in production conditions to fulfil the welfare standards and ethical rules in livestock breeding. The necessity of ethical reports in publishing the results of studies involving farm animals is based on sensitivity. This study aims to discuss the factors affecting animal welfare and the methods determining welfare conditions in light of current developments.

Keywords: Animal Welfare, Stress, Animal Food, Reproduction, Quality



1. GİRİŞ

Dünyadaki değişim ve gelişmelerin insan hayatına olan her türlü etkisi (sosyal, kültürel, ekonomik, iletişim araçları, vb.) ile insanların diğer canlılara karşı hassasiyetleri ve dolayısıyla hayvan refahına olan ilgileri artmıştır. Hayvan refahı ile ilgili hassasiyetin 1960'lı yıllardan sonra başladığı bildirilmesine rağmen, asırlar önce, kutsal metinlerde hayvan refahı ve hakları ile ilgili metinler (Aghwan vd., 2016, Farouk vd., 2016) yer almaktadır. Son 25-30 yıldan beri hayvan refahı konusunda toplumsal bilincin artması, hayvan refahı ve hayvan hakları konusunda örgütlenmelerin yaygınlaşması, güvenilir gıda konusunda hassasiyetin artması, yasal düzenlemelerin güncellenmesi ve kapsamının genişlemesi bakımından önemli aşamalar kaydedilmiştir (Dawkins, 2006; Vilas-Boas vd., 2022).

Yeryüzünün hâkimi olan insanoğlunun hayvan hakları ve hayvan refahı üzerindeki değerlendirmesi, bireylerin dini inancına, kültürüne, bilgi birikimine ve kişisel tecrübelerine göre değişmektedir. Bu nedenle hayvan hakları ve hayvan refahı üzerinde uzlaşma sağlanmış bir tanım bulmak zorlaşmaktadır. Uluslararası sanayileşmiş et üretim sistemleri içinde hayvan refahı ahlaki, ekonomik, politik, kültürel, bilimsel ve dinsel olmak üzere çok yönlü ve disiplinler arası bir konu durumundadır (Vilas-Boas vd., 2022; Beaver ve Golab, 2023).

Hayvan refahı tanımının, konuyla ilgilenenlerin uzmanlık alanına göre değiştiği görülmektedir. Örneğin, etologlar ve ekolojistler refahta davranışsal yönler daha fazla ağırlık verirken zooteknistler verimliliğin yüksekliğine, fizyologlar stresin yokluğuna ve veteriner hekimler hastalığın yokluğuna odaklanmaktadır (Fraser vd., 2013). Nicks ve Vandenheede (2014), hayvan refahında hayvanların zihinsel durumları ile evcilleştirmeye uyum sağlama yetenekleri üzerinde durmaktadırlar. Dünya Hayvan Sağlığı Örgütü (WOAH, 2018; Wickham vd., 2012) hayvan sağlığını, hayvanların sadece hasta olmaması veya sakat olmaması değil, aynı zamanda hayvanların zihinsel ve fiziksel zindeliğinin sağlanması ve hayvanın sosyal durumunun da iyi olması şeklinde tanımlamıştır.

Hayvan refahının ilk gündeme geldiği 1960'lı yıllarda bu sözcük; tamamen hayvanlar üzerindeki stresin varlığı veya yokluğuna dayanarak tanımlanmıştır. Daha sonraki yıllarda hayvanların da duygulara sahip oldukları ve refahın iyi olması için fiziksel koşulların iyileştirilmesinin yanında duyguların da dikkate alınması gerektiğinin önemi vurgulanmıştır (Dawkins, 2006, 2008). Bir hayvan; sağlıklı, rahat, iyi beslenmiş, güvenli ve doğuştan gelen davranışlarını sergileyebiliyor ise, acı ve korku gibi hoş olmayan durumlardan mustarip değilse iyi bir refah durumuna sahiptir. Diğer bir ifadeyle iyi hayvan refahı; uygun barınma, yönetim ve besleme sağlanması, hayvanlara yönelik insanca muamele yapılması, hastalıkların



önlenmesi ile tedavisinin sağlanması ve insanca öldürme uygulamasını gerektirmektedir (Trevisi ve Bertoni, 2009; Mellor, 2012, 2015; Suárez vd., 2017). Bununla birlikte, hayvan refahı kavramı içinde özellikle besleme, çevre ve sağlık gibi bazı temel kavramlar genel olarak kabul görmektedir ve gelecekte hayvan refahı alanında elde edilecek muhtemel yeni bilgiler veya buluşlarla da uyumlu olmaya devam edecektir (Fraser ve Broom, 1990; Fraser, 2008; Hemsworth vd., 2015). Hayvan refahının tanımına ilişkin değişim, hayvanların özellikle mental ve duygusal yönlerinin keşfedilmesi ile süreceği öngörülmektedir (Beaver ve Golab, 2023). Hayvan yetiştiriciliğinde hayvan haklarına, hayvan refahına ve hayvanlara yaklaşımda ahlaki değerlendirmelerde özgürlük açısından beş husus üzerinde durulmaktadır. Bunlar; hayvanın temel ihtiyaçları olan yeme ve suya ulaşma, huzursuzluk, rahatsızlık, yaralanma, ağrı-acı ve hastalık gibi birçok normal davranışını ifade edebilme, korku ve stres koşullarına maruz kalmama, duygusal durumlarını gerçekleştirebileceği ortamın sunulması gibi hususların değerlendirilmesine dayanmaktadır.

Artan nüfus ve hayvanların otlama alanlarının daralması hayvansal ürün taleplerinin karşılanmasında birim hayvan başına daha fazla ürün almayı zorunlu kılmaktadır. Bu durum hayvansal üretimde entansifleşmeyi beraberinde getirmiştir. Entansif yetiştirmede, zorunlu olan kontrollü yetiştirme ve bunun için yapılan modern barınaklar hayvanların yabani atalarının sergiledikleri davranışları sergilemelerini kısıtlamaktadır (Wechsler, 2007; Ottersen vd., 2022). Bu nedenle hayvan refahı ile ilgili olan ve refah değerlendirmeleri olan kriterlerin değerlendirilmesinde dikkatli olmak gerekmektedir.

Hayvanlar, nasıl yetiştirildiklerine bakılmaksızın, insanlar için gıda ve giyim kaynağı olarak hizmet etmektedirler. Refah insanların hayvanlara sunduğu bir ihsan değil, hayvanın bir özelliğidir. Hayvanın refah durumu, insanın ona sunmuş olduğu koşullardan etkilenmektedir (Beaver ve Golab, 2023).

Hayvansal ürün tüketiminde doyuma ulaşmış, sanayilerini tamamlamış zengin ülkelerde hayvansal üretimin sera gazı salınımına, biyoçeşitlilikte kayıplara, su kirliliğine, ormanların tahribi gibi çevresel sorunlara ve aşırı kırmızı et üretiminin insanlarda kalp damar hastalıklarına, tip 2 diyabete ve bazı kanser türlerine yol açarak insan sağlığı üzerinde olumsuz etkiler oluşturduğu gerekçesiyle, hayvansal üretimin, dolayısı ile hayvan sayısının azaltılması yönünde söylemlerin (Grummon vd., 2023) yaygınlaştığı görülmektedir. Diğer yandan yapay et üretiminin geliştirilmesi ve yapay etin faydalarına övgüler (Zhang vd., 2022; Chriki ve Hocquette., 2020; Espinosa vd, 2020; Wilks ve Philips, 2017) düzülmektedir. Bu durum refah konusunun, atmosfere salınan sera gazı emisyonunda artış, sağlığa zararlı ürünler üretme gibi



çeşitli bahanelerle, hayvanların kesilmesinin insani olmadığı benzeri ajitasyonlarla istismar edilerek, doğal ürünler yerine yapay ürün pazarlarının ikame edilmesi kuşkusunu artırmaktadır. Hayvan refahı konusunun önemli ve yasalarla düzenlenmesi gereken bir konu olduğunda kuşku bulunmamaktadır. Kutsal metinlerde de hayvanlara iyi davranılması ile ilgili teşvik edici ifadelerin bulunması refah konusundaki hassasiyetin önemini ortaya koymaktadır.

Hayvanlarda refah konusu, insan refahı temel alınarak değerlendirilen bir konudur. Bu nedenle hazza dayalı (hedonik), ruhsal (iyi ruh hali ile ilgili, eudaemonic), sosyal ve bilişsel refah gibi insanlarda gruplandırılan refah biçimlerini (Williams, 2021) hayvanlar için tanımlamak ve ifade etmek ütopyik kaçmaktır. Hayvanlar insanlar gibi hallerini, duygu ve düşüncelerini doğrudan sözle ifade edemedikleri için onlarda refah düzeyinin belirlenmesi veya ölçülmesi subjektif kalmaktadır. Ancak kalp atış hızının, vücut sıcaklıklarının ve rektal sıcaklıklarının, belli bir süredeki solunum sayılarının ve endokrin seviyelerinin çeşitli koşullarda belirlenmesi hayvanların refahı konusunda bilgiler vermekte, bunun değerlendirilmesinde ise hata payı bulundurmaktadır. Hayvan refahı kavramına üç noktadan yaklaşılmaktadır; 1- Hayvanda olumlu durumun varlığı veya hayvanı etkileyen olumsuz durumun yokluğu, 2- Hayvanın sağlıklı ve fonksiyoner olması ve 3- Hayvanın doğal yaşam davranışlarını yerine getirebilmesi (Williams, 2021).

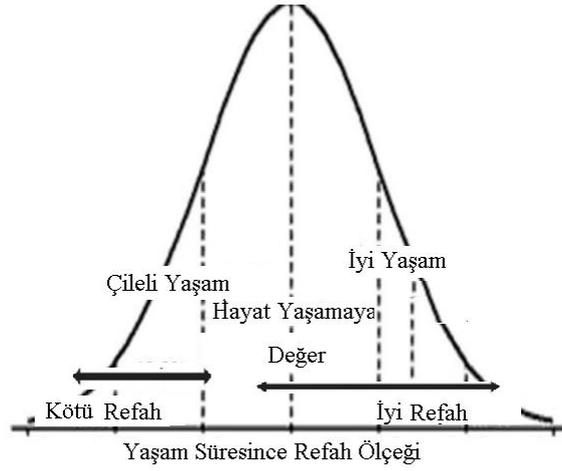
1.1 Hayvan Refahı Üzerinde Olumlu ve Olumsuz Stres Faktörleri

Stres genelde olumsuz bir anlam taşımaya karşın, çevrede meydana gelen tüm olumsuzluklara karşın tüm hayvanların kendi uyum mekanizmalarını kullanarak hayatta kalabilme mücadelesi (homeostasis) için kaçınılmaz bir tepki olarak değerlendirilmektedir (Mellor, 2012; Dhama vd., 2019; Cappelozza ve Marques, 2021). Bu değerlendirmeden, hayatın varlığı ve sürekliliğinin strese (mücadeleye) bağlı olduğu anlaşılmaktadır. Ayrıca, çevresel değişikliklerden kaynaklı strese tepki olarak, canlı organizmaların genetik yapısında meydana gelen değişimin (mutasyon, biyolojik ve genetik çeşitliliğin) kaynağını oluşturması muhtemeldir.

Hayvan insan etkileşimiyle oluşan dostluklar ve duygusal bağlarla, birkaç hayvanın bir araya gelerek oluşturdukları gruplardaki bağlar, hayvanların beslenme aralıklarında oluşan seslerle kurdukları bağlantıların hayvanlar üzerinde pozitif bir stres oluşturduğu var sayılabilir. Özellikle bazı küçük aile işletmelerinde, sağılan bazı dişi hayvanların (inek, manda) sağım için belli kişiye izin vermesi, bir köpeğin sahibini görünce ona koşup sevgi gösterilerinde bulunması pozitif stres için örnek verilebilir. Negatif stresin ortaya çıkmasında; yeni girilen bir barınak, yeni girilen bir sosyal topluluk, beklenmedik ses, yem kısıtlaması, su kısıtlaması, güneş tutulması, yırtıcı bir hayvanla karşılaşmak gibi durumlar etkili olmaktadır.



Bir hayvanın yaşamı; ya refah durumunun en iyi olduğu bir konfor (hayat yaşamaya değer) bölgesinde, ya bu bölgenin sağına doğru iyi yaşam, iyi refah bölgesinde ya da konfor alanının soluna doğru çileli yaşam veya kötü refah bölgesinde geçmektedir (Şekil 1). Bir hayvan, yaşamı boyunca bu bölgelerin her birinde bulunmuş olabilir. Bu bölgeler refah üzerinde etkili olan her bir stres faktörü için düşünülebilir.



Şekil 1. Yaşam süresince karşılaşılabilen refah durumları

Burada ortalamadan sağa doğru gittikçe refah üzerinde pozitif, sola doğru gittikçe negatif bir etkiden bahsedilebilir. Ancak hayvanlara sunulan çok aşırı şartlar örneğin beslemede hayvanın ihtiyaçlarını dikkate almadan yapılan dengesiz ve aşırı yemleme hayvan sağlığının bozulmasına ve refah düzeyinin bozulmasına neden olacaktır. Hayvanlarda gözler, kulaklar, burun ve derideki duyu alıcıları gibi "dış alıcılardan" gelen duyuşal girdiler, olumlu ve olumsuz duygusal durumların oluşmasında görev alırlar (Panksepp 2005; Denton vd.,2009). Pozitif etkiler arasında rahatlık, merak ve oyun oynama duyguları yer alırken, negatif olanların ise panik, depresyon ve yalnızlık duygularını içerdiği bildirilmektedir (Panksepp, 2005; Boissy vd., 2007; Yeates ve Main, 2008). Yüksek veya düşük düzeyde çevresel uyarımla veya aynı ya da başka türlerin üyeleriyle iyi huylu, hoş, çekişmeli veya tehdit edici etkileşimlerle ilgili bir dizi durumsal algı ortaya çıkarılabilir.

Avrupa'da hayvan refahına duyarlılığın yüksek (%95) olduğu, ama geliştirilen hayvansal üretimde hayvan refahına düşen payın düşük olduğu, bunun için örnek olarak Almanya için verilen değerlendirmede koyunculukta organik üretim payının düşük (%5,2) olduğu ve bunun da hayvan refahı ile ilgilendirildiği anlaşılmaktadır (Gross vd., 2021). Tamamen meraya dayalı yetiştiriciliğin hâkim olduğu Asya ve Afrika kıtalarında kuraklık ve yeterli beslenme koşullarının olmaması, refah şartlarına uymamaktadır.



2. HAYVANLARDA REFAH DÜZEYİNİ BELİRLEME YÖNTEMLERİ

Hayvanların refah düzeyleri, stres oluşturan faktörler tarafından etkilenmektedir. Hayvanlarda stres oluşturan faktörlerin etki süreleri; yerleşik (kronik, sürekli), aralıklı ve şiddetli (akut) olarak adlandırılırken stres oluşturan faktörler ise; fiziksel (boynuz kesme, boynuz köreltme, yaralanmalar, kavgalar, kastrasyon, kuyruk kesme, hayvanların kesim biçimleri vb.), psikolojik (sütten kesme, yeni bir çevre, yeni bir sürüye karışma vb.) ve fizyolojik (psikolojik veya fiziksel stres nedeniyle ortaya çıkan endokrinolojik ve metabolik değişiklikler) faktörler şeklinde sayılamayacak kadar çoktur ve stres hayvancılık işletmelerinin kaçınılmaz bir sorunudur (Arfuso vd., 2022; Kumar vd., 2023).

WOAH (2018) hayvan refah düzeyini; refah üzerinde etkili olan stres faktörlerinin ortaya çıkardığı fiziksel, fizyolojik, duygusal ve zihinsel durum, kaçınılan davranışlar, hayvanın biyokimyasal durumu, sosyal veya fiziko-kimyasal uyarılara tepkilerle ölçülebildiğini bildirilmektedir.

Bir hayvanın refah düzeyinin iyi olup olmadığı, stres faktörlerinin oluşturduğu değişimlerin tespitine dayanılarak belirlenebilmektedir. Bununla birlikte hayvanlarda iyi ve kötü refahın nasıl belirleneceği temel sorunlardan biri olarak durmaktadır (Paul vd., 2022).

2.1. Stres Hormonları Düzeyinin Belirlenmesi

Sempatik sinir sistemi ile böbrek medullası arasındaki fizyolojik ilişki ve hipotalamus-hipofiz-böbrek (HPA) eksenindeki iletişim, algılanan stres faktörlerine karşı tepki olarak böbrek üstü bezesinden salgılanan katekolaminler (adrenalin, epinefrin ve nöroadrenalin- nöroepinefrin) ve kortisol (glukokortikoidler) farklı fizyolojik değişimlere ve anlık davranışsal değişimlere neden olmaktadır (Kumar vd., 2023). Stres faktörlerine karşılık hipotalamustan salgılanan kortikotropin salgılatan hormon (CRH), böbrek üstü bezelerden salgılanan hormonlar değişen çevre koşulları altında bir hayvanın yaşama gücünü artırmak için uygun enerji üretimi ve metabolizmayı dengede tutmada görev almaktadır (Sheng vd., 2021). Akut veya uzun süreli strese verilen fizyolojik tepkilerinin araştırılması, rutin olarak hipotalamus-hipofiz-adrenal (HPA) ekseninin aktivitesinin bir göstergesi olarak kılda, dışkıda, tükürükte ve kan örneklerindeki kortizol ölçümü ile yapılmaktadır (Heimbürge, 2019).

2.2. Biyolojik Stres Belirteçleri

Biyolojik stres belirteçleri çeşitli biyolojik süreçlerin muhtemel işaretçilerdir ve objektif olarak belirlenebilmektedirler (Dhama vd., 2019). Kalp atış oranı, rektal sıcaklık, solunum sıklığı gibi değişik fizyolojik parametreler yaygın olarak gözlemlenen çevresel, sosyal ve psikolojik



biyolojik stres işaretleridir (Carboni, 2013). Rektal sıcaklık, fizyolojik durumun önemli bir ölçüsü ve hayvanlarda stresin değerlendirilmesi için ideal bir gösterge olarak kabul edilmektedir. Artan ortam sıcaklığında, mandalarda tropikal sığırlara göre rektal sıcaklık ve cilt sıcaklığının çok daha fazla dalgalandığı bildirilmiştir (Ganaie vd., 2013). Sıcak stresi sırasında ineklerde (El-Masry ve Marai, 1991) ve manda buzağlarında (Koubkova vd., 2002) plazma albumin seviyelerinde önemli bir artış bildirilmiştir.

Stres ve buna bağlı olarak refah düzeyindeki olumsuzlukların; hayvanlarda rektal sıcaklık ve vücut sıcaklığını arttırdığı (Arfuso vd., 2022), yemden yararlanmayı azalttığı (McManus vd., 2020), besi hayvanlarında günlük canlı ağırlık artışı ve besi sonu canlı ağırlığı düşürdüğü, süt verimini azalttığı (Tao vd., 2020; Adriaens vd., 2021), üreme performansı üzerinde olumsuz etkiler yaptığı (Polsky ve von Keyserlingk, 2017) ve et pH'sını etkileyerek (Cam vd., 2021) et kalitesini etkilediği bildirilmektedir.

3. SONUÇ

İnsanoğlunun yeryüzünde yaşamaya başladığı ilk andan günümüze kadar ve ilerleyen süreçte de beslenmemizde, giyimimizde, ulaşımımızda, zaman zaman duygusal bağlar da kurabildiğimiz hayvanlara, fizyolojilerine en uygun en ideal koşullarda refah içerisinde yaşayıp barınabileceği bir ortam sunmak vefa borcumuzdur. İçerisinde bulunduğumuz ekosistem bir denge üzerine yürümektedir. Bir canlının yaşaması bir diğer canlının yaşamasına bağlıdır. Sistemde bir zincirin kırılması, dengeyi bozmaktadır. Hayvanlar, insanlara çeşitli alanlarda hizmet sunan bir kaynak olarak yetiştirilmektedir. Yetiştirme şartlarının onların refah düzeylerinin ideal şartlarda gerçekleştirilmesi durumunda ürettikleri hizmetlerin ve ürünlerin kalitesi de artmaktadır.

Hayvanların refah durumlarını etkileyen stres faktörlerinin tamamen ortadan kaldırılması mümkün değildir. Çünkü hayvanların refah düzeylerini iyileştirmek için yapılan aşılama, ilaçlama, tırnak bakımı, kırkım, birbirlerine zarar vermemeleri için yapılan gaga kesimi gibi uygulamalar da bir stres kaynağıdır. Bununla birlikte, hayvan sağlığı ve yetiştirme açısından olumsuzluk oluşturacak durumların önlenmesine yönelik uygulamalar dışında, stres oluşturacak faktörleri mümkün olduğunca en aza indirebilecek önlemlerin alınması hayvan refahına, hayvanlardan elde edilen ürünlerin miktar ve kalitelerinin artmasına olumlu katkılar sağlayacaktır.



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EVALUATION OF DROUGHT TOLERANCE IN PEANUT VARIETIES ACCORDING TO DROUGHT STRESS INDEXES AND COMPARISON OF THE INDEXES

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ABSTRACT

Arid and Semi-Arid regions of the world are adversely affected by drought. These effects are especially seen in agricultural sector. Since drought negatively limits vegetative production, cultivating drought-tolerant varieties in these regions also reveals necessity of deficed irrigation. Various indexex have been developed to measure drought tolerance of plants. Most of these indexex consist of evaluating yield values of treatments in which plant does not suffer from water stress and water stress is applied according to various mathematical formulations. In this study, YI (Yield Index), HM (Harmonic Mean), Yr (Yield Reduction Ratio), MP (Mean Productivity), YSI (Yield Stability Index), GMP (Geometric Mean Productivity), TOL (Tolerance Index), SSI (Stress) Susceptibility Index), STI (Stress Tolerance Index), K₁STI (Modified Stress Tolerance), K₂STI (Modified Stress Tolerance) including 11 drought stress indexex and 2 varieties of peanuts were studied. Among the peanut varieties that are subject of the study, NC-7 is for snack and Florispan is for oil. The study was carried out in Kahramanmaraş Eastern Mediterranean Transition Zone Agricultural Research Institute in 2020. Irrigation was applied full irrigation and 75% lacking of full irrigation. Indexex were calculated using the yield values obtained. At the end of the study, there was no statistical difference for both plants. However, it was understood that NC-7 (0.54) variety was more drought tolerant than Florispan (1.36) in SSI index. Among indexex, there was a positive



correlation between MP and HM (0.95), a positive correlation between GMP and HM, MP (0.99), a positive correlation between TOL and Yr (1.00), a negative correlation with YSI (-1.00), and a positive correlation between SSI and TOL and Yr (1.00).), negative correlation with YSI (-1.00), positive correlation between SSI and YI, HM, MP, GMP (0.93, 0.92, 0.79, 0.86, respectively), positive correlation between K₁STI and MP, GMP and TOL (0.88, 0.8, respectively). and 0.83), positive correlations were found between K₂STI and YI, HM and STI (0.99, 0.8 and 0.94, respectively). It has been understood that indexes with positive correlations show similar trends in predicting drought. In particular, lower value of NC-7 compared to Florispan in SSI showed that it was more tolerant, and that Yr and TOL indexes, which were positively correlated with SSI, had similarly lower values. This shows that the SSI index is most accurate index in predicting drought, while Yr and TOL indexes with positive correlations are also indexes that can be used to determine drought-tolerant varieties.

Keywords: Deficit Irrigation, Florispan, NC-7, drought tolerance



Introduction

One of the important events caused by global climate change is drought. It is defined as a type of natural disaster that can recur, spread over one or more seasons, occur due to decreasing precipitation and increasing temperatures, and affect all natural resources depending on the presence of water. However, due to global climate change, excessively increasing temperature and decreasing precipitation in the world increase the continuity and possible negative effects of drought (Akbaş, 2014, Partigöç and 2019). Turkey has faced drought in the past, and it will be more dangerous in the future, as drought will occur more frequently and severely with global climate change in the near future. In general, all plants need soil, water and sunlight to grow. If one of them is insufficient or absent, the plant cannot complete its development (Özdemir and Aksoy, 2022).

What needs to be done for the crop production to be less affected by drought and for the continuity of production is to ensure the cultivation of varieties that are resistant to drought and limited irrigation. It is possible to find a wide variety of studies on the application of limited irrigation in many plants (Coyago-Cruz et al., 2019; Cheng et al., 2021; Liu et al., 2021; Tong et al., 2022). In addition, drought-resistant varieties should be grown for the continuity of plant production against the negative effects of drought. Thanks to these varieties, plant cultivation in Arid and Semi-Arid regions gives better results than other varieties. Various methods have been developed for the selection of drought tolerant plants. One of them is indexes developed according to various mathematical methods. Most of the developed indexes draw conclusions by considering the yield values of plants grown in arid and irrigated conditions.

Many researchers have used indexes such as STI, SSI, TOL, MP, GMP, YI, Yr, HM, YSI, K1STI and K2STI (Khalili et al., 2012; Khalili et al., 2014; Barutcular et al., 2016; Ullah. et al., 2019; Urechean et al., 2019; Hoelle et al., 2020; Khatibi et al., 2022; Memari et al., 2022; Ali et al., 2022). Tolerance indexes are used to select drought-resistant genotypes due to yield loss under arid conditions (Mitra, 2001; Anwar et al., 2011). Thanks to these indexes, drought tolerance of a genotype can be determined as well as its sensitivity to drought. The drought susceptibility of a genotype is seen as a function of yield reduction under water stress (Blum, 1988). Indexes developed to evaluate the drought resistance of genotypes are determined based on the mathematical relationship between stressful and non-stressful conditions (Sabaghina and Janmohammadi, 2014). Farshadfar et al. (2011) reported that the most appropriate indexes for determining drought tolerance in chickpea plants are MP, GMP, STI and MH. Golparvar (2000) showed a high correlation of GMP with STI and MP. Nouraein et al. (2013), STI index is



advantageous in identifying cultivars suitable for stressful and non-stressful conditions. Adhikari et al. (2019) considered varieties with high STI and low SSI and TOL in rice as resistant. According to Keten et al. (2019) showed that there is a significant positive correlation between SSI and MP, GMP, Yp, GMP, STI, TOL, and the applicability of HM, MP, GMP, STI, K1STI index in a cotton genotype under stressed and unstressed conditions. TOL and SSI values show a significant positive correlation with Yp, and a negligible correlation with Ys. Higher TOL and SSI values are associated with higher yields in both conditions, while lower TOL and SSI are associated with greater yield production under stress-free conditions (Singh et al., 2015; Karimizadeh et al., 2011).

Peanut is an important legume crop for producers in arid and semi-arid regions, and its seeds contain high amounts of oil (43-55%), protein (25-28%) and mineral matter (2.5%) (Abou Kheira, 2009). Peanut (*Arachis hypogaea* L.), an important oilseed plant in the world, is accepted as a source of oil, fatty acids, folic acid, protein and antioxidants (Sebei et al. 2013, Zahran and Tawfeuk, 2019; Beycioğlu et al., 2022). Peanut seeds contain 43-55% oil and 25-28% protein, depending on market types, along with essential mineral elements such as Na, Cu, Zn, Fe, Ca, Mg and K. In addition, peanuts (*Arachis hypogaea* L.) are a good source of vitamins E, K and B group, and because of these properties, peanuts (*Arachis hypogaea* L.) are an important food source for both humans and animals (Şahin et al. 2022). Peanut, which is used for many purposes with its snack and oil varieties, is a very important product in terms of food. However, its cultivation is limited in arid and semi-arid climatic regions. Therefore, in order for the peanut plant to be cultivated in these regions, it is necessary to develop and cultivate drought-resistant varieties.

The aim of this study is to determine the drought tolerance of two varieties, oil (Florispan) and snack (NC-7) in the province of Kahramanmaraş, which is located in the Semi-Arid climate region, and to suggest the cultivation of the variety suitable for the region according to the results obtained. Another aim is to show the index that best determines drought tolerance or sensitivity by using various drought stress indexes.

Material and Method

Experiment site, climate and soil characteristics

The research was carried out in the trial areas of the Eastern Mediterranean Transition Zone Agricultural Research Institute in 2020. The land where the experiment was conducted is 465 m above sea level; It is located between 37°55'08" North latitude and 36°55'09" East longitude. The climatic characteristics of the experimental area are given in Table 1.



Table 1. Some climatic values of peanut growing period

Months	Avg. Temperature (°C)	Avg. precipitation (mm)	Humidity (%)
June	25	4.1	48.4
July	30.5	0	44.6
August	29.5	0.5	39.7
September	29.1	0	40.5
October	23	0.5	39.1

Table 2. Physical properties of the soil of the study area

Year	Soil depth (cm)	Field capacity		Wilting point		Bulk density		Water holding capacity		Texture	Sand (%)	Clay (%)	Silt (%)
		Pw(%)	mm	Pw(%)	mm	(gcm ⁻³)	Pw(%)	mm					
2020	0-30	21.45	105.53	12.19	59.97	1.64	9.26	45.56	SiL	40.1	2.97	56.93	
	30-60	23.35	107.88	14.28	65.97	1.54	9.07	41.91	SiL	35.68	9.6	54.72	
	60-90	23.54	114.40	13.03	63.32	1.62	10.51	51.08	SL	50.7	9.8	39.5	

Table 3. Chemical properties of the soil of the study area

Salinity(%)	Organic material %	Calcitic CaCO ₃ (Kg/da)	pH
0.99	1.05	35.98	7.59
Saltless	Middle	Too Calcareous	Slightly alkaline

The average temperature value during the peanut growing period varied between 23 and 30.5°C. The monthly total precipitation decreased by 4.1 mm in June and 0.5 mm in August and October. When Table 2 is examined, the volume weight of the soil varied between 1.54-1.64 g cm⁻³. The total usable water holding capacity was obtained as 138.55 mm and 90 cm⁻¹. When Table 3 is examined, it is understood that the soils of the trial area are slightly alkaline, very calcareous and have moderate organic matter content.

Plant Material

In the experiment, NC-7 from the snack peanut varieties and Florispan from the oily peanut varieties were used. NC-7 was registered in 1991 by the Western Mediterranean Agricultural Research Institute. It is in semi-horizontal form and its leaf color is green, medium-sized. Average fruit yield is 400-450 kg/da, and the maturation period varies between 140-160 days (Boydak et al., 2019). Florispan variety is early, its seeds are round and light pink, its oil rate is 53-55% and it is an oily variety (Kadiroğlu, 2022).

Observations on irrigation

The same irrigation water schedule was applied to both peanut varieties. Irrigation applications Two levels of irrigation were applied: the non-stressed subject (full irrigation) where the entire plant water consumption was met, and the stressed subject (25% irrigation), which was 75% less than the irrigation amount applied to the unstressed subject. Irrigations were laid with a drip irrigation system, one lateral pipe for each row of peanuts. Dripper flow rate 4 l h⁻¹ and dripper spacing 25 cm, 16 mm lateral pipes were used. The irrigation interval varied between 4 and 6 days.



Drought tolerance index

11 drought stress indexes were used in the study. For these indexes, the yield values of the conditions without water stress and under water stress were used. While the conditions without water stress were taken from the yield values of the subject where full irrigation was performed, the conditions with water stress were obtained from the yield values of the subject of 25% where irrigation water was given as 75% of the water given to full irrigation. Equations of drought stress indexes are given in Table 4. While Y_p (unstressed subject) in Table 4 expresses the yield value obtained from the full irrigation subject, Y_s (stressed subject) shows the yield value obtained from the 25% subject.

Table 4. Equations of drought tolerance indexes

Index	Formül	Referance
Tolerance index (TOL)	$Y_p - Y_s$	Rosielle ve Hamblin, 1981
Mean productivity (MP)	$(Y_p + Y_s) / 2$	Rosielle ve Hamblin, 1981
Yield Stability index (YSI)	Y_s / Y_p	Bouslema ve Schapaugh, 1984
Harmonic Mean (HM)	$2(Y_p \times Y_s) / (Y_p + Y_s)$	Kristin ve ark., 1997
Yield reduction ratio (Yr)	$1 - (Y_s / Y_p)$	Golestani-Araghi ve Assad, 1998
Geometric mean productivity (GMP)	$\sqrt{(Y_s \times Y_p)}$	Kristin ve ark, 1997
Yield index (YI)	Y_s / \bar{Y}_s	Gavuzzi ve ark., 1997
Stress tolerance index (STI)	$(Y_p \times Y_s) / (\bar{Y}_p)^2$	Fernandez, 1992
Stress susceptibility indeks (SSI)	$(1 - Y_s / Y_p) / (1 - (\bar{Y}_s / \bar{Y}_p))$	Fisher and Maurer, 1978
Modified stress tolerance indeks, MSTI \rightarrow STI	$(Y_p)^2 / (\bar{Y}_p)^2$	Farshadfar ve Sutka, 2002
Modified stress tolerance indeks, MSTI \rightarrow STI	$(Y_s)^2 / (\bar{Y}_s)^2$	Farshadfar ve Sutka, 2002

Statistical Analysis

The LSD test was used to determine the differences in the analysis of variance in the evaluation of the differences between peanut varieties. The SAS program was used in the evaluation of statistical analyses.

RESULTS AND DISCUSSION

Average values of varieties and drought tolerance indexes are given in Table 5. According to the results obtained, there was no statistical difference between the varieties in any index. However, when the values were examined, it was understood that the NC-7 (0.54) variety was more drought tolerance than Florispan (1.36) in the SSI index. Because SSI value less than 1 indicates drought tolerance, and greater than 1 indicates sensitivity to drought (Singh et al., 2015; Baloch et al., 2011). Similarly, the fact that the GMP value of NC-7 cultivar was higher



than Florispan suggested that it was more drought tolerance than Florispan. Related to this, Singh et al. (2015) reported that cotton genotypes with high GMP may be drought tolerant genotypes. The fact that the YSI and HM values were higher in NC-7 than Florispan indicates that it is drought tolerant. Related to this, Keten and Değirmenci (2022) reported that the YSI value was higher in the sorghum plant in their study where they compared the drought tolerance of sorghum and maize plants, and therefore the sorghum plant was more resistant to drought than maize. Rad and Abbasian (2011) SSI value between 0.28 and 1.30, TOL value between 250 and 1732, MP value between 2625 and 3660, GMP value between 2622 and 3602, STI value between 0.51 and 0.83, YI value between 0.51 and 1.21, YSI value between 0.58 and 0.91 has found. Shrief et al (2020) found peanut genotypes to be high in STI, MP, GMP, and low in SSI and TOL.

In Figure 1, all index values of both peanut varieties except SSI are given. According to Figure 1, YI, HM, YSI, GMP, STI and K2STI, among 6 indexes other than SSI, were higher in NC-7, while the remaining Yr, MP, TOL, K1STI indexes were higher in Florispan. This suggested that cultivars with high index values may be more drought tolerant. However, the fact that the SSI index was lower than the other indexes showed that the NC-7 variety could be more tolerant than the Florispan variety due to its drought tolerance. However, in order to be able to decide with clearer expressions, studying these two varieties again in the same and other regions and comparing them with various indexes made us think that it would be more useful in terms of supporting the above statements.

Table 5. Value of drought tolerance indexes of varieties

Varieties	YI	HM	Yr	MP	YSI	GMP	TOL	SSI	STI	K1STI	K2STI
NC-7	1.09	434.54	0.15	438.99	0.85	436.75	79.22	0.54	0.85	0.90	1.20
Florispan	0.91	414.14	0.39	440.34	0.61	427.02	212.52	1.36	0.61	1.14	0.83

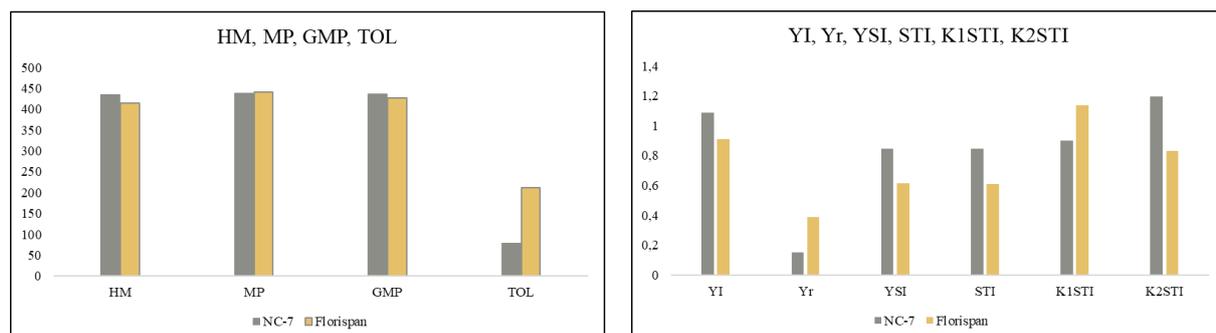


Figure 1. Comparison of peanut genotypes according to indexes



Correlation was made between tolerance indexes in order to determine the most appropriate one among the indexes and the relationship between the indexes. Correlations of drought tolerance indexes are given in Table 6. Positive correlation between MP and HM (0.95), positive correlation between GMP and HM and MP (0.99), positive correlation between TOL and Yr (1.00), and negative correlation with YSI (-1.00) among indexes, positive correlation (1.00) between SSI and TOL and Yr), YSI and negative correlation (-1.00), SSI and YI, HM, MP, GMP positive correlation (0.93, 0.92, 0.79, 0.86), positive correlation between K1STI and MP, GMP and TOL (0.88, 0.8, respectively).) and 0.83), positive correlations were found between K2STI and YI, HM and STI (0.99, 0.8 and 0.94, respectively). It has been understood that indexes with positive correlations show similar tendencies in predicting drought. In particular, the fact that NC-7 was lower in SSI than Florispan showed that it was more tolerant, and that the Yr and TOL indexes, which were positively correlated with SSI, had similarly lower values. This shows that the SSI index is the most accurate index to predict drought, and the positively correlated Yr and TOL indexes are indexes that can be used to identify drought-resistant varieties. Rad and Abbasian (2011) reported that SSI and MP and YSI indexes, TOL and GMP, STI and YI indexes were positively correlated, MP and YSI were negatively correlated, GMP was positively correlated with STI and YI, and STI and YI were also found in rapeseed. reported a positive relationship. Shrief et al (2020) reported that the yield under stress in peanut genotypes showed a positive correlation with TOL, MP and GMP. The results of the researcher agree with the results obtained in many aspects.

Table 6. Correlation coefficients of drought tolerance indexes

	YI	HM	Yr	MP	YSI	GMP	TOL	SSI	STI	K ₁ STI	K ₂ STI
YI	1.00										
HM	0.78	1.00									
Yr	-0.53	0.11	1.00								
MP	0.57	0.95**	0.40	1.00							
YSI	0.53	-1.10	-1.00**	-0.39	1.00						
GMP	0.68	0.99**	0.25	0.99**	-0.25	1.00					
TOL	-0.45	0.19	1.00**	0.47	-1.00**	0.34	1.00				
SSI	-0.51	0.12	1.00**	0.40	-1.00**	0.26	1.00**	1.00			
STI	0.93**	0.92**	-0.23	0.79*	0.23	0.86*	-0.13	-0.22	1.00		
K ₁ STI	0.12	0.71	0.77	0.88*	-0.07	0.80*	0.83*	0.78	0.43	1.00	
K ₂ STI	0.99**	0.80*	-0.50	0.59	0.50	0.70	-0.42	-0.48	0.94**	0.15	1.00



CONCLUSION

As a result of the precaution and improvements to be taken against the reality of facing drought, it is necessary to produce deficed irrigation and drought-tolerant varieties. Based on this requirement, the drought tolerance of two peanuts used in many food-related fields was evaluated. While there was no statistically significant difference between the cultivars, some relative differences were detected. These results suggested that NC-7, the snack variety, may be more resistant to drought than the oily variety Florispan. However, in order to be able to decide with clearer expressions, studying these two varieties again in the same and other regions and comparing them with various indexex made us think that it would be more useful in terms of supporting the above statements. Among the indexex, SSI was thought to be prominent compared to the others. The fact that NC-7 was lower in SSI than Florispan showed that it was more tolerant, and the Yr and TOL indexex, which were positively correlated with SSI, had similarly lower values. This shows that the SSI index may be the most accurate index to predict drought, and the positively correlated Yr and TOL indexex can be used to identify drought-tolerance varieties.



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ÖZET

Şeker, yüzyıllardır insanlığın önemli besin kaynaklarından birisi olmuştur. Şekerin (sakkaroz) en önemli bitkisel kaynakları şeker kamışı ve şeker pancarıdır. Türkiye’de şeker üretiminin hammaddesi şeker pancarıdır. Şeker pancarı üretiminde biyotik ve abiyotik birçok etmen çeşitli ölçülerde zararlar meydana getirmektedir. Bu biyolojik etmenlerden birisi olan Kalkan böcekleri şeker pancarı alanlarında başlıca zararlıları arasındadır. Şeker pancarı üretiminde önemli ekonomik kayıplara neden olan zararlının biyolojisi, tanımlanması uygun mücadelenin başlatılmasında büyük önem arz etmektedir. Şeker pancarı üretim alanlarında *Cassida* spp. (Coleoptera: Chrysomelidae) Kalkan Böcekleri zararlılarını ekonomik zarar eşiği altında tutmak için uygun mücadele yöntemleri değerlendirilmiştir. Bu çalışmada, şeker pancarı üretiminde zararlının biyolojik yaşam döngüsü, şeker pancarındaki zarar semptomları incelenmiştir.

Anahtar Kelimeler: Kalkan böceği, Şeker Pancarı, *Cassida* spp.



SUGAR BEET PESTS; CASSIDA SPP. BIOLOGICAL LIFE CYCLE OF (COLEOPTERA: CHRYSOMELIDAE)

ABSTRACT

Sugar has been one of humanity's most important food sources for centuries. The most important vegetable sources of sugar (sucrose) are sugar cane and sugar beet. In sugar beet production, many biotic and abiotic factors cause damage to various extents. Shield beetles, one of these biological factors, are among the main pests in sugar beet fields. The biology and identification of the pest, which causes significant economic losses in sugar beet production, is of great importance in initiating appropriate control. In sugar beet grown in Muş ecological conditions, *Cassida* spp. (Coleoptera: Chrysomelidae) Appropriate control methods have been investigated to keep Tortoise beetle pests below the economic damage threshold. In this study, the biological life cycle of the pest in sugar beet production and the damage symptoms in sugar beet were investigated.

Keywords: Tortoise beetle, Sugar Beet, *Cassida* spp.



1. GİRİŞ

İnsan beslenmesinde önemli bir enerji kaynağı olarak kullanılan bitkisel kaynaklı şeker, dünyada genel olarak şeker kamışı ve şeker pancarından elde edilmektedir. Dünya şeker üretiminin büyük bir kısmı şeker kamışından elde edilirken ikinci sırada ise şeker pancarı yer almaktadır. Şeker kamışı dünya genelinde tropik alanlarda yetiştirilirken şeker kamışının ekonomik olarak yetiştirilmediği alanlarda şeker üretimi şeker pancarından yapılmaktadır. Şeker pancarından ana ürün olan şeker üretiminin yanında yan ürünlerinden hayvan yemi, ispiroto üretimi gibi alanlarda yararlanılması gibi faktörler söz konusu bitkinin önemini artırmaktadır.

İhtiva ettiği yüksek enerji içeriği ile insan beslenmesinde önemli bir yeri olan şeker pancarı yaygın ve çeşitli kullanım alanları ile son derece önemli bir endüstri bitkisidir. Tarımının yapıldığı alanlarda Modern tarım tekniklerinin ve ileri düzey mekanizasyonun kullanılabildiği şeker pancarı, üretimi yapılan alanlarda geniş bir istihdam yelpazesi oluşturan stratejik bir bitkidir. Ülkemizde şeker pancarı yetiştiriciliğinde en uygun ekim alanları ülkemizin Orta Anadolu karasal iklim bölgesi ile Ege tipi geçit iklim bölgesidir. İklim faktörlerinin ekonomik bağlamda şeker pancarı üretimine elverişli olması ve buna bağlı olarak bölgede şeker fabrikasının bulunması gibi faktörler Muş ili tarım potansiyeli içerisinde şeker pancarını ekonomik önemi olan değerli bitkilerden biri yapmaktadır.

Ülkemizde 2019 yılında 18.05 bin ton olan şeker pancarı üretimi 2020 yılında artarak 23.02 bin tona yükselmiştir. 2019 yılında 3 milyon 13 bin da olan şeker pancarı ekim alanı 2020 yılında 3 milyon 38 bin da alana yükselmiş olup ekim alanındaki artış üretim ve verimi de olumlu etkilemiştir. Dekara verim ise yıllara göre değişmekle birlikte 2020 yılında 6.84 kg/da olarak kaydedilmiştir (Anonim, 2020a). Ülkemizde şeker pancarı üretimi, tarımı yapılan alanlarda üreticiler ve fabrikalar ile belirli sözleşmeler yapılarak kota düzenlemesi ile yapılmaktadır. Ülkemizde şeker pancarı tarımının yaygın olarak yapıldığı iller sırasıyla; ekiminin en fazla yapıldığı yerler %31,2'si Konya, %9,1'i Eskişehir ve %8,5 ile de Yozgat'tır (Anonim, 2020b). Diğer kültür bitkilerinde olduğu gibi şeker pancarı tarımında da verim ve kaliteyi etkileyen pek çok etmen vardır. Şeker pancarı üretiminde çeşit seçimi verim ve kaliteyi etkileyen en önemli faktörlerdendir. Üreticiler pancar kooperatifinin verdiği çeşitlerin yanı sıra piyasada satışı yapılan farklı pancar çeşitlerini de kullanmaktadırlar. Çeşit seçimi yapılırken; Bölgenin ekolojik yapısına uygun, hastalık ve zararlılara dayanıklı, çimlenme gücü yüksek, kök verimi ve şeker oranı fazla, sertifikalı ve güvenilir olmasına dikkat edilmelidir. Bu özelliklere sahip



çeşitler tercih edildiğinde doğru yetiştirme teknikleri ile verimli bir pancar tarımı yapılabilmektedir.

2019 yılı TUİK verilerine Muş ili 125.303 ton şeker pancarı üretimi ile Türkiye üretiminin yaklaşık olarak %0,7'sini oluşturmuştur. Havada nem miktarının fazla olması bitkide şeker miktarının düşmesine ve nemden kaynaklı özellikle fungal hastalıkların ve zararlı böceklerin yayılmasına neden olmaktadır (Er, 1988 ve Anonim, 1997). Şeker pancarında ürün verim ve kalitesini olumsuz etkileyen önemli stres faktörlerinden biri de zararlı böceklerdir. . Önemli şeker pancarı üretim bölgelerinden biri olan Muş ilinde de birim alandan elde edilen ürün miktarını ve kalitesini arttırmak için her geçen gün yeni çalışmalar yapılmaktadır. Bölgeyi için ekonomik bağlamda son derece önemli olan şeker pancarında ürün artışını olumsuz yönde etkileyen önemli faktörlerden biri olan zararlı böceklerdir. Bu zararlı etmenlerden birisi olan Kalkan böceği şeker pancarı alanlarında ana zararlılar arasında yer almaktadır. Şeker pancarı üretiminde önemli ekonomik kayıplara neden olan zararlının biyolojisi, tanımlanması uygun mücadelenin başlatılmasında büyük önem arz etmektedir. Bu çalışmada, zararlının biyolojik yaşam döngüsü, şeker pancarındaki zarar semptomları incelenmiştir.

2. KALKAN BÖCEKLERİNİN TANIMI VE BİYOLOJİSİ

Cassida sevaphina Men., *C. nebulosa* L., *C. nobilis* L. ve *C. viridis* L. Önemli kalkan böceği türleridir. *Cassida* erginleri 5 mm boyunda, dorsal kısmı açık, ya da koyu kahverengidir. Elitranın orta kısmı kenarları, baş şildinin ön kenarı açık sarı renktedir. Vücut kubbemsi ve karın tarafı düzdür. Thorax plakası ve elitralar vücudun 3 parça halinde kapatır. Larvalar krem ile açık kahverengi arasında, 6 mm boyundadır. Yanlarda 16 çift uzantı bulunur. Son abdomen segmentinde 2 adet vücudun üzerine doğru kıvrılmış kuyruk çatalı vardır. Atılan gömlek derileri bu çatalın üzerinde toplanarak vücut üzerinde toplanarak vücut üzerinde bir şemsiye şeklinde durur. Pupa yaprak üzerinde bulunur. Kahverengindedir. Yumurta sarımsı kahverengi bir salgı ile kaplanmış, küçük bir paketçik şeklindedir. Yumurtalar paket içerisinde sarı renkte ve 1,1.5 mm boyundadır (Şekil 1).



Şekil 1. Kalkan böceği ergini ve pupa çıkışı görünümü.

Erginler Mart-Nisan döneminde aktif hale geçerek beslenmeye başlar. Bir hafta içinde çiftleştikten sonra yumurtalarını koyar. Yumurta yaprak altına 6-16 adetlik paketler halinde bırakılır, paketlerin üzeri şeffaf bir salgı ile kapatılır. Bir dişi 200-250 yumurta bırakır, yumurta bırakma süresi 2 ay sürer. Erginler 2-3 ay yaşarlar. Erginler sıcak ve güneşli havalarda çok aktiftirler. Yumurta 8-10 günde açılır. Larvalar yaprağın alt kısmında beslenmeye başlar. 2,3 haftada 4-5 larva dönemi geçirerek gelişmeleri tamamlarlar. Yapraklarda pupa olurlar. Pupa dönemi 1-2 hafta sürer. Temmuz ortasında yeni dölün erginleri uçmaya başlarlar, kışı ergin halde, hareketsiz olarak, toprak tezekleri arasında, güneşli kuytu yerlerde veya orman kenarlarında geçirir. Yılda 1-2 döl verirler (Anonim, 2007).

3. KALKAN BÖCEKLERİNİN ZARAR ŞEKLİ

Oligofag zararlıdır. Esas konukçuları Chenopodiaceae ve Compositaea familyasından bitkilerdir. Ayrıca şeker pancarı önemli konukçuları arasındadır. Zararı veren ergin ve larvadır. Ergin ve larvalar, yaprak dokusunu yiyerek zarar verirler. Zarar gören yapraklar küçük deliklerden oluşan bir kalbur görünümünü alır, ağır zararda yaprak yalnızca damarlardan ibaret kalır. Ana zararı larvalar yapmaktadır. Yaprakların alt veya üst yüzeylerinde küçük yuvarlak (1-2 mm) yüzeysel yirik izleri görülür. İlk dönem larvalar yaprak üst epidermisinde beslenir ve alt epidermis kurumuş bir hal alır.

Zarar yoğunluğunun yüksek olduğu dönemlerde yapraklarda delikler oluşur ve yaprak dantel görünümünü alır. Son dönem larvalar ise yaprağı kenarlarından yemek suretiyle zarar yapar.

Popülasyonun yüksek olduğu durumlarda, pancar yapraklarının yalnızca damarları kalacak şekilde tamamen yiyerek veya yaprağın tamamen kurumasına neden olarak önemli oranda zarar meydana getirir.



Şekil 2. Kalkan böceği genel zararı.

4. SONUÇ VE ÖNERİLER

Kültürel önlem olarak tarla etrafındaki ve içindeki konukçu yabancı bitkilerin yok edilmesi önemlidir. Şekerpancarı mutlaka münavebe sistemlerinin uygulanması gereken bir üründür. Ülkemizde şekerpancarı üretim alanlarında zorunlu ekim nöbeti uygulaması yapılmaktadır. Aynı alanda 3-4 yılda bir şekerpancarı ekimi yapılabilmektedir. Şekerpancarı için; nohut, mercimek, fasulye, fiğ ve yonca gibi baklagil bitkileri; buğday, yulaf, arpa ve çavdar gibi serin iklim tahılları; kolza, ayçiçeği, aspir gibi yağ bitkileri; patates, mısır, kabak, lahana gibi bitkiler ekim nöbetine girebilecek uygun bitkilerdir. Tarlanın köşegenleri doğrultusunda hareket ederek zararlı yoğunluğu tespit edilir ve m²'de 20 ergin görüldüğünde kimyasal mücadele başlatılması önerilir. Kimyasal mücadeleye karar verilmeden önce doğal düşmanların durumunu ve diğer başlıca zararlıların durumunu bilmek önemlidir. İlaçlamalar sabah erken veya akşam saatlerinde, rüzgârsız bir havada, bitkinin her tarafı ilaçla kaplanacak şekilde uygulanmalıdır.



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ÖZET

Bu çalışma 2017-2021 yıllarında Erzincan Bahçe Kültürleri Araştırma Enstitüsü Müdürlüğü araştırma ve uygulama alanlarında yürütülmüştür. Proje 2017 yılında Karadeniz Tarımsal Araştırma Enstitüsü Müdürlüğünden gelen F5 kademesindeki açılan materyallerin ekimi ile başlamıştır. Açılan materyaller 50 cm X 20 cm sıra aralığında 5 metre boyundaki parsellere 4 sıra şeklinde ekilmiştir. Buradan tek bitkiler seçilerek tek bitki sıraları oluşturulmuş buradan da genotipler seçilerek gözlem bahçesine aktarılmıştır. Gözlem bahçesinden seçilen hatlar ön verim denemesine alınmış tesadüf blokları deneme desenine göre 3 tekrarlamalı 3 standart çeşitle(Göynük-98, Önceler-98 ve Sururbey) ekilmiş, gözlem ve veriler alınarak önemli bulunan hatlar verim denemesine aktarılmıştır. Verim denemesine aktarılan hatlar iki lokasyonda(Merkez lokasyonu Bahçeliköy lokasyonu) ve üç standart çeşit(Göynük-98, Önceler-98 ve Sururbey) ile yarıştırmak üzere ekilmiş, gözlem ve verim değerleri alınmıştır. Sonuçlara istatistikî analizler yapılarak önemli bulunanlar çoklu karşılaştırma testine tabi tutulmuşlardır. İstatistikler Jmp 5.0.1programı kullanılarak yapılmıştır. Denemelerde hat ve çeşitlere ait bitki boyu, ilk bakla yüksekliği, bitkide bakla sayısı, baklada tane sayısı, 100 tane ağırlığı ve tane verimi özellikleri incelenmiştir. Bu araştırma sonuçlarına göre kontrol çeşitlerinin tane verimleri 2017-2021 yılı aralığında Bahçeliköy lokasyonunda 238,70 – 443,30 kg/da, Merkez lokasyonda 140,20 – 438,90 kg/da arasında olmuştur. Hatların tane verimleri Bahçeliköy lokasyonunda 138,75 – 386,68 kg/da, Merkez lokasyonda 59,85 – 417,69 kg/da arasında olmuştur. Yine kontrol çeşitlerinin 100 tane ağırlıkları Bahçeliköy lokasyonunda 35,47 – 56,75 g, Merkez lokasyonda 35,66- 57,42 g arasında olurken, hatların 100 tane ağırlıkları Bahçeliköy lokasyonunda 38,75 – 54,70 g, Merkez lokasyonda 35,42 – 53,1 g arasında olmuştur. Çalışmada incelenen özellikler dikkate alınarak yapılan değerlendirmeler sonucu 3 hat (3, 17, 26 nolu hatlar) çeşit adayı olarak bölge verim denemesine gönderilmiş bir hat (17 nolu hat) çeşit adayı olarak belirlenmiştir. Çalışmada 2020 yılında belirlenen 3 hat(2016-1, 2016-5, 2016-10 nolu hat) bölge verim denemesine gönderilmiş, 2021 yılında ise belirlenen 5 hat(2017-6-3, 2017-6-2, 2017-3-2, 2017-2-2, ve 2017-2-1) 2022 yılında bölge verim denemesi için koordinatör enstitüye gönderilmiştir.

Anahtar Kelimeler: F5, Seleksiyon, Verim, Kuru Fasulye, *Phaseolus vulgaris* L.



ERZINCAN REGION DRIED BEAN BREEDING STUDIES

ABSTRACT

This study was carried out in the research and application areas of the Erzincan Horticultural Research Institute in 2017-2021. The project started in 2017 with the planting of the opened materials in the F5 level from the Black Sea Agricultural Research Institute Directorate. The opened materials were planted in 4 rows on plots of 5 meters in length with 50 cm X 20 cm row spacing. From here, single plants were selected and single plant rows were created, from which genotypes were selected and transferred to the observation garden. The lines selected from the observation garden were taken to the preliminary yield trial and planted with 3 standard varieties (Göynük-98, Erkenler-98 and Sururbey) with 3 replications according to the randomized blocks trial design, and the lines that were found important were transferred to the yield trial by taking observations and data. The lines transferred to the yield trial were planted in two locations (Central location Bahçeliköy location) and three standard cultivars (Göynük-98, Erkenler-98 and Sururbey) to compete, and observation and yield values were taken. Statistical analyzes were made on the results, and those found to be significant were subjected to multiple comparison tests. Statistics were made using Jmp 5.0.1 program. In the experiments, plant height, first pod height, number of pods per plant, number of pods per pod, 100-seed weight and grain yield characteristics of lines and varieties were investigated. According to the results of this research, the grain yields of the control cultivars were between 238.70 – 443.30 kg/da in the Bahçeliköy location and between 167.25 – 438.90 kg/da in the Central location between the years 2017-2020, while the grain yields of the lines in the Bahçeliköy location were 138.75 – 375.83 kg/da, in the Central location it was between 59.85 – 417.69 kg/da. Again, the 100-grain weights of the control varieties are 35.47 - 56.75 g in Bahçeliköy location, 35.66-57.42 g in Central location, while 100-seed weights of the lines are 40.03 - 54.70 g in Bahçeliköy location, 40.18 in Central location. – It was between 5.31 g. As a result of the evaluations made considering the characteristics examined in the study, 3 lines (lines 3, 17, 26) were sent to the region yield trial as a variety candidate and one line (line no. 17) was determined as a variety candidate. This study, 3 lines (line no. 2016-1, 2016-5, 2016-10) that determined in 2020 were sent to the region yield trial and also 5 lines determined in 2021, (line no: 2017-6-3, 2017-6-2, 2017-3-2, 2017-2-2 and 2017-2-1) were sent to the coordinating institute in 2022 for to region yield trial.

Keywords: F5, Selection, Yield, Dry Bean, *Phaseolus vulgaris* L.



1. Giriş

Fasulye (*Phaseolus vulgaris* L.) *Leguminosae* familyasına dâhil bir baklagil bitkisi olup anavatanının Güney Amerika olduğu bildirilmektedir. İlk kez günümüzden yaklaşık 7 bin yıl önce Orta Amerika'da kültüre alınmış olan fasulye, buradaki sıcak bölgelerden subtropikal ve ılıman bölgelere yayılmıştır. Amerikan orijinli olan fasulye ülkemize yaklaşık 250 yıl önce getirilmiştir (Şehirli, 1988).

İnsan beslenmesinde büyük önemi olan bitkisel protein kaynaklarından biri olan fasulye, dünyada yemeklik baklagil kültürü arasında ilk sırayı almaktadır. Bileşimlerinde %18-32 protein, A, B ve D vitaminleri içerir. Fasulye % 99 oranında kendi çiçek tozlarıyla tozlanan autogam bitki olup, döllenme çiçekler açılmadan antherlerin olgunlaşması ve polenin stigma üzerine dökülmesiyle gerçekleşmektedir (Eser, 1974).

Dünyada ve ülkemizde nüfus hızla artmakta olup hızla artan bu nüfusun yanında üretiminde artması gerekmektedir. Bunun en önemli ve emin yolu ise daha iyi yetiştirme teknikleri ve daha üstün çeşitlerin geliştirilmesiyle mümkün olacaktır. Ülkemizde baklagiller içerisinde üretim ve tüketim bakımından kuru fasulyenin önemli bir yeri vardır.

Türkiye genelinde kuru fasulye ekim alanı 1.029.857 da, üretimi 279.518 ton ve ortalama verimi 271 kg/da dır. Erzincan ilinde ise 25.945 da ekim alanı 3.289 ton üretim miktarı ve 127 kg/da ortalama verim ile ülke ortalamasının çok altında kalmıştır(Anonim, 2020).

Bölgemizin birçok yerinde üretimi yapılan ve sevilerek tüketilen yerel fasulye popülasyonları mevcuttur. Bunların belirli ıslah metotları ile çeşit haline getirilmesi, hem verimin artmasını hem de kaliteli ürün elde edilmesini sağlayacaktır. Ancak yerel fasulye popülasyonlarımızın çok az bir kısmı üzerinde çalışmalar yapılmıştır. Bu popülasyonların çeşit haline getirilmesi ve kalitesinin artırılması bölgemiz ve ülkemiz için önemlidir.

Bölgenin ülke genelindeki yüksek olan üretim payını korumak ve daha da yükseltmek için iki seçenek vardır; birincisi kuru fasulye ekim alanlarını artırmak, ikincisi ise birim alandan daha yüksek verim almaktır. Özellikle tarla tipi bodur kuru fasulye çeşitlerini geliştirerek üretim alanlarını genişletmek ve daha geniş alanlarda makinalı tarıma geçilmesi için önem arz etmektedir. Çünkü bu şekilde kısa zamanda işler bitirildiği gibi üreticinin işçilik masrafları da azalmış, birim alandan daha fazla kar elde edilmiş olacaktır. Buda yüksek verim potansiyeline sahip tarla tipi bodur kuru fasulye çeşitlerini geliştirmek ve üreticiye sunmakla mümkündür.

Bölgemizde bodur ve yarı sarılıcı yerel popülasyon fasulyeler küçük alanlarda yetiştirilmektedir. Bu fasulyeler vejetasyon süresi kısa olan yörede geç olgunlaşmaktadırlar. Bunun için tane verimleri arzu edilen seviyeye çıkmamaktadır. Bu araştırmada; birim alandan



yüksek verim almak için adaptasyon kabiliyeti yüksek, hastalıklara dayanıklı, tarla tipi yeni ıslah çeşitleri geliştirme amaçlanmıştır. Bu amaç doğrultusunda Karadeniz Tarımsal Araştırma Enstitüsü tarafında sağlanan F5 kademesindeki açılan materyaller kullanılmıştır.

2. Literatür özeti

Denis (1972), 16 çeşit üzerinde 22 verim ögesi ile yaptığı çalışmada; bakla ağırlığını verim yönünden önemli bir verim ögesi olarak belirlemiştir. Araştırmacı yüksek verimli bitkilerde yüksek bakla sayısı ve tohum ağırlığı belirlemiştir. Ayrıca, bakla sayısı yüksek olan bitkilerin tane verimleri yüksek, vegetatif büyümenin fazla olduğunda ise verim düşüklüğü saptamıştır.

Shkodrani (1972), nin Arnavutluk'ta yaptığı çalışmalarda sarılıcı ve bodur fasulye çeşitlerini karşılaştırmış; Sarılıcı çeşitlerin bodur çeşitlere oranla daha verimli olduğunu açıklamıştır. 100 tane ağırlığının bodur çeşitlerde sarılıcılara oranla yüksek olduğunu saptamıştır.

Aggarwal ve Singh (1973)'in, 35 fasulye çeşidi üzerindeki çalışmalarında; tane veriminin bitkideki bakla sayısı, bakladaki tane sayısı ve 1000 tane ağırlığı ile önemli olumlu ilişkili olduğunu belirlemişlerdir. Araştırmacılar, bitkideki bakla sayısı ile bakladaki tane sayısı arasında olumlu ve önemli; bitkideki bakla sayısı ile 1000 tane ağırlığı arasında ise olumsuz ilişkiler bulmuşlardır.

Eser (1974), de yaptığı çalışmada fasulye % 99 oranında kendi çiçek tozlarıyla tozlanan autogam bitki olup, dölllenme çiçekler açılmadan antherlerin olgunlaşması ve polenin stigma üzerine dökülmesiyle gerçekleştiğini bildirmiştir.

Edje ve Muphogho (1976), fasulye bitkisinin seçiminde baklada tane sayısının önemli bir verim ögesi ve yararlı bir ölçüt olduğunu belirtmişlerdir. Araştırmacılar, tanelenme oranı ile bakladaki tane sayısı arasında olumlu ilişki bulmuşlar ve bu durumun çok taneli baklalarda meyve kabuklarının ince olması ya da tanelerin tombul olmasından ileri geldiğini açıklamışlardır

Panaiaqua ve Pinchinat (1976), fasulye ıslah çalışmalarında, tane verimi yönünden bitkide bakla sayısı, baklada tane sayısı ve bitkideki boğum sayısının fazlalığına özen gösterilmesi gerektiğini açıklamışlardır.

(Sinha, 1977), baklagillerde genel olarak tane verimi ile bitkide bakla sayısı, baklada tane sayısı ve tane büyüklüğü arasında olumlu ilişki olduğunu, bitki boyu ile bitkide dal sayısı ve tane verimi arasında bir ilişki olmadığı bildirilmektedir.

Şehirali (1980), fasulye çeşitlerinin ekim sıklığı üzerinde yaptığı çalışmada; tane verimi ile bitkide bakla sayısı baklada tane sayısı ve hasat indeksi arasında önemli ve olumlu ilişkiler bulmuştur. Path analizi sonunda, tane verimini etkileyen en önemli ögenin bitkide bakla sayısı



olduğunu saptamıştır. Tane verimini doğrudan etkileyen diğer öğelerin hasat indeksi ve baklada tane sayısı olduğunu belirlemiştir.

Salih (1981), 3 fasulye çeşidi ile yaptığı çalışmalardan tane büyüklüğünün, çeşit ve bunların interaksiyonuna, 100 tane ağırlığına, % 50 çiçeklenmeye kadar gün sayısına ve erginleşmeye kadar geçen gün sayısına önemli derecede etkili olduğunu belirtmektedir. Bitkide bakla sayısı ve baklada tane sayısının, tane büyüklüğünden etkilenmediğini saptamıştır.

Joshi ve Mehra (1983), çalışmalarında kalıtımın değişiminde genotip ve fenotipin etkisi olduğunu görmüşlerdir. Yaptıkları çalışmalarda 42 bölgeden gelen çeşitlerle 10 karakter üzerinde bitki başına tohum verimi ve kalıtımla ilişkisini incelemişlerdir. Kalıtımın istatistik olarak hesaplanabileceğini, seçimde bitki boyu, 100 tane ağırlığı, bitkide bakla sayısının alınabileceğini ancak esas seçimde bakla uzunluğu ve bitki başına verimin önemli olduğunu söylemişlerdir.

Neinhuis and Almeida et al. (1984), Brezilya Sao-Paulo'nun güneydoğusunda farklı tipteki üç fasulyede tane verimlerini karşılaştırmışlardır. Sonuçta verim bakımından genotipler arasında istatistiki açıdan çok önemli farklılıklar (0.01) görülmüştür. Farklı lokasyonlarda denedikleri çeşitlerde en yüksek verimi 40 cm sıra aralığından elde etmişlerdir. Ayrıca çeşitlerden Araona 149.0 kg/da ve Carioca 146.0 kg/da'lık verimlerle ilk sıraları almışlardır.

Singh (1984), Kuru fasulyede morfolojik karakterler ve tane verimi üzerine lokasyon ve ekim sıklıklarının etkisi ile ilgili çalışmalar yapmışlardır. Morfolojik karakterlerden boğum arası mesafe, bitki başına dal ve bakla sayısının tane verimi ile olan korelasyon ilişkilerinin istatistiki yönden önemli olduğunu bulmuşlardır. Ayrıca verim ve morfolojik özellikler yönünden lokasyonlar arasında farklılıklar tespit etmişlerdir.

Zeytun (1987), Çarşamba Ovası'nda yetiştirilen fasulye çeşitlerinin fenolojik ve morfolojik karakterlerinin tespiti amacıyla yürüttüğü araştırmada, fenolojik özellikleri ve ilk çiçeklenmedeki bitki boyu, hasat sırasındaki bitki boyu, bakla ve tohum özellikleri gibi morfolojik özelliklerini incelemiştir. Çarşamba Ovası'nda yetiştirilen 33 fasulye çeşidinde bodur çeşitlerde bitki boyunun 32-58 cm, sırik çeşitlerde ise 273-474 cm arasında bulunduğunu, bitkideki bakla sayısının 16.32-86.28 adet ve bakladaki tohum sayısının ise 3.14-5.87 arasında olduğunu belirlemiştir. Bu çalışma sırasında bakla uzunluğu ile tohum sayısı arasında olumlu ve önemli ($r:0.494$) ilişki olduğu saptanmıştır.

Şehirali (1988), fasulye (*Phaseolus vulgaris* L.) *Leguminosae* familyasına dâhil bir baklagil bitkisi olup anavatanının Güney Amerika olduğu bildirilmektedir. İlk kez günümüzden yaklaşık 7 bin yıl önce Orta Amerika'da kültüre alınmış olan fasulye, buradaki sıcak



bölgelerden subtropikal ve ılıman bölgelere yayılmıştır. Amerikan orijinli olan fasulye ülkemize yaklaşık 250 yıl önce getirilmiştir.

Zeytun ve Gülümser (1988), Çarşamba ovasında yetiştirilen 33 fasulye çeşidi ve ıslah edilmiş 2 adet ıslah edilmiş yabancı hat ile yaptıkları çalışmada; çeşitlerin çıkış, çiçeklenme, bakla bağlama, vejetasyon süresi gibi fenolojik; bitki boyu, ilk bakla yüksekliği, bitkide bakla sayısı, baklada tane sayısı, 100 tane ağırlığı, tohum rengi ve büyüklüğü gibi morfolojik özellikleri bakımından karşılaştırılmıştır.

Çiftçi ve Yılmaz (1992), bu çalışmada 1'i yerli 11'i ise Türkiye'nin değişik ekolojik bölgelerinden getirilen toplam 12 çeşitle çalışılmış ve çalışmanın sonucunda ,çıkış 17-21 günde ,çiçeklenme 60-70 günde, bakla bağlama 67-81 günde ve olgunlaşma ise 108-116 günde gerçekleşmiştir.

Deniz (1992), İnsan beslenmesinde büyük önemi olan bitkisel protein kaynaklarından biri olan fasulye, dünya yemeklik baklagil kültürleri arasında ilk sırayı almaktadır. Bileşimlerinde %18 protein, A, B, ve D vitaminleri içerir.

Tu and Park (1993), tarafından adi fasulyede (*Phaseolus vulgaris*) kök çürüklüğüne dayanıklılık üzerine bir çalışma yapılmıştır. Denenen fasulyelerden A-300 hattının *Fusarium solani f. sp phaseoli* ve *Phytium ultimum*'a dayanıklı olduğu görülmüştür.

Akdağ ve Şahin (1994), Tokat yöresinde yüksek verimli fasulye çeşitleri belirlemek amacıyla yapılan bu çalışmada; çeşitlerin ortalama bitki boyları 22,01-67,00cm, bakla sayısı 6,25-11,96 adet/bitki, tane sayısı 14,08-39,79 adet/bitki, 1000 tane ağırlığı 234,3-627,8 g. arasında değişmiştir.

Rois ve ark. (1994), Kolombiya ICA Quimbay'da bodur kırmızı fasulye üzerine yaptıkları çalışmada, yöreye adaptasyonun iyi, çoğu hastalıklara dayanıklı olduğunu, bitki başına bakla sayısının 16 – 22 adet arasında değiştiğini belirtmişlerdir.

Sepetoğlu (1994), fasulye ılıman iklim bitkisi olduğundan kültürü genellikle ılıman iklim kuşağında yapılmaktadır. Gelişimi için 20-26 oC sıcaklık isteyen fasulyenin, gece/gündüz sıcaklık farkı 10.5 oC' den fazla olursa büyümesi yavaşlamaktadır. Bodur tiplerde ekimden yaklaşık 43 gün, sıırıklarda ise 46 gün sonra çiçeklenme başlar. Bu dönemde sıcaklığın 20' den az veya 27' den fazla ve oransal nemin de % 50' den az ve diğer taraftan kuvvetli rüzgârlar çiçeklenme ve dölllenmeye büyük ölçüde zarar verir ya da meyve tutanlarda tanelerin gelişmemesine neden olur.



Yılmaz ve Çiftçi (1994), Van ekolojik koşullarında yapılan bu çalışmada 12 fasulye çeşidi denenmiş ve çıkış süreleri 19,3-23,2 gün, vejetasyon periyodu ise 108,2-121,7 gün arasında tespit edilmiştir.

Akgün ve ark. (1998), Bitki ıslahı çalışmalarının esasını genetik kaynaklardaki çeşitlilik oluşturmaktadır. Primitif formlar ve lokal varyeteler genetik taban olarak kültür bitkilerinin ileride çıkabilecek sorunlarının giderilmesinde veya kültür bitkilerine yeni özelliklerin aktarılmasında önemli gen depolarıdır. Özellikle son zamanlarda teknolojiye dayalı tarımın ve yüksek verimli çeşitlerin devreye girmesiyle primitif formlar ve lokal varyetelerin bir çoğu yok olmuş ve yok olmaya devam etmektedir. Bitkisel üretimde devamlılık ancak yabani türlerin ve yerel çeşitlerin korunmasıyla mümkün olacaktır. Bu nedenle bitkisel gen kaynaklarının kullanılmasına ihtiyaç vardır.

Escribano ve ark. (1998), Yeni çeşitlerin genetik tabanının genişletilmesine yardımcı olacak mevcut çeşitler arasında genetik farklılığının bilinmesi ve gen kaynaklarının kullanılması gerektiğini bildirmişlerdir. İspanya'dan toplanmış 66 yerel fasulye çeşidinde morfolojik özelliklerinin farklılıklarını belirlemek ve bunları phaseolin tohum proteini ile ilişkilendirmek üzere bir çalışma yürütmüşlerdir. 14 kantitatif ve 5 kalitatif özellik yönünden yapılan cluster analizi sonucu 11 grup belirlemişlerdir. Çeşitler phaseolin elektroforezis ile de tanımlanmıştır. Bu gruplardan üçü Orta Amerikan çeşitleri içinde 8 grup ise And Amerikan çeşitleri içerisinde yer aldığı bildirilmiştir. .

Özgen ve ark. (1998), nüfus arttıkça ve ekonomik kalkınma düzeyi yükseldikçe doğal zenginliklerimizde buna bağlı olarak azalmaktadır. Genel olarak bu zenginliklerimizi kaybettiğimiz veya kaybolmaya yöneldiği zaman değeri anlaşılmaktadır. Doğal dengenin korunması çevre faktörleri ile özellikle de hayvan ve bitkisel canlılar arasında oluşan ilişkilerin düzenli olarak devam etmesine bağlıdır.

Çakmak ve ark. (1999), U.Ü. Ziraat Fakültesinde yürütülen bu çalışmada Anadolu Tarımsal Araştırma Enstitüsü'nden ve ICARDA'dan temin edilen toplam 61 hatlık bir set ve 1 kontrol çeşidiyle yürütülmüştür. Hatların tane verimi, bitki verimi, 1000 tane ağırlığı, bitki boyu, ilk bakla yüksekliği gibi bazı özellikler incelenmiştir. Yapılan bu çalışma ile 9 hat ümitvar olarak seçilmiştir.

Balkaya (1999), yaptığı çalışmada, Karadeniz Bölgesinden 36 adet bodur ve 164 adet sırk formundaki materyal toplanarak incelenmiştir. Çalışmanın 2. yılında bunlar içinden 12 adet bodur ve 34 adet sırk hat seçilmiş, 3. yıl sonucunda ebeveyn hatlardan çoğaltılan 16 adet bodur



ve 46 adet sırik hattı çeşit adayı olarak belirlenmiştir. Aynı çalışmada incelenen tiplerin ve hatların fenolojik ve morfolojik özellikleri de tespit edilmiştir.

Bozoğlu ve Gülümser (2000), bu çalışma kuru fasulyede verim bazı verim karakterlerinin genotip x çevre intraksiyonlarını belirlemek üzere Samsun, Bafra, Çarşamba ve Ladik ilçelerinde yapılmıştır. Denemede 14 çeşit/hat kullanılmıştır. Yerli çeşitlerinin tane verimi bakımından stabil oldukları görülmüştür. Kullanılan çeşitlerde verim 162,7-237,7 kg arasında değişmiş olup, Türkiye ve bölge verim ortalamasının üzerinde olmuştur.

Akdağ ve Düzdemir (2001), yaptıkları çalışmada Türkiye gen kaynaklarının bazı fenolojik ve morfolojik özelliklerini belirlemeyi amaçlamışlardır. Kullandıkları genotiplerde çiçeklenme 22,75-50,50 gün ve vejetasyon süreleri ise 108,5-146,00 gün arasında değişmiştir.

Düzdemir ve Akdağ (2001), bu çalışmada Türkiye kuru fasulye gen kaynaklarının tane verimleri ile diğer bazı özelliklerinin belirlenmesi amaçlanmıştır. Elde edilen bulgulara göre bitki boyu 49,9-154,9 cm ilk bakla yüksekliği 9,9-23,9 cm, bitki başına bakla sayısı 8,6-26,2 adet, 1000 tane ağırlığı 236,2-1314,8 g ve dekara tane verimi 73,4-205 kg arasında değişmiştir. Balkaya ve Yanmaz (2003), yaptıkları çalışmada 15 fasulye çeşit adayı ile ülkemizde ticari olarak yetiştirilen 5 taze fasulye çeşidini morfolojik çeşit özellikleri dikkate alınarak protein markörler yardımı ile tanımlamışlardır. Tarla koşullarında yürütülen çalışmada % 50 çiçeklenme zamanı dikkate alındığında sırik tiplerde 45 – 50 gün arasındakilerin erkenci, 51 – 70 gün arasındakilerin orta, 71 günün üzerindeki geççi olduklarını, bodur tiplerde ise 36 - 45 gün arasında % 50 çiçeklenme gösterenlerin erkenci, 46 – 51 gün arasındakilerin orta ve 52 günün üzerindeki geççi tip formunda olduklarını belirlemişlerdir. Yine aynı çalışmada hasat zamanı 70 günün altındaki sırik tiplerin erkenci, 71 – 85 gün arasındakilerin orta ve hasat zamanı 86 gün üzerindeki geççi formunda oldukları, bodur tiplerde ise hasat zamanı 40 – 50 gün arasındakilerin erkenci, 51 – 70 gün arasındakilerin orta ve 72 gün üzerindeki geççi olarak gruplandıklarını tespit etmişlerdir.

Cengiz (2007), Sakarya ve Eskişehir lokasyonlarında yetiştirilen bazı kuru fasulye çeşitlerinin kalite özelliklerini araştırdıkları çalışmada ortalama olarak kuru 100 tane ağırlığının 17,45 – 46,37 g, su alma kapasitesinin 0,168–0,487 g/tane, su alma indeksinin % 0,963–1,157, sisme kapasitesinin 0,125–0,420 ml/tane, şişme indeksinin % 1,213–1,511, pişme süresinin 31,8–37,8 dk, kül oranının % 4,014 – 4,752, ham protein oranının ise % 19,25 – 23,66 arasında değiştiğini tespit etmiştir.

Varankaya (2011), bu araştırma, seleksiyon yoluyla geliştirilen fasulye hatları ve ticari çeşitlerinin Yozgat ekolojik koşullarında bazı tarımsal özelliklerinin belirlenmesi amacıyla



yürütülmüştür. Araştırma “Tesadüf Blokları Deneme” desenine göre 3 tekrarlamalı olarak 2010 yılında Yozgat ilinin Akdağmadeni ilçesi Konacı Köyünde yürütülmüştür. Denemede materyal olarak Araştırmada, 2 adet bodur fasulye (*Phaseolus vulgaris* L.) (Gina (yeşil tane için) ve Akman-98 (kuru tane için)) çeşidi, 15 fasulye hattı (bu hatlar Doç. Dr. Ercan CEYHAN tarafından toplanan yerel populasyonlardan seçilmiş saf hatlardır) ve 5 yerel populasyon olmak üzere toplam 22 genotip materyal olarak kullanılmıştır. Araştırma sonuçlarına göre incelenen tüm özellikler bakımından genotipler arasında istatistiki olarak önemli farklar tespit edilmiştir. Araştırma sonucunda elde edilen verilere göre genotiplerin bitki boyları 25.44 (PV1) ile 68.89 cm (PV7), dal sayıları 1.44 (PV9) ile 4.89 adet/bitki (PV20), boğum sayıları 6.11 (PV22) ile 15.44 adet/bitki (PV18), yaprak sayıları 13.67 (PV1) ile 27.33 adet/bitki (PV3), bakla boyları 7.42 (PV14) ile 11.53 cm (PV20), bakla sayıları 7.45 (PV8) ile 18.33 adet/bitki (PV13), baklada tane sayıları 2.35 (PV6) ile 3.68 adet (PV20), bitkide tane sayıları 21.78 (PV14) ile 63.44 adet (PV2), bin tane ağırlıkları 259.20 (PV15) ile 469.00 g (PV8), tane verimleri 150.42 (PV1) ile 400.74 kg/da (PV18), protein oranları % 18.57 (PV9) ile 26.80 (PV22) ve protein verimleri 31.83 (PV19) ile 75.88 kg/da (PV22) arasında değişim gösterdiğini bildirmiştir.

Ekincialp ve Şensoy (2013), bu çalışma Van Gölü havzasının farklı bölgelerinden toplanan 95 adet fasulye genotipine ait bazı bitkisel özellikleri belirlemek amacıyla yapılmıştır. İncelenen genotiplerin çıkış süresi 10-28.50 gün, çiçeklenme süresi 49.67-83.67 gün, taze bakla hasat süresi 77.67-125.50 gün, orta yaprakçığın boyu 61.48-130.22 mm, brakte boyu 3.74-8.67 mm, salkımda çiçek tomurcuğu sayısı 1-7.94 adet, bakla boyu 8.96-30.59 cm, bakla eni 9.49-20.26 mm, yüz tane ağırlığı 14.92-98.16 g, arasında değerler göstermiştir. Çalışmada ayrıca yüz tane ağırlıkları esas alınarak genotiplerin 66 tanesinin Güney Amerika, 29 tanesinin de Orta Amerika orijinli genotipler olduğunu belirtmişlerdir.

Sözen ve ark (2014), bu çalışma; Orta Karadeniz Bölgesi sınırları içinde yer alan Samsun, Tokat, Amasya ve Çorum illeri ile bu illere bağlı 14 ilçe ve 41 köy gezilerek 54 adet yerel fasulye materyalinin toplanması ve morfolojik varyabilitesinin ortaya konulması için yapılmıştır. Morfolojik varyabilitenin belirlenebilmesi amacıyla Karadeniz Tarımsal Araştırma Enstitüsünde 2010 yılında, her bir genotipten 68 adet gözlem alınmış olup karakterizasyonları gerçekleştirilen fasulye populasyonları ABA (Ana Bileşen Analizi) ve Cluster (Kümeleme) analizine tabi tutularak dendrogram oluşturulmuştur. Uygulanan cluster analizinde fasulye genotiplerinin 14 grupta toplandıklarını belirtmişlerdir. Bu gruplar incelendiğinde 12 adet ile Grup N en fazla genotipe sahip olurken; 2’şer adet ile A, J, K ve M’nin ise en az genotipe sahip gruplar olduklarını belirtmişlerdir. ABA ve Cluster analizi sonucunda gerek kalitatif gerekse



kantitatif özelliklerde görülen varyasyon tanımlamaları gerçekleştirilen genotiplerin çeşit geliştirme ve ıslah çalışmalarında kullanılabileceğini bildirmişlerdir.

Kahraman (2014), Konya koşullarında farklı tarihlerde (15 Nisan, 1 Mayıs, 15 Mayıs, 1 Haziran, 15 Haziran ve 30 Haziran) ekilen bodur kuru fasulye genotiplerinin verim ile bazı tarımsal ve kalite özelliklerinin belirlenmesi amacıyla yürüttüğü çalışmada, iki yılın ortalaması olarak, bitkide bakla sayısı 11.97 – 53.17 adet, baklada tane sayısı 3.80 – 5.92 adet, bitki boyu 53.17 – 104.33 cm, ilk bakla yüksekliği 6.40 – 15.07 cm, anadal sayısı 2.93 – 5.00 adet/bitki, tane verimi 104.00 – 562.50 kg/da, 100 tane ağırlığı 17.13 – 47.94 g, tohum kabuğu oranı % 0.08 – 0.13, protein oranı % 23.04 – 34.08 arasında değiştiğini tespit etmiştir.

Özbekmez (2015), Ordu ili ekolojik koşullarında bazı kuru fasulye çeşit ve genotiplerinin verim, verim öğeleri ile tohum ve teknolojik özelliklerinin belirlenmesi amacıyla yürütülmüş olduğu bir çalışmada, deneme materyali olarak 27 fasulye genotipi ile 5 adet tescilli kuru fasulye çeşidi (Önceler, Karacaşehir-90, Bulduk, Zülbiye, Yunus-90) kullanmıştır. Deneme 2014 yılında Ordu ili ekolojik koşullarında “Tesadüf Blokları Deneme” desenine göre 3 tekerrürlü olarak kurulmuştur. Deneme sonucunda; çıkış süresi 11.33-16.33 gün, çiçeklenme süresi 33.33-61.67 gün, vejetasyon süresi 94.33-118.33 gün, bitki boyu bodur tiplerde 28.40-50.47 cm sırik sarılıcı tiplerde 97.63-197.77 cm, ilk bakla yüksekliği 12.23-50.30 cm, bitkide dal sayısı 3.03-5.33 adet, olduğunu bildirmiştir. Verim ve verim öğeleri, bitkide bakla sayısı 9.67-18.53 adet, baklada tane sayısı 4.30-9.60 tane, bitkide tane verimi 51-178 g, hasat indeksi %13.50-%45.33, dekara tane verimi 88-237 kg, bin tane ağırlığı 182-779 g arasında bulunmuştur. Tek yıllık çalışma sonucunda dekara tane verimi bakımından en yüksek verim 238 kg/da ile Kabadüz genotipinden elde edildiğini bildirmiştir.

Çınar (2015), bazı kuru fasulye çeşit ve genotiplerinin Erzurum ekolojisine adaptasyonları, verim ve bazı tarımsal özelliklerinin belirlenmesi için yaptığı çalışmada bitki boyu 37,7-50,5 cm, bitkide dal sayısı 2,1-3,6 adet, bitkide bakla sayısı 6,5-14,6 adet, bakla uzunluğu 8,6-11,5 cm, ilk bakla yüksekliği 12,9-19,7 cm, baklada tane sayısı 3.27-4.83 adet, tane verimi 92,4-195,4 kg/da, 100 tane ağırlığı 18,0-99,8 g arasında değiştiğini tespit etmiştir.

Elkoca ve Çınar (2015), Erzurum koşullarında bazı kuru fasulye çeşit ve hatlarının adaptasyon, bazı verim ve kalite özelliklerini araştırdıkları çalışmada ortalama bitki boyunu 43.6 cm, ilk bakla yüksekliğini 18.1 cm, bitkide dal sayısını 2.9 adet, bitkide bakla sayısını 9.9 adet, baklada tane sayısını 4.18 adet, 100 tane ağırlığını 43.4 g, tane verimini 133.2 kg/da, su alma kapasitesini 0.406 g/tane, su alma indeksini % 1.123, şişme kapasitesini 0.360 ml/tane, şişme indeksini % 2.050 olarak tespit etmişlerdir.



3. Materyal ve Metot

Materyal:

Denememizin materyalini Karadeniz Tarımsal Araştırma Enstitüsünden temin edilen F5 kademesindeki (Melezleme Yoluyla Islah Metodu -Koordinatör enstitü tarafından kullanılmış (Şehirli, 1974; Akçin, 1988)) kuru fasulye açılan materyalleri ile Göynük-98, Önceler-98, Karaman ve Sururbey standart kuru fasulye çeşitleri oluşturmuştur.

Metot:

Araştırma 2017-2021 yıllarında Erzincan Bahçe Kültürleri Araştırma Enstitüsü araştırma ve uygulama alanlarında yürütülmüştür. Çalışmamızda metot olarak Seleksiyon Yoluyla Islah Metodu kullanılmıştır.

Deneme açılan materyaller, tek bitki seçimi, tek bitki sırası seçimi, gözlem bahçeleri, ön verim denemeleri ve verim denemeleri parsellerinin ekimleri ile 2017-2021 yılları arasında devam etmiştir.

Tek bitki seçimi

Açılan materyaller 5 m boyundaki parsellere 50 cm sıra arası 20 cm sıra üzeri 4 sıra ekilerek ümitvar olan hatlardan tek bitki seçimleri yapılmıştır.

Tek bitki sırası seçimi

Tek bitki seçimi sırası 5 m boyundaki parsellere 50 cm sıra arası 10 cm sıra üzeri 2 sıra ekilen tek bitki sıralarında gözlemler yapılmış isteğimize uygun hatlar seçilmiştir.

Gözlem bahçesi

Gözlem bahçesi seçilen tek bitki sıraları tekerrürüz olarak 5 m boyundaki parsellere 50 cm sıra arası 10 cm sıra üzeri 4 sıra ekilerek yıl boyu gözlemler yapılmış istenen özelliklere uygun hatların seçimleri yapılmıştır.

Ön verim denemesi

Gözlem bahçesindeki seçilen hatlarla 3 standart çeşit Tesadüf Blokları Deneme Desenine göre 3 tekerrürlü 5 m boyundaki parsellere 50 cm sıra arası 10 cm sıra üzeri 4 sıra ekilerek gözlemler sonucunda seçilen hatlar verim denemesine aktarılmıştır.

Verim denemesi

Ön verim denemesinden seçilen hatlarla 3 standart çeşit Tesadüf Blokları Deneme Desenine göre 4 tekerrürlü 2 lokasyonda 5 m boyundaki parsellere 50 cm sıra arası 10 cm sıra üzeri 4 sıra ekilerek gözlemler sonucunda seçilen hatlar bölge verim denemesine gönderilmiştir.

Bitkilerde yetiştirme mevsimi boyunca fenolojik gözlemler ve teknolojik ölçümler yapılmıştır.

Fenolojik Gözlemler



Ekim Tarihi: Denemenin kurularak ekimin yapıldığı tarih alınmıştır.

Çıkış Tarihi: Ekim yapıldıktan sonra parsellerde % 75 oranında çıkış olduğu tarih alınmıştır.

Çiçeklenme Gün Sayısı (gün) : Çıkış ile bitkilerin % 50 sinde çiçeklenmenin görüldüğü tarih arasındaki gün sayısıdır.

Teknolojik Ölçümler

Bitki Boyu (cm) : Hasat döneminde toprak yüzeyi ile bitkinin doğal halinde iken en üst noktası arasında ki dikey açıklık ölçülerek belirlenmiştir.

İlk Bakla Yüksekliği (cm) : Hasat döneminde toprak yüzeyi ile meyve bağlayan ilk bakla arasında ki dikey açıklık ölçülerek belirlenmiştir.

Bitkide Bakla Sayısı (adet) : Hasatta parsel içinde seçilen bitkilerde bakla sayımı yapılmış ve bitki başına düşen ortalama bakla sayısı adet olarak belirlenmiştir.

Baklada Tane Sayısı (adet) : Hasatta parsel içinde seçilen bitkilerde bakla sayımı ve tane sayımı yapılmış. Tane sayısı bakla sayısına bölünerek bakla tane sayısı belirlenmiştir.

100 Tane ağırlığı (gr) : Tane kuruduktan sonra her parselden alınan ürün içinden saf tohumluktan rasgele seçilen 100 tanenin ağırlıkları alınarak %14 neme göre düzeltilmiş 100 tane ağırlığı belirlenmiştir.

Verim (kg/da): Parselden alınan ürün tartılarak ve dekara çevrilerek belirlenmiştir.

Yukarıda belirtilen gözlem, tartım ve sayımlar yapılarak, istatistiki analizleri yapılmış, farklı bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır.

4. Bulgular ve Tartışma

Tek Bitki Seçimi

Erzincan yöresi kuru fasulye ıslah projesi kapsamında 2017 yılından itibaren 4 yıl süre ile Karadeniz Tarımsal Araştırma Enstitüsü tarafından gönderilen F 5 kademesindeki açılan kuru fasulye materyalleriyle projemiz devam etmiştir. Bu kapsamda 2017 yılında ekilen 11 açılan materyalden 28 tek bitki, 2018 yılında ekilen 10 açılan materyallerden 151 tek bitki, 2019 yılında ekilen 15 açılan materyallerden 157 tek bitki, 2020 yılında ekilen 10 açılan materyallerden 76 tek bitki, 2021 yılında ekilen 7 açılan materyallerden 65 tek bitki seçilmiştir. Seçilen tek bitkiler bir sonraki yıllarda tek bitki sıralarını oluşturmak üzere depoya kaldırılmıştır.

Tek Bitki Sıraları Seçimi

Proje kapsamında bir önceki yıl seçilen tek bitkiler sonrasındaki yıllarda ekilerek tek bitki sıraları oluşturulmuş ve isteğimize uygun(ilk çiçeklenen, erken olgunlaşan, tip 1 formunda olan vb. gibi) bitki sıraları seçilmiştir. 2017 yılında ekilen 30 tek bitki sırasından 10 tek bitki sırası,



2018 yılında ekilen 28 tek bitki sırasından 20 tek bitki sırası, 2019 yılında ekilen 151 tek bitki sırasından 37 tek bitki sırası, 2020 yılında ekilen 157 tek bitki sırasından 42 tek bitki sırası, 2021 yılında ekilen 76 tek bitki sırasından 30 tek bitki sırası seçilmiştir. Seçilen bu tek bitkiler seçilen yılları takip eden yıllarda gözlem bahçelerini oluşturmuştur.

Uludağ Üniversitesi Ziraat Fakültesinde yürütülen bir çalışmada Anadolu Tarımsal Araştırma Enstitüsü'nden ve ICARDA'dan temin edilen toplam 61 hatlık bir set ve 1 kontrol çeşidi kullanılmış hatların tane verimi, bitki verimi, 1000 tane ağırlığı, bitki boyu, ilk bakla yüksekliği gibi bazı özellikler incelenmiş ve 9 hat ümitvar olarak seçilmiştir(Çakmak ve ark. 1999). Balkaya (1999), yaptığı bir çalışmada, Karadeniz Bölgesinden 36 adet bodur ve 164 adet sırik formundaki materyal toplayarak incelemiş, 12 adet bodur ve 34 adet sırik hat seçilmiş, 3. yıl sonucunda ebeveyn hatlardan çoğaltılan 16 adet bodur ve 46 adet sırik hattı çeşit adayı olarak belirlenmiştir.

Gözlem Bahçesi

Gözlem bahçelileri bir önceki yıllarında seçilmiş olan tek bitki sıralarından elde edilen hatlarla kurulmuştur. Çalışmamızın ilk yılında, bir önceki yıl(2016) tek bitki sırası seçilemediğinden gözlem bahçeleri kurulamamıştır.

2018 yılında gözlem bahçesine ekilen 10 hattan 8 hat, 2019 yılında gözlem bahçesine ekilen 20 hattan 14 hat, 2020 yılında gözlem bahçesine ekilen 37 hattan 17 hat, 2021 yılında 42 hattan 17 hat seçilerek ön verim denemesine aktarılmıştır. Gözlem bahçeleri ile ilgili çalışmamızın detayları çizelge 1-2-3-4'de verilmiştir.

Çizelge 1. Gözlem Bahçesi Denemesindeki Seçilen Hatlara Ait Verim ve Verim Unsurları(2018)

Hatlar	Verim (kg/da)	100 Tane Ağırlığı(gr)	Olgunlaşma Gün Sayısı (gün)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı
2015-6	276,00	53,30	110	27	5
2015-7	204,27	38,89	110	34	6
2015-9	217,60	44,84	120	28	5
2016-1	224,80	50,14	110	23	5
2016-5	184,93	40,99	110	38	5
2016-6	261,47	54,78	110	21	5
2016-10	147,07	47,64	120	32	5
2016-22	230,27	47,25	108	24	6

Çizelge 1 deki verim ve verim kriterleri göz önüne alınarak 8 hat ön verim denemesine aktarılmıştır. Bu hatlardan 2019 yılında ön verim denemesi kurulmuştur.



Çizelge 2. Gözlem Bahçesi Denemesindeki Seçilen Hatlara Ait Verim ve Verim Unsurları (2019)

Hatlar	Verim (kg/da)	100 Tane Ağırlığı(gr)	Olgunlaşma Gün Sayısı (gün)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı
2017-3-2	247,13	51,16	107	26	5
2017-6-2	227,10	42,92	110	28	5
2017-3-1	270,67	42,70	109	32	5
2017-1-1	230,60	41,03	115	30	5
2017-6-3	310,20	40,37	107	35	5
2017-2-2	194,30	39,90	107	25	5
2017-5-1	184,93	39,05	115	26	5
2017-1-3	232,54	38,19	115	32	5
2017-7-2	222,41	37,75	115	33	5
2017-2-1	189,31	36,66	109	27	5
2017-6-1	250,12	36,63	110	35	5
2017-2-3	312,24	36,01	110	40	5
2017-4-2	280,41	35,05	115	42	5
2017-4-1	275,14	32,19	115	44	5

Çizelge 2 de seçilen hatlardan 2020 yılında ön verim denemesi kurulmuştur

Çizelge 3. Gözlem Bahçesi Denemesindeki Seçilen Hatlara Ait Verim ve Verim Unsurları(2020)

Hatlar	Verim (kg/da)	100 Tane Ağırlığı(gr)	Olgunlaşma Gün Sayısı (gün)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı
GB-2016-11-1	282,03	47,01	92	25	5
GB-2016-11-2	266,90	43,58	92	28	5
GB-2016-17-2	284,58	52,14	105	26	5
GB-2016-17-5	194,31	43,81	105	27	5
GB-2016-20-4	207,40	46,59	90	20	5
GB-2016-21-5	182,58	44,81	95	28	6
GB-2018-1-12	274,55	45,61	108	17	5
GB-2018-1-3	364,65	40,09	105	21	5
GB-2018-1-4	351,56	39,69	104	21	5
GB-2018-1-6	238,00	53,41	97	25	5
GB-2018-1-7	317,22	43,54	103	17	5
GB-2018-2-4	374,51	40,16	92	27	6
GB-2018-3-7	383,86	47,36	103	26	5
GB-2018-7-2	271,49	44,78	104	21	5
GB-2018-8-10	308,55	43,85	99	24	5
GB-2018-8-2	284,92	45,17	99	17	4
GB-2018-9-12	403,58	38,68	95	25	5

Çizelge 3 de seçilen hatlardan 2021 yılında ön verim denemesi kurulacaktır.



Çizelge 4 Gözlem Bahçesi Denemesindeki Seçilen Hatlara Ait Verim ve Verim Unsurları(2021)

Hatlar	Verim (kg/da)	100 Tane Ağırlığı(gr)	Olgunlaşma Gün Sayısı (gün)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı
GB-2019-5-8	3260	54,27	111	20	5
GB-2019-11-16	2454	51,50	111	16	5
GB-2019-6-14	1574	50,90	106	13	5
GB-2019-2-8	1448	49,94	106	15	5
GB-2019-2-3	2198	49,59	112	17	5
GB-2019-6-13	2798	49,09	112	21	5
GB-2019-11-5	1996	47,44	108	19	5
GB-2019-10-3	3478	46,69	114	25	5
GB-2019-10-9	2684	46,29	106	23	5
GB-2019-11-3	3036	44,83	112	24	5
GB-2019-5-2	2706	43,74	113	25	5
GB-2019-1-3	3360	42,33	111	26	5
GB-2019-10-7	3044	39,29	111	27	5
GB-2019-13-5	3566	33,89	112	33	5
GB-2019-14-5	2956	33,39	115	32	5
GB-2019-13-3	3168	33,20	108	34	5
GB-2019-8-2	3168	32,64	113	33	5

Çizelge 4 de seçilen hatlardan 2022 yılında ön verim denemesi kurulacaktır.

Ön Verim Denemesi

Ön verim denemeleri bir önceki yıllarında gözlem bahçelerindeki seçilmiş olan hatlarla 3 çeşit Tesadüf Blokları Deneme Desenine göre 3 tekerrürlü olarak ekilerek devam edilmiştir. 2017 yılında standart çeşitler ekilemediğinden bütün hatlar seçilerek verim denemesine aktarılmıştır.

Çizelge 5. Ön Verim Denemesindeki Hatlara Ait Verim ve Verim Unsurları(2017)

Hatlar	Bitki Boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet/bitki)	Baklada Tane Sayısı (adet/bak.)	Verim (kg/da)	100 tane Ağırlığı (gr)	Olgunlaşma Gün Sayısı (gün)
3	54,40b	12,93c	27,33a	3,43e	355,00b	43,45c	95
5	49,87c	14,33ab	21,67b	3,86bc	380,07b	52,10a	98
10	49,73c	14,80a	21,27b	3,74cd	290,20c	50,36a	95
17	58,93a	13,27bc	21,00c	4,40,a	345,73b	47,44b	95
26	60,73a	12,93c	27,60a	3,59d	417,13a	42,58c	109
29	44,27d	13,60bc	17,00c	3,99b	273,20c	47,56b	109
% CV	4,03	4,89	3,71	2,37	4,49	2,32	

Çizelge 5 incelendiğinde bitki boyları 44,27 cm ile 60,73 cm arasında olmuş 17 ve 26 nolu hat a gurubuna girmiş 29 nolu hat d gurunda yer almıştır. İlk bakla yükseklikleri 12,93cm ile 14,80cm arasında olmuş 17 nolu hat a gurubuna girerken 3 ve 26 nolu hat c gurubuna girerek



sonuncu olmuştur. Bitkide bakla sayısı 17,00 adet ile 27,60 adet arasında olmuş 3 ve 26 nolu hatlar a gurubuna girmiş 17 ve 29 nolu hatlar ise c gurubunda yer almıştır. Baklada tane sayıları bakımından 17 nolu hat 4,40 adet tane ile a gurubunda yer almış 3,43 adet/bakla ile 3 nolu hat e gurubunda yer almıştır. Dekara verim 273,20 kg ile 417,13 kg arasında olmuş 26 nolu hat a gurubunda 10 ve 29 nolu hat c gurubunda yer almıştır. 100 tane ağırlıkları 42,58g ile 52,10 g arasında olmuş 5 ve 10 nolu hat a gurubunda 3 ve 26 nolu hat c gurubunda yer almıştır. Buradaki verilerden yola çıkılarak bu 6 hat ümitvar olarak görüldüğünden bir sonraki yıl verim denemesine aktarılmıştır.

2018 yılında bir önceki yıl gözlem bahçesinden hat seçilemediğinden ön verim denemesi kurulamamıştır.

Çalışmamızın 2019 yılı ayağına 2018 yılında gözlem bahçesinden seçilen 8 hat ve 3 çeşitle 3 tekerrürlü ön verim denemesi kurularak devam edilmiştir. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Hatlara ve çeşitlere ait veriler Çizelge 6 de verilmiştir.

Çizelge 6. Ön Verim Denemesindeki Hatlara ve Çeşitlere Ait Verim ve Verim Unsurları(2019)

Hatlar	Bitki Boyu (cm)	İlk Bakla Yüksekliği (cm)	Bit.Bakla Sayısı (adet/bitki)	Bak.Tane Sayısı (adet/bak.)	Olgunlaşma Gün Sayısı (gün)	Verim (kg/da)	100 tane Ağırlığı (gr)
2015-6	88,33a	15,87ab	31,00bc	4,80bc	113,00	153,07cde	48,17ab
2015-7	86,00a	13,40c	32,47ab	4,80bc	113,00	173,87bcd	39,95e
2015-9	46,53e	14,93bc	15,67e	5,87a	110,00	68,33f	47,02abc
2016-10	53,80d	13,07c	28,53bc	5,00b	112,00	191,33abc	41,44de
2016-1	44,13e	13,67c	18,40de	4,87bc	112,00	111,27ef	49,59a
2016-22	44,13e	13,93bc	32,53ab	5,00b	110,00	185,87bc	44,81bcd
2016-5	45,93e	10,53d	32,00ab	5,93a	111,00	128,40de	40,73e
2016-6	44,40e	10,67d	21,53d	4,80bc	110,00	117,67ef	46,12abc
Göynük	57,00cd	14,27bc	31,87ab	4,20d	111,00	244,67a	43,42cde
Önceler	59,00c	13,73bc	35,80a	4,60c	111,00	223,40ab	40,31e
Sururbey	77,60b	17,89a	27,40c	5,00b	110,00	188,47bc	48,94a
Aöf	4,46	2,18	4,05	2,12		53,71	4,21
cv	2,50	5,36	4,91	0,311		19,44	2,81

Çizelge 6 incelendiğinde bitki boyları 88,33 cm ile 44,13 cm arasında olmuş 2015-6 ve 2015-7 nolu hat ilk guruba girmiş 2016-1 ve 2016-22 nolu hat son gurupta yer almıştır. İlk bakla yükseklikleri 17,89 cm ile 10,53 cm arasında olmuş Sururbey çeşidi ilk gurupta yer alırken 2016-5 ve 2016-6 nolu hat son gurupta yer almıştır. Bitkide bakla sayısı 35,80 adet ile 15,67 adet arasında olmuş Önceler çeşidi ilk guruba girmiş 2015-9 nolu hatlar ise son gurupta yer almıştır. Baklada tane sayıları bakımından 2016-5 nolu hat 5,93 adet tane ile ilk gurupta yer



almış 4,20 adet/bakla ile Göynük çeşidi son grupta yer almıştır. Dekara verim 244,67 kg ile 68,33 kg arasında olmuş Göynük çeşidi ilk grupta 2015-9 nolu hat son grupta yer almıştır. 100 tane ağırlıkları 49,59 g ile 39,95 g arasında olmuş 2016-1 nolu hat ve Sururbey çeşidi ilk grupta 2016-5 nolu hat ve Önceler çeşidi son grupta yer almıştır. Buradaki verilerden yola çıkılarak bu 8 hat ümitvar olarak görüldüğünden bir sonraki yıl verim denemesine aktarılmıştır. 2020 yılında 2019 yılında gözlem bahçesinden seçilen 14 hat ve 3 çeşitle 3 tekerrürlü ön verim denemesi kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Hatlara ve çeşitlere ait veriler Çizelge 7 da verilmiştir.

Çizelge 7. Ön Verim Denemesindeki Hatlara ve Çeşitlere Ait Verim ve Verim Unsurları(2020)

Hatlar	Bitki Boyu (cm)	İlk Bakla Yüksekliği (cm)	Bit.Bakla Sayısı (adet/bitki)	Bak.Tane Sayısı (adet/bak.)	Olgunlaşma Gün Sayısı (gün)	Verim (kg/da)	100 tane Ağırlığı (gr)
2017-1-1	85,13ab	17,73a	26,80a	4,82ab	106	246,33d	35,63f-ı
2017-1-3	52,27gh	14,00d	21,13c-e	4,73ab	99	360,47a-c	41,01cd
2017-2-1	65,53d	15,40b-d	20,47c-e	4,87ab	91	352,07a-c	39,08c-f
2017-2-2	50,80h	17,87a	25,20ab	4,83ab	90	422,60a	38,84c-g
2017-2-3	54,33g	14,33cd	20,13de	4,81ab	90	401,20ab	41,71bc
2017-3-1	86,40a	17,47ab	20,93c-e	5,05a	95	299,20cd	44,25b
2017-3-2	64,73d	15,53b-d	20,47c-e	4,78ab	97	422,53a	50,91a
2017-4-1	52,33gh	15,07cd	19,13ef	4,76ab	98	249,27d	32,19ı
2017-4-2	82,87b	17,40ab	23,00bc	4,78ab	97	300,93cd	33,91ı
2017-5-1	50,00h	13,93d	27,20a	4,69b	95	419,33a	37,62d-g
2017-6-1	50,87h	14,60cd	21,13c-e	4,81ab	97	377,20a-c	37,94d-g
2017-6-2	64,87d	18,20a	22,53b-d	4,79ab	103	375,73a-c	40,11cd
2017-6-3	62,53de	16,27ab	22,73b-d	4,79ab	97	374,87a-c	39,84c-e
2017-7-2	58,47f	14,73cd	25,87a	4,81ab	104	388,67a-c	36,27e-g
GÖYNÜK-98	60,67ef	14,47cd	20,13de	4,57b	105	316,67b-d	41,94bc
ÖNCELER-98	65,2d	16,20a-c	26,87a	4,75ab	105	356,27a-c	35,29gı
SURURBEY	73,75c	18,08a	16,43f	4,64b	104	229,50d	52,21a
cv	5,12	4,48	4,03	2,39		8,41	3,33
aöf	3,36	2,2	2,78	0,35		90,11	3,75

Çizelge 7 incelendiğinde bitki boyları 50,00 cm ile 86,40 cm arasında olmuş 2017-3-1 nolu hat ilk guruba girmiş 2017-2-2, 2017-5-1, 2017-6-1 nolu hat son grupta yer almıştır. İlk bakla yükseklikleri 13,93 cm ile 18,20 cm arasında olmuş 2017-1-1, 2017-2-2, 2017-6-2 nolu hatlar ve Sururbey çeşidi ilk grupta yer alırken 2017-1-3 ve 2017-5-1 nolu hat son grupta yer almıştır. Bitkide bakla sayısı 16,43 adet ile 27,20 adet arasında olmuş 2017-1-1, 2017-5-1, 2017-7-2 nolu hatlar ile Önceler çeşidi ilk guruba girmiş Sururbey çeşidi son grupta yer almıştır. Baklada tane sayıları bakımından 2017-3-1 nolu hat 5,05 adet tane ile ilk grupta yer almış



2017-5-1 nolu hat ile Göynük-98 ve Sururbey çeşidi sırasıyla 4,69-4,57-4,64 adet/bakla değerler olarak son grupta yer almışlardır. Dekara verim 229,50 kg ile 422,60 kg arasında olmuş 42017-2-2, 2017-3-2, 2017-5-1 nolu hatalr ilk grupta 20171-1, 2017-4-1 nolu hatlar ile Sururbey çeşidi son grupta yer almışlardır. 100 tane ağırlıkları 32,19 g ile 52,21 g arasında olmuş 2017-3-2 nolu hat ile Sururbey çeşidi ilk grupta 2017-4-1, 2017-4-2 nolu hat son grupta yer almıştır. Buradaki verilerden yola çıkılarak 9 hat(2017-1-3, 2017-2-1, 2017-2-2, 2017-2-3, 2017-3-1, 2017-3-2, 2017-5-1, 2017-6-2, 2017-6-3) ümitvar olarak görüldüğünden bir sonraki yıl verim denemesine aktarılmıştır.

2021 yılında 2020 yılında gözlem bahçesinden seçilen 17 hat ve 3 çeşitle 3 tekerrürlü ön verim denemesi kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Hatlara ve çeşitlere ait veriler Çizelge 8 da verilmiştir.

Çizelge 8 Ön Verim Denemesindeki Hatlara ve Çeşitlere Ait Verim ve Verim Unsurları(2021)

Hatlar	Bitki Boyu (cm)	İlk Bakla Yüksekliği (cm)	Bit.Bakla Sayısı (adet/bitki)	Bak.Tane Sayısı (adet/bak.)	Olgunlaşma Gün Sayısı (gün)	100 tane Ağırlığı (gr)	Verim (kg/da)
2016-11-1	49,60j	13,60i-k	16,26i-k	4,87bc	108	43,93de	191,60hi
2016-11-2	48,53j	15,73d-f	24,73cd	4,87bc	111	45,39cd	268,90de
2016-17-2	71,73c	15,40e-g	17,66hi	4,87bc	106	53,01a	193,46hi
2016-17-5	61,27f	12,86k-l	16,80h-j	4,93bc	106	50,03b	194,06hi
2016-20-4	48,93ij	14,26h-j	25,53c	4,93bc	112	44,27de	278,03cd
2016-21-5	51,20hi	13,26jk	15,73j-l	5,87a	107	44,12de	192,13hi
2018-1-3	65,00de	17,06ab	28,80b	5,00bc	111	f40,84	368,33b
2018-1-4	65,73de	16,06b-e	24,46c-e	4,93bc	107	35,71g	315,53c
2018-1-6	73,20bc	17,00a-c	18,20h	4,93bc	112	44,54d	219,73f-i
2018-1-7	64,13e	15,26e-h	15,00kl	4,93bc	114	36,72g	177,40i
2018-1-12	65,07de	15,20e-h	15,40jl	5,06b	114	41,03f	225,00e-h
2018-2-4	71,87c	16,73a-d	31,67a	5,80a	108	40,07f	423,20a
2018-3-7	74,87ab	12,20l	15,733j-l	4,87bc	108	36,17g	277,13cd
2018-7-2	66,67d	16,00ce	20,13g	5,00bbc	109	37,29g	263,20d-f
2018-8-2	75,93a	17,27a	14,13l	4,93bc	112	47,15c	198,33g-i
2018-8-10	57,60g	14,46g-i	16,13i-k	4,93bc	114	46,25cd	197,46hi
2018-9-12	65,67de	15,60ef	15,93i-k	4,93bc	115	35,05g	193,90hi
Göynük-98	52,33h	14,86f-h	22,20f	4,93bc	111	42,03ef	288,63cd
Karaman	65,80de	14,87f-h	22,93ef	4,93bc	115	41,40f	243,27d-g
Önceler-98	70,93c	16,00c-e	23,66d-f	4,80c	112	36,19g	212,10g-i
CV	2,42	4,22	5,35	2,42	ö.d.	3,41	11,25
AÖF	2,54	1,06	1,77	0,2		2,37	45,77

Çizelge 8 incelendiğinde bitki boyları 48,53 cm ile 75,93 cm arasında olmuş 2018-8-2 nolu hat ilk guruba girmiş 2016-11-2 nolu hat son grupta yer almıştır. İlk bakla yükseklikleri 12,20 cm



ile 17,27 cm arasında olmuş 2018-8-2 nolu hat a gurubunda yer alırken 2018-3-7 nolu hat 1 gurubuna girerek son gurupta yer almıştır. Bitkide bakla sayısı 14,13 adet ile 31,67 adet arasında olmuş 2018-2-4 nolu hatlar ilk guruba girmiş 2018-8-2 nolu hat son gurupta yer almıştır. Baklada tane sayıları bakımından 2016-21-5 ve 2018-2-4 nolu hatlar sırasıyla 5,87 ve 5,80 adet/tane ile ilk gurupta yer almış önceler çeşidi 4,80 adet/tane ile son gurupta yer almışlardır. Dekara verim 177,40 kg ile 423,20 kg arasında olmuş 2018-2-4 nolu hat ilk gurupta, 2018-1-7 nolu hat son gurupta yer almışlardır. 100 tane ağırlıkları 35,05 g ile 53,01 g arasında olmuş 2016-17-2 nolu hat ilk gurupta, 2018-1-4, 2018/1,7, 2018-3-7, 2018-7-2, 2018-9-12 nolu hatlar ve Önceler-98 çeşidi son gurupta yer almıştır. Buradaki verilerden yola çıkılarak 11 hat(2018-3-72016-11-2, 2016-17-2, 2016-17-5, 2016-20-4, 2018-1-3, 2018-1-4 2018-1-6, 2018-2-4, 2018-8-10, 2018-8-2) ümitvar olarak görüldüğünden bir sonraki yıl verim denemesine aktarılmıştır. Yaman ve ark. (1998), Kuru fasulye araştırmaları kapsamındaki faaliyetlerini bizim çalışmamızla paralel olarak yürütmüş bitki gen kaynakları, gözlem bahçeleri, ön verim, verim ve bölge verim denemeleri şeklinde kriterleri incelemişlerdir.. Yaptıkları bu çalışmada 1996 yılında 2 lokasyonda(Menemen ve Bozdağ), 2 standart ve 14 hattan oluşan 3'er adet verim denemesi kurulmuşlar Aynı lokasyonlarda Çanakkale popülasyonundan seçilen 30 hat gözlem bahçesinde augmented deneme desenine göre değerlendirmeye alınmış, bunlardan 28 tanesi verim yönünden, 29 tanesi yüz tane ağırlığı açısından, 26 hat bitki boyu açısından standardı geçtiğini bildirmişlerdir. Bu hatlardan 17 tanesi verim denemesine aktarılmak üzere seçilmiştir. Bu hatlarla iki lokasyonda verim denemeleri kurulmuş 5 hattın standartlardan üstün bulunduğunu bildirmişlerdir.

Verim Denemesi

Verim denemeleri bir önceki yıllarda ön verim denemelerinden seçilmiş olan hatlarla 3 standart çeşit(Gönük-98, Önceler-98, Sururbey) 2 lokasyonda(Bahçeliköy, Merkez) Tesadüf Blokları Deneme Desenine göre 4 tekerrürlü kurulmuştur. Yetiştirme periyodu içerisinde gerekli ölçüm kayıt yapılarak istatistiki analizler yapılarak çeşit adayları belirlenmeye çalışılmıştır.(Çizelge - 9- 10- 11- 12-13-14)

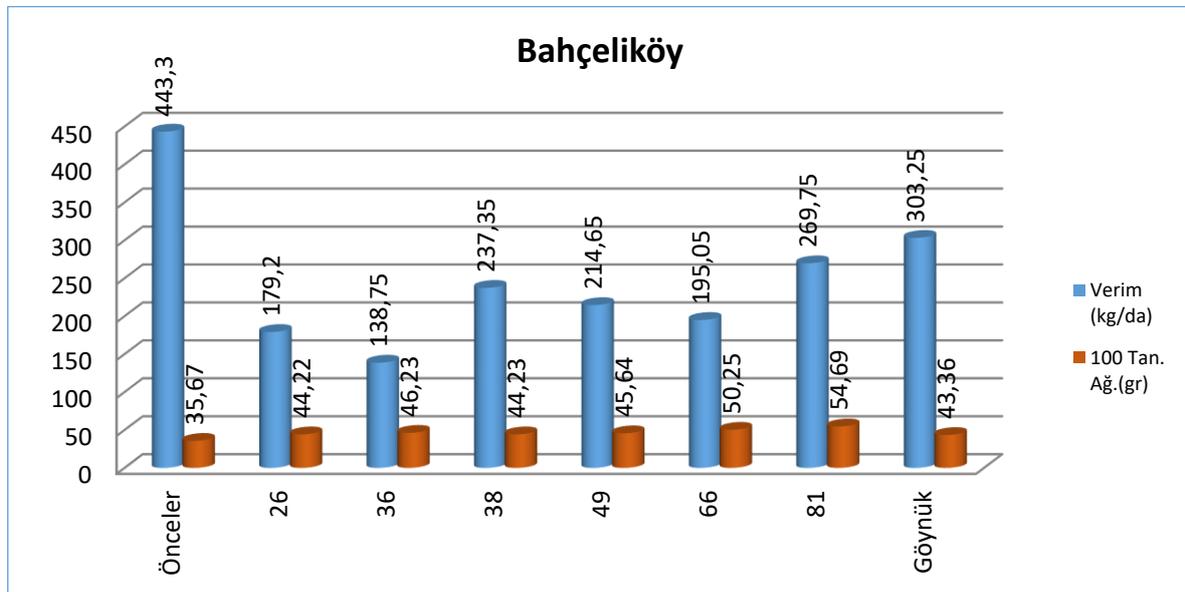
Verim denemesi 2017 yılında, 2016 yılında ön verim denemesinden seçilen 6 hatla 2 çeşit(Göynük-98, Önceler-98) ve 2 lokasyonda(Bahçeliköy, Merkez) kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Hatlara ve çeşitlere ait veriler çizelge 9 ve çizelge 10 de verilmiştir.



Çizelge 9 Bahçeliköy Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları(2017)

Hat ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	Dekara Verim (kg)	100 tane Ağırlığı (g)
26	54,45c	13,20de	22,50cd	3,46g	179,20f	44,22d
36	51,90d	12,75e	20,80d	3,74de	138,75g	46,23c
38	58,20b	13,95cd	24,35c	3,62f	237,35d	44,23d
49	49,45e	14,15b-d	20,85d	4,05c	214,65de	45,65c
66	51,45d	11,05f	23,25c	4,77a	195,05ef	50,26b
81	74,70a	19,00a	27,40b	4,57b	269,75c	54,70a
Göynük-98	51,95d	14,20bc	29,05b	3,68ef	303,25b	43,36d
Önceler-98	55,15c	14,95b	35,10a	3,82d	443,30a	35,67e
cv	1,5	4,57	5,3	1,46	7,52	1,9
ö.d	0,01	0,01	0,01	0,01	0,01	0,01

Çizelge 9 incelendiğinde bitki boyları 49,45cm ile 74,70 cm arasında olmuş, 81 nolu hat a gurubuna girerken 49 nolu hat e gurubuna girerek sonuncu olmuştur. İlk bakla yüksekliğine bakıldığında 81 nolu hat 19,00 cm ile a gurubuna girerken 11,05 cm ile f gurubuna giren 66 hat sonuncu olmuştur. Bitkide bakla sayılarına bakıldığında 35,10 adet/bitki ile önceler a gurubuna girerken 36 nolu hat 20,80 adet/bitki ile d gurubuna girmiştir. Baklada tane sayıları bakımından 4,77 adet/bakla ile 66 nolu hat a gurubunda yer alırken 3,46 adet*/bitki ile 36 nolu hat g gurunda yer alarak sonuncu olmuştur. Çizelge 2 incelendiğinde standart çeşitlerle mukayese edilen hatların dekara verimleri standart çeşitlerin altında kalmıştır. Önceler-98 çeşidi 443 kg/da verimle a gurubunda yer almış, 138,75 kg/da verimle 36 nolu hat sonda kalmıştır. 100 tane ağırlıklarına bakıldığında bütün hatlar standart çeşitleri geçmiştir(Şekil 1). 81 nolu hat 54,70 g/100 tane ağırlık ile a gurubuna girmiş, 35,67 g/100 tane ağırlık ile önceler e gurubunda sonuncu olmuştur.



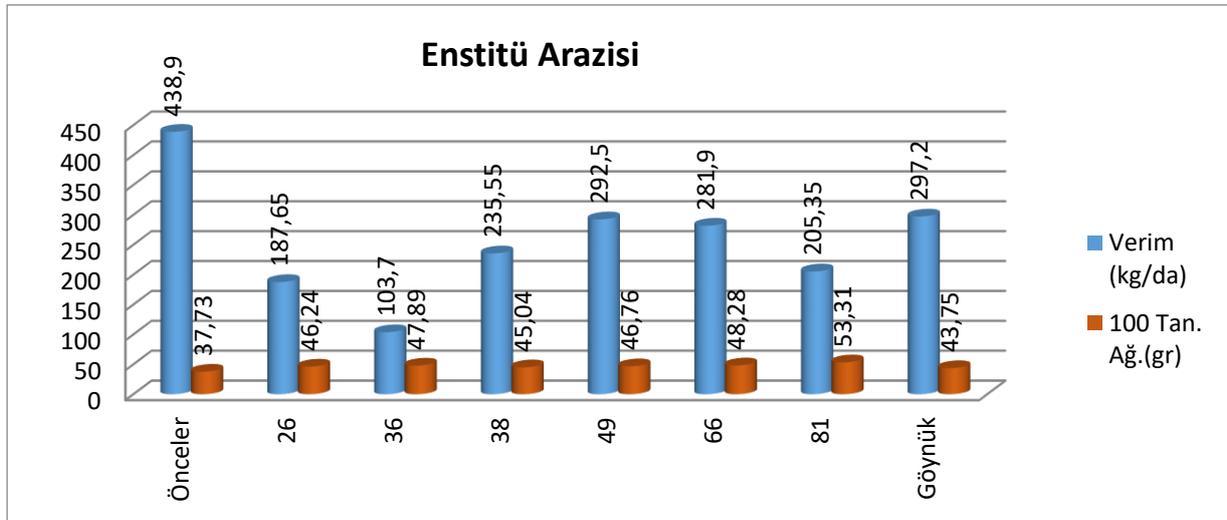
Şekil 1. Bahçeliköy lokasyonundaki verim ve 100 tane ağırlığı(2017)



Çizelge 10 Merkez Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları(2017)

Hat ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	Dekara Verim (kg)	100 tane Ağırlığı (g)
26	61,40b	12,45d	23,90e	3,48e	187,65d	46,24c
36	54,45d	11,10e	16,85f	3,70d	103,70e	47,89b
38	61,80b	14,65b	24,00e	3,52e	235,55c	45,04d
49	50,45e	13,00d	27,35d	4,14b	292,50b	46,77c
66	50,05e	11,15e	28,80c	4,68a	281,90b	48,28b
81	82,80a	18,75a	26,45d	4,77a	205,35cd	53,31a
Göynük-98	58,00c	13,85c	30,80b	3,88c	297,20b	43,76e
Önceler-98	62,25b	15,10b	36,75a	3,79cd	438,90a	37,72f
cv	1,73	3,37	3,28	1,59	10,12	1,61
ö.d	0,01	0,01	0,01	0,01	0,01	0,01

Çizelge 10 incelendiğinde bitki boyları 50,05cm ile 82,80 cm arasında olmuş, 81 nolu hat a gurubuna girerken 66 nolu hat e gurubuna girerek sonuncu olmuştur. İlk bakla yüksekliğine bakıldığında 81 nolu hat 18,75 cm ile a gurubuna girerken 11,10 cm ile e gurubuna giren 36 hat sonuncu olmuştur. Bitkide bakla sayılarına bakıldığında 36,75 adet/bitki ile önceler a gurubuna girerken 36 nolu hat 16,85 adet/bitki ile f gurubuna girmiştir. Baklada tane sayıları bakımından 4,77 adet/bakla ile 81 nolu hat a gurubunda yer alırken 3,48 adet/bitki ile 26 nolu hat e gurunda yer alarak sonuncu olmuştur. Çizelge 8 incelendiğinde standart çeşitlerle mukayese edilen hatların dekara verimleri standart çeşitlerin altında kalmıştır. Önceler-98 çeşidi 438,90 kg/da verimle a gurubunda yer almış, 103,70 kg/da verimle 36 nolu hat e gurubunda sonda kalmıştır. 100 tane ağırlıklarına bakıldığında bütün hatlar standart çeşitleri geçmiştir(Şekil 2). 81 nolu hat 53,31 g/100 tane ağırlık ile a gurubuna girmiş, 37,72 g/100 tane ağırlık ile önceler e gurubunda sonuncu olmuştur.



Şekil 2. Merkez lokasyonundaki verim ve 100 tane ağırlığı(2017)



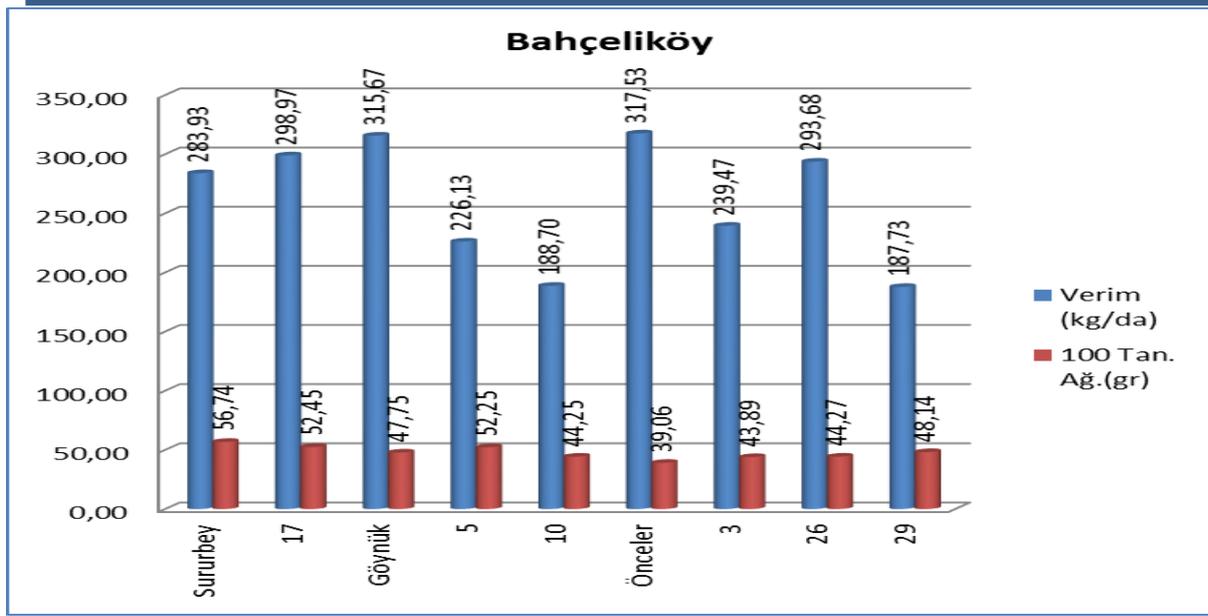
Çizelge 9 ve 10 incelendiğinde yarıştırdığımız hatların özellikleri incelendiğinde standart hatları geçemediği için çeşit aday hatlar olmadığı kanaatine varılmıştır.

2018 yılında verim denemesi 2017 yılında ön verim denemesinden seçilen 6 hat 3 çeşitle(Göynük-98, Önceler-98, Sururbey), 2 lokasyonda(Bahçeliköy Lokasyonu, Merkez Lokasyonu) kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Bahçeliköy lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 11 ve şekil 3 verilmiştir.

Çizelge 11. Bahçeliköy Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2018)

Hatlar Ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	Dekara Verim (kg)	100 tane Ağırlığı (gr)
3	49,15ef	12,85bc	29,40ab	4,35cd	239,47b	43,89d
5	47,65fg	11,80c	21,15d	4,80a-c	226,14b	52,25b
10	50,85de	12,10c	24,10cd	4,00d	188,70c	44,25d
17	54,10c	13,25bc	25,40c	4,45b-d	298,97a	52,45b
26	59,95b	14,45ab	29,50ab	4,80a-c	293,68a	44,28d
29	46,15g	13,9a-c	24,85c	4,70a-c	187,73c	48,14c
Sururbey	63,30a	13,25bc	24,60c	5,05a	283,93a	56,75a
Göynük-98	51,95cd	14,35ab	26,90bc	4,45b-d	315,67a	47,76c
Önceler-98	57,33b	16,05a	31,25a	4,85ab	317,54a	39,06e
cv%	2,1	6,8	4,85	4,3	5,47	2,82
p≤0,01	0,01	0,01	0,01	0,01	0,01	0,01

Çizelge 11 incelendiğinde bitki boyları 46,15 cm ile 63,30 cm arasında olmuş, Sururbey çeşidi a gurubuna girerek birinci olurken, 29 nolu hat g gurubuna girerek sonuncu olmuştur. İlk bakla yüksekliğine bakıldığında Önceler çeşidi 16,05 cm ile a gurubuna girmiş, 11,80 cm ile 5 nolu hat, 12,10 cm ile 10 nolu hat c gurubuna girmiştir. Bitkide bakla sayıları incelendiğinde 31,25 adet/bitki bakla ile önceler a gurubuna girerek birinci olmuş, 5nolu hat 21,15 adet/bitki bakla ile d girerek sonuncu olmuştur. Baklada tane sayıları bakımından Sururbey çeşidi 5,05 adet/bakla ile a gurubunda yer alırken, 10 nolu hat 4,00 adet/bitki ile d gurunda yer alarak sonuncu olmuştur. Çizelge 11 incelendiğinde standart çeşitlerle mukayese edilen hatlardan 17 ve 26 nolu hattın standart çeşitlerle aynı grupta yer aldığı görülmüştür. Hatlardan 10 ve 29 nolu hat ise c gurubunda yer almıştır. 100 tane ağırlıklarına bakıldığında Sururbey çeşidi 56,75gr ile a gurubuna girerken Önceler çeşidi 39,06gr ile e gurubuna girerek sonuncu olmuştur.



Şekil 3. Bahçeliköy lokasyonundaki verim ve 100 tane ağırlığı(2018)

Şekil 3 incelendiğinde 17 ve 26 nolu hat verim ve 100 tane ağırlığı bakımından standartları yakalamış durumdadır.

Merkez enstitü lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 12 ve şekil 4 verilmiştir.

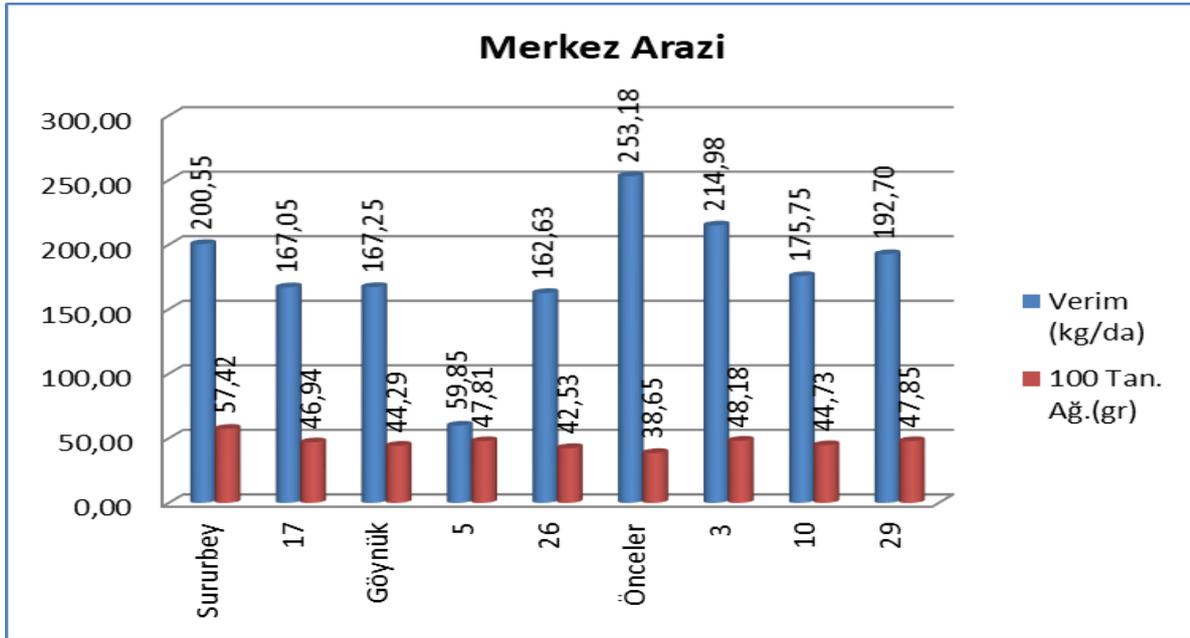
Çizelge 12. Merkez Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2018)

Hatlar Ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	Dekara Verim (kg)	100 tane Ağırlığı (gr)
3	46,00d	12,90	29,15ab	4,35bc	214,98ab	48,18b
5	43,70d	12,85	17,50f	4,7ab	59,85d	47,81b
10	47,20d	12,70	22,45e	4,00c	175,75bc	44,73c
17	52,30c	12,55	24,65c-e	4,55ab	167,05c	46,94b
26	52,35c	12,50	25,95b-d	4,95a	162,63c	42,53d
29	44,30d	12,00	26,45bc	4,7ab	192,70bc	47,85b
Sururbey	65,95a	12,95	22,60de	4,8ab	200,55bc	57,42a
Göynük-98	52,05c	13,10	21,85e	4,4bc	167,25c	44,29cd
Önceler-98	57,10b	13,55	31,50a	4,75ab	253,18a	38,65e
cv%	3,53	7,46	7,50	4,4	10,81	1,78
p≤0,01	0,01	ö.d	0,01	0,01	0,01	0,01

Çizelge 12 incelendiğinde bitki boyları 43,70 cm ile 65,95 cm arasında olmuş, Sururbey çeşidi 66,95 cm ile a gurubuna girerken 3, 5, 10, ve 29 nolu hat d gurubuna girmişlerdir. İlk bakla yüksekliğine bakıldığında ilk bakla yüksekliğinin çeşit ve hatlarda istatistiki anlamda önemli olmadığı görülmüştür. Bitkide bakla sayılarına bakıldığında 31,50 adet/bitki bakla ile önceler a gurubuna girerken 5 nolu hat 17,50 adet/bitki bakla ile f gurubuna girmiştir. Baklada tane sayıları bakımından 4,95 adet/bakla tane ile 26 nolu hat a gurubuna girerek ilk sırayı almış, 4,00 adet/bitki tane ile 10 nolu hat e gurunda yer alarak sonuncu olmuştur. Çizelge 12 incelendiğinde



standart çeşitlerle mukayese edilen hatların dekara verimleri genellikle standart çeşitlerin altında kalmıştır. 3 nolu hat 2 standart hattı geçerken Önceler-98 çeşidini geçememiştir. 100 tane ağırlıklarına bakıldığında Sururbey 57,42 gr ile a gurubuna girmiş, Önceler-98 çeşidi ise 38,65 gr ile e gurubuna girerek sonuncu olmuştur.



Şekil 4. Merkez lokasyonundaki verim ve 100 tane ağırlığı(2018)

Şekil 4 incelendiğinde 3 nolu hat verim ve 100 tane ağırlığı bakımından 2 standart çeşidi geçmiş durumdadır.

Çizelge 11, 12 ve Şekil 3, 4 incelendiğinde çeşitlerle yarıştırdığımız hatlardan 3, 17, 26 nolu hatların çeşit adayı olacağı Kanaat'ına varılmıştır Bu hatlar 2019 yılında bölge verim denemesi için koordinatör enstitüye gönderilmiştir. Koordinatör enstitüden gelen sonuçlara göre 17 nolu hattın tescil edilmesine karar verilmiştir.

Çalışmamızın 2019 yılı verim denemesi çalışmaları yapılamamıştır. Bir önceki yıl(2018) ön verim denemesi kurulamadığından verim denemesi için hat seçilememiştir, dolayısıyla verim denemesi kurulamamıştır.

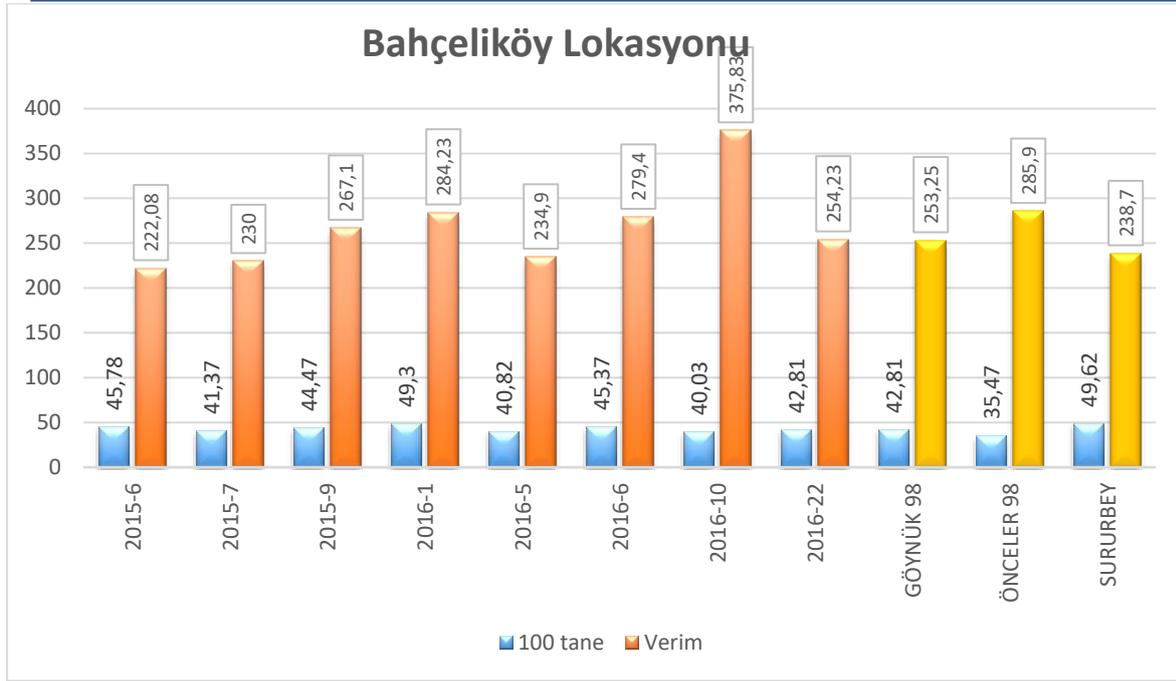
2020 yılında verim denemesi, 2019 yılında ön verim denemesinden seçilen 8 hat, 3 standart çeşitle (Göynük-98, Önceler-98 ve Sururbey) 2 lokasyonda(Bahçeliköy lokasyonu, Merkez lokasyonu) Tesadüf Blokları Deneme Desenine göre 4 tekerrürlü kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Bahçeliköy lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 13 ve şekil 5 verilmiştir.



Çizelge 13 Bahçeliköy Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2020)

Hatlar Ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	100 tane Ağırlığı (gr)	Dekara Verim (kg)
2015-6	77,75b	16,35a	15,40d	4,39a-c	45,78b	222,08d
2015-7	83,45a	16,2a	17,90c	4,28bc	41,37d	230,00cd
2015-9	63,75d	14,20b-d	17,30c	4,43a-c	44,47bc	267,10b-d
2016-1	62,75d	13,25-d	18,20c	4,62ab	49,30a	284,23b
2016-5	52,60f	13,50cd	16,60cd	4,68ab	40,82d	234,90b-d
2016-6	59,05e	15,70ab	17,00cd	4,40a-c	45,37bc	279,40bc
2016-10	63,10d	15,20a-c	21,30b	4,73a	40,03d	375,83a
2016-22	52,80f	13,20-d	17,25c	4,58ab	42,81cd	254,23b-d
GÖYNÜK 98	54,10f	14,55a-d	17,35c	4,08c	42,81cd	253,25b-d
ÖNCELER 98	62,80d	14,90a-d	23,85a	4,41a-c	35,47e	285,90b
SURURBEY	73,10c	15,30a-c	15,40d	4,03c	49,62a	238,70b-d
CV	1,93	5,16	3,9	4,08	2,61	7,96
AÖF	3,06	1,87	1,72	0,44	2,78	52,08
p<0,01	0,01	0,01	0,01	0,01	0,01	0,01

Çizelge 13 incelendiğinde bitki boyları 52,60 cm ile 83,45 cm arasında olmuş, 2015-7 nolu hat a gurubuna girerek birinci olurken, 2016-5, 2016-22 nolu hat ve Göynük-98 çeşidi f gurubuna girerek sonuncu olmuştur. İlk bakla yüksekliğine bakıldığında 2015-6, 2015-7 nolu hatlar sırası ile 16,35 cm ve 16,20 cm ile a gurubuna girerek ilk grupta yer alırken 2016-1 ve 2016-22 nolu hatlar sırasıyla 13,25 cm ve 13,20 cm değer alarak son grupta yer almışlardır. Bitkide bakla sayıları incelendiğinde 23,85 adet/bitki bakla ile önceler a gurubuna girerek birinci olmuş, 2015-6 nolu hat ile Sururbey 15,40 adet/bitki bakla ile d gurubuna girerek sonuncu olmuştur. Baklada tane sayıları bakımından 2016-10 nolu hat 4,73 adet/bakla ile ilk grupta yer alırken Göynük-98 ve Sururbey çeşitleri sırasıyla 4,08 ve 4,03 adet/bakla ile son grupta yer almışlardır. 100 tane ağırlıklarına bakıldığında Sururbey çeşidi ve 2016-1 nolu hat sırasıyla 49,62 gr ve 49,30 gr değerleri alarak ilk guruba girmiş, Önceler çeşidi 35,47gr ile e gurubuna girerek sonuncu olmuştur. Çizelge 13 incelendiğinde verim açısından standart çeşitlerle mukayese edilen hatlardan 2016-10 nolu hattın standart çeşitleri 375,83 kg/da verimle geçerek ilk grupta yer aldığı, 2015-6 nolu hattın ise 222,08 kg/da verimle son grupta yer aldığı görülmektedir.



Şekil 5. Bahçeliköy lokasyonundaki verim ve 100 tane ağırlığı(2020)

Şekil 5 incelendiğinde 2016-10 nolu hat verim bakımından standart çeşitleri geçmiş durumdadır. 100 tane ağırlığı bakımından incelendiğinde 2016-1 nolu hat Sururbey çeşidi ile aynı grupta yer almıştır.

Enstitünün merkez lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 14 ve şekil 6 verilmiştir.

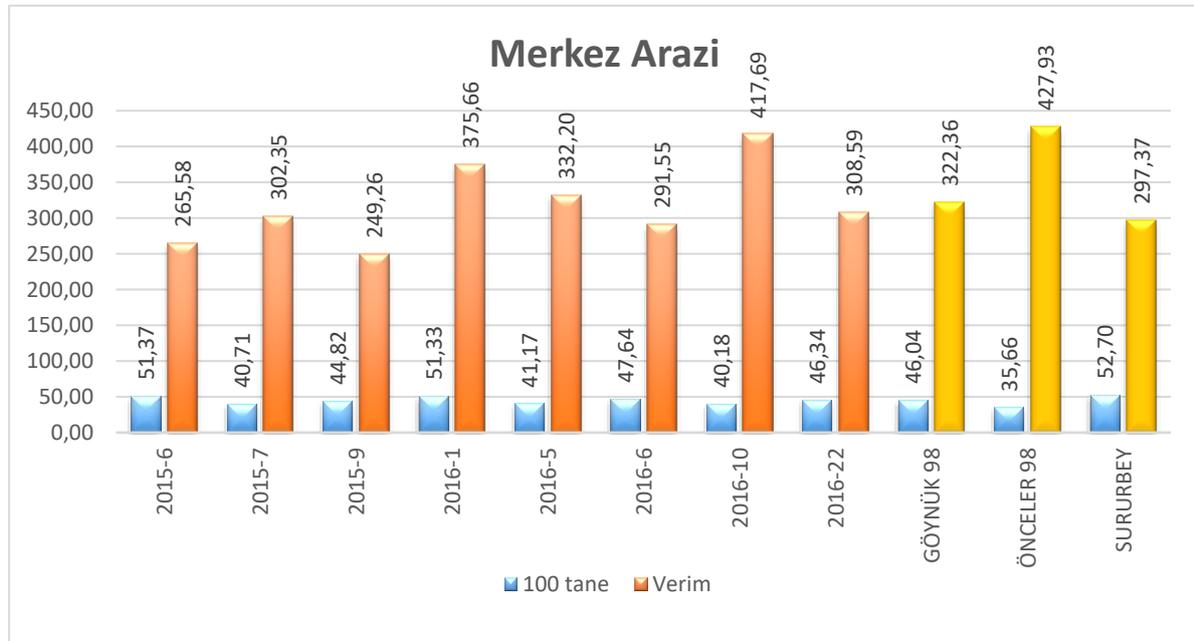
Çizelge 14. Merkez Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2020)

Hatlar Ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı (adet)	Baklada Tane Sayısı (adet)	100 tane Ağırlığı (gr)	Dekara Verim (kg)
2015-6	81,05b	16,10ab	16,25f	4,51ab	51,37a	265,58cd
2015-7	91,00a	17,80a	20,45cd	4,68a	40,71c	302,35cd
2015-9	67,50cd	13,90de	21,25bc	4,59ab	44,82b	249,26d
2016-1	63,95de	16,40ab	18,45d-f	4,57ab	51,33a	375,66ab
2016-5	53,85g	11,35f	20,05cd	4,47ab	41,17c	332,20bc
2016-6	60,55ef	14,95bd	19,00c-e	4,61ab	47,64b	291,55cd
2016-10	64,05de	15,20b-d	23,45b	4,73a	40,18c	417,69a
2016-22	55,40g	13,75de	19,45cd	4,69a	46,34b	308,59cd
GÖYNÜK 98	57,90fg	12,90ef	19,55cd	4,22bc	46,04b	322,36bc
ÖNCELER 98	63,45de	15,80bc	26,95a	4,61a	35,66d	427,93a
SURURBEY	71,80c	14,05c-e	16,95ef	4,01c	52,70a	297,37cd
CV	2,76	5,13	4,96	3,5	2,72	9
AÖF	4,51	1,85	2,46	0,39	3,03	72,18
p≤0,01	0,01	0,01	0,01	0,01	0,01	0,01



Çizelge 14 incelendiğinde bitki boyları 53,85 cm ile 91,00 cm arasında olmuş, 2015-7 nolu hat 91,00 cm ile ilk guruba girerken 2016-5 ile 2016-22 nolu hatlar 53,85cm ile 55,40 cm ile son grupta yer almışlardır. İlk bakla yüksekliğine bakıldığında ilk bakla yükseklikleri 11,35 cm ile 17,80 cm arasında olmuş 2015-7 nolu hat 91,00 cm ile ilk grupta, 2016-5 nolu hat ise 11,35 cm ile son grupta yer almıştır. Bitkide bakla sayılarına bakıldığında 26,95 adet/bitki bakla ile önceler a gurubuna girerken 2015-6 nolu hat 16,25 adet/bitki bakla ile f gurubuna girerek sonuncu olmuştur. Baklada tane sayıları bakımından 2015-7, 2016-10, 2016-22 nolu hatlar ile Önceler-98 çeşidi sırasıyla 4,68-4,73-4,69-4,61 tane/bakla ile a gurubuna girer ilk grupta Sururbey çeşidi ise 4,01 tane/bakla ile c gurubuna girerek son grupta yer almıştır. Verim açısından çizelge 4 incelendiğinde standart çeşitlerle mukayese edilen hatlardan 2016-10 nolu hattın iki standart çeşidi geçip bir standart çeşitle aynı grupta yer aldığı görülmüştür. Ayrıca 2016-1 ve 2016-5 nolu hat ise verim açısından iki standart çeşidi geçip Önceler-98 çeşidinin altında kalmıştır. 100 tane ağırlıklarına bakıldığında Sururbey çeşidi 2016-1, 2015-6 nolu hatlar sırasıyla 52,70-51,33-51,37 gr değerler alarak ilk grupta yer almışlar Önceler-98 çeşidi ise 35,66 gr ile d gurubuna girerek sonuncu olmuştur.

Merkez lokasyondaki hatların ve standart çeşitlerin verim ve 100 tane ağırlıklarına ait veriler şekil-6 da verilmiştir.



Şekil 6 Hat ve Çeşitlere Ait Merkez Lokasyonundaki Verim ve 100 Tane Ağırlıkları(2020)

Şekil 6 incelendiğinde 2016-10 nolu hat verim bakımından Önceler çeşidi ile aynı, 2016-5 ve 2016-1 nolu hatlar ise 2 standart çeşidi geçip önceler-98 çeşidinin altında kalmışlardır. 100 tane ağırlığı bakımından 2016-1, 2015-6 nolu hatlar sırasıyla 51,33 g -51,37 g değerleri alarak 2



standart çeşidi geçmiş durumdadır. Çınar (2015), bazı kuru fasulye çeşit ve genotiplerinin Erzurum ekolojisine adaptasyonları, verim ve bazı tarımsal özelliklerinin belirlenmesi için yaptığı çalışmada bitki boyu 37,7-50,5 cm, bitkide dal sayısı 2,1-3,6 adet, bitkide bakla sayısı 6,5-14,6 adet, bakla uzunluğu 8,6-11,5 cm, ilk bakla yüksekliği 12,9-19,7 cm, baklada tane sayısı 3.27-4.83 adet, tane verimi 92,4-195,4 kg/da, 100 tane ağırlığı 18,0-99,8 g arasında değiştiğini tespit etmiştir. Yine Elkoca ve Çınar (2015), Erzurum koşullarında bazı kuru fasulye çeşit ve hatlarının adaptasyon, bazı verim ve kalite özelliklerini araştırdıkları çalışmada ortalama bitki boyunu 43.6 cm, ilk bakla yüksekliğini 18.1 cm, bitkide dal sayısını 2.9 adet, bitkide bakla sayısını 9.9 adet, baklada tane sayısını 4.18 adet, 100 tane ağırlığını 43.4 g, tane verimini 133.2 kg/da, olarak tespit etmişlerdir.

Çizelge 13, 14 ve Şekil 5, 6 incelendiğinde çeşitlerle yarıştırdığımız hatlardan 2016-10, 2016-5 ve 2016-1 nolu hatların çeşit adayı olacağı Kanaat'ına varılmıştır Bu hatlar 2021 yılında bölge verim denemesi için koordinatör enstitüye gönderilmiştir.

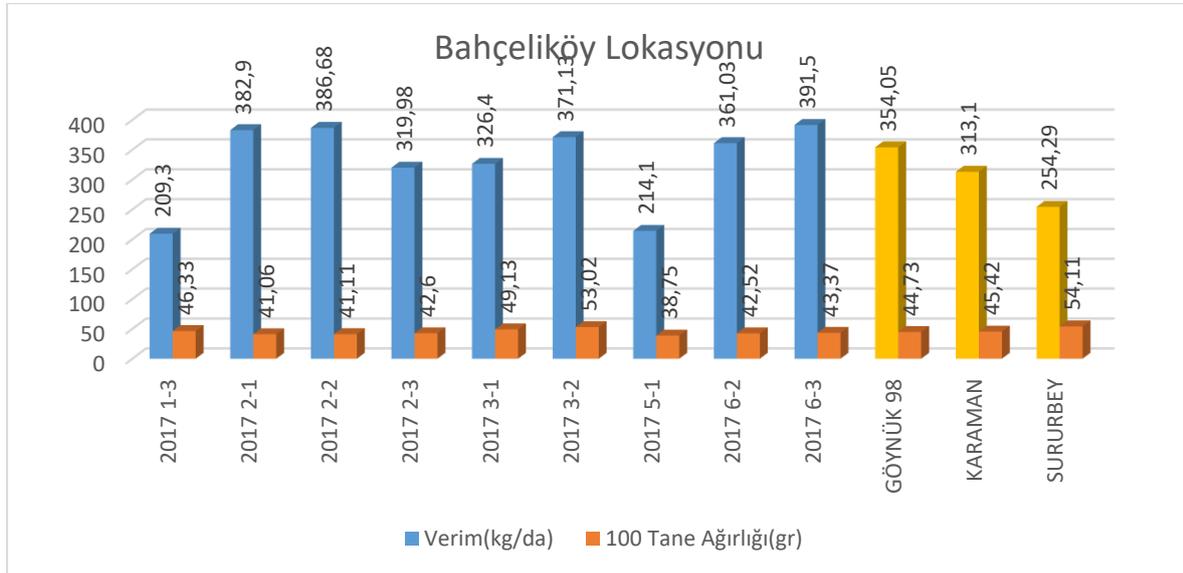
2021 yılında verim denemesi, 2020 yılında ön verim denemesinden seçilen 9 hat, 3 standart çeşitle (Göynük-98, Karaman ve Sururbey) 2 lokasyonda(Bahçeliköy lokasyonu, Merkez lokasyonu) Tesadüf Blokları Deneme Desenine göre 4 tekerrürlü kurulmuştur. Elde edilen sonuçlara istatistiki analiz uygulanarak farklılık bulunan özelliklere çoklu karşılaştırma testi uygulanmıştır. Bahçeliköy lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 15 ve şekil 7 verilmiştir.

Çizelge 15 Bahçeliköy Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2021)

Hat ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı (adet)	Dekara Verim(kg/da)	100 Tane Ağırlığı(gr)
2017 1-3	48,40e	13,75g	18,20e	4,00d	209,30d	46,33c
2017 2-1	70,40a-c	17,70b	29,00a-c	50ab	382,90a	41,06fg
2017 2-2	70,85a-c	15,15f	27,45bc	4,50a-d	386,68a	41,11fg
2017 2-3	57,50c-e	15,4ef	27,45bc	4,00d	319,98bc	42,60ef
2017 3-1	78,40a	17,70b	27,15bc	4,94a-c	326,40bc	49,13b
2017 3-2	75,40ab	19,25a	29,70ab	3,94d	371,13ab	53,02a
2017 5-1	53,85de	15,45ef	16,95e	4,25cd	214,10d	38,75g
2017 6-2	60,65b-e	16,45c-e	28,90a-c	4,31b-d	361,03a-c	42,52ef
2017 6-3	53,00de	15,80d-f	30,95a	4,75a-c	391,50a	43,37d-f
GÖYNÜK 98	58,60c-e	15,95d-f	25,85cd	4,00d	354,05a-c	44,73c-e
KARAMAN	66,30a-d	17,10bc	26,85b-d	4,38a-d	313,10c	45,42cd
SURURBEY	52,89de	16,82b-d	23,62d	5,09a	254,29d	54,11a
CV	17,6	4,61	5,96	6,78	11,32	4,21
AÖF	15,72	1,87	3,29	0,74	52,81	2,73



Çizelge 15 incelendiğinde bitki boyları 48,40 cm ile 78,40 cm arasında olmuş, 2017-3-1 nolu hat a gurubuna girerek birinci olurken, 2017-1-3 nolu hat f gurubuna girerek sonuncu olmuştur. İlk bakla yüksekliğine bakıldığında 217-3-2 nolu hat 19,25 cm ile a gurubuna girerek ilk grupta yer alırken 2017-1-3 nolu hat 13,75 cm değer alarak son grupta yer almışlardır. Bitkide bakla sayıları incelendiğinde 30,95 adet/bitki bakla ile 2017-6-3 nolu hat a gurubuna girerek birinci olmuş, 2017-5-1 ve 2017-1-3 nolu hatlar sırasıyla 16,95 adet/bitki ve 18,20 adet/bitki bakla ile g gurubuna girerek sonuncu olmuşturlardır. Baklada tane sayıları bakımından Sururbey çeşidi 5,09 adet/bakla ile ilk grupta yer alırken Göynük-98 çeşidi ile 2017-3-2, 2017-2-3 ve 2017-1-3 nolu hatlar sırasıyla 4,00, 3,94, 4,00, 4,00 adet/bakla ile son grupta yer almışlardır. 100 tane ağırlıklarına bakıldığında Sururbey çeşidi ve 2017-3-2 nolu hat sırasıyla 54,11 gr ve 53,02 gr değerleri alarak ilk guruba girmiş, 2017-5-1 nolu hat 38,75gr ile g gurubuna girerek sonuncu olmuştur. Çizelge 15 incelendiğinde verim açısından standart çeşitlerle mukayese edilen hatlardan 2017-6-3, 2017-2-2 ve 2017-2-1 nolu hatların standart çeşitleri geçerek ilk grupta yer aldığı, 2017-5-1, 2017-1-3 nolu hatlar ile Sururbey çeşidinin son grupta yer aldığı görülmektedir.



Şekil 7. Bahçeliköy lokasyonundaki verim ve 100 tane ağırlığı(2021)

Şekil 7 incelendiğinde 2017-6-3, 2017-6-2, 2017-3-2, 2017-2-2, ve 2017-2-1 nolu hatlar verim bakımından standart çeşitleri geçmiş durumdadır. 100 tane ağırlığı bakımından incelendiğinde 2017-3-2 nolu hat Sururbey çeşidi ile aynı grupta yer almıştır.

Enstitünün merkez lokasyonundaki hatlara ve çeşitlere ait veriler çizelge 16 ve şekil 8 verilmiştir.

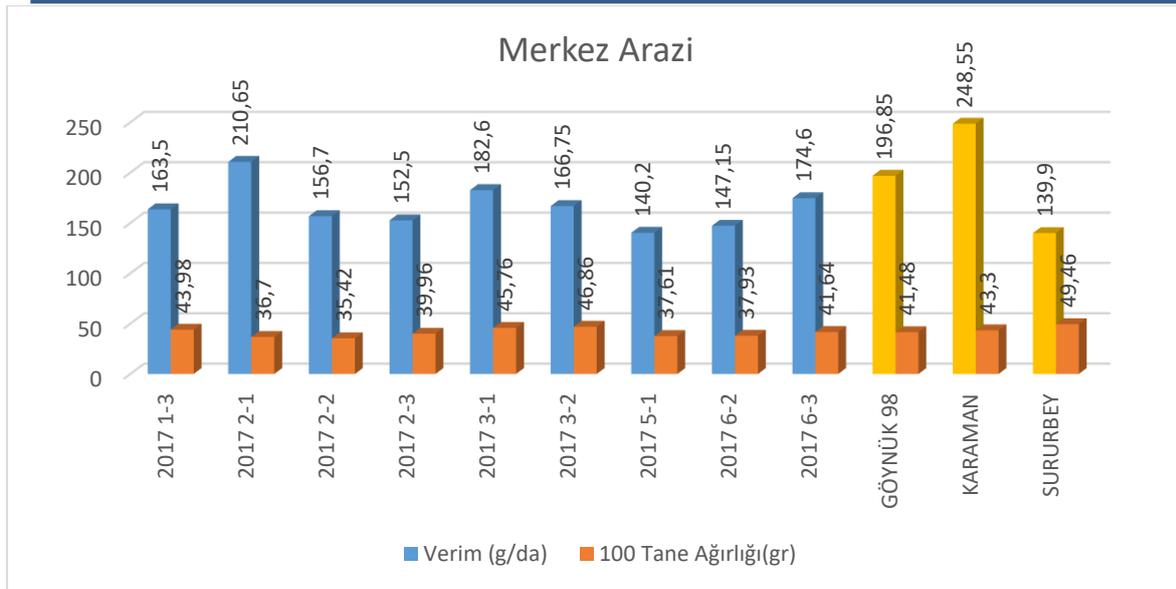


Çizelge 16. Merkez Lokasyonundaki Gözlemler ve Bazı Verim ve Verim Unsurları (2021)

Hat ve Çeşitler	Bitki boyu (cm)	İlk Bakla Yüksekliği (cm)	Bitkide Bakla Sayısı(adet)	Baklada Tane Sayısı (adet)	Dekara Verim(kg/da)	100 Tane Ağırlığı(gr)
2017 1-3	48,60f	14,55g	15,70f	4,25bc	163,50c-e	43,98cd
2017 2-1	68,10c	17,35a-d	29,00bc	4,75ab	210,65ab	36,70gh
2017 2-2	66,95c	16,8b-e	27,45cd	4,5bc	156,70c-e	35,42h
2017 2-3	60,95d	16,50c-e	27,45cd	4,25bc	152,50de	39,96f
2017 3-1	74,60a	17,45a-c	27,15cd	4,75ab	182,60b-d	45,76bc
2017 3-2	73,90ab	18,20a	29,70ab	4,25bc	166,75c-e	46,86b
2017 5-1	53,6e	17,60ab	16,95f	4,25bc	140,20e	37,61g
2017 6-2	61,05d	17,65ab	28,90bc	4,5bc	147,15de	37,93g
2017 6-3	52,7e	16,05ef	30,95a	4,75ab	174,60b-e	41,64ef
GÖYNÜK 98	52,7e	15,10fg	25,85d	4,00c	196,85bc	41,48ef
KARAMAN	68,10c	16,35de	26,85d	4,75ab	248,55a	43,30de
SURURBEY	71,50b	16,50c-e	23,75e	5,25a	139,90e	49,46a
CV	3,16	4,5	5,24	11,01	16,8	3,13
AÖF	2,85	1,08	1,95	0,72	41,9	1,87

Çizelge 16 incelendiğinde bitki boyları 48,60 cm ile 74,60 cm arasında olmuş, 2017-3-1 nolu hat 74,60 cm ile ilk guruba girerken 2017-1-3 nolu hat 48,06 cm ile son grupta yer almıştır. İlk bakla yüksekliğine bakıldığında ilk bakla yükseklikleri 14,55 cm ile 18,20 cm arasında olmuş 2017-3-2 nolu hat 18,20 cm ile ilk grupta, 2017-1-3 nolu hat ise 14,55 cm ile son grupta yer almıştır. Bitkide bakla sayılarına bakıldığında 30,95 adet/bitki bakla ile 2017-6-3 nolu hat a gurubuna girerken 2017-5-1 ve 2017-1-3 nolu hatlar sırasıyla 16,95 adet/bitki ve 15,70 adet/bitki bakla ile f gurubuna girerek sonuncu olmuştur. Baklada tane sayıları bakımından Sururbey çeşidi 5,25 tane/bakla ile a gurubuna girerek ilk grupta, Göynük-98 çeşidi ise 4,00 tane/bakla ile c gurubuna girerek son grupta yer almıştır. Verim açısından çizelge 16 incelendiğinde standart çeşitlerle mukayese edilen hatlardan bütün standart çeşitleri geçen hatlar olmamıştır. Karaman çeşidi 248,55 kg/da verimle a gurubunda yer alırken, Sururbey çeşidi ile 2017-5-1 nolu hat sırasıyla 139,90 kg/da ve 140,20 kg/da değer olarak son grupta yer almışlardır. 100 tane ağırlıklarına bakıldığında Sururbey çeşidi 49,46 gr değerler olarak ilk grupta yer almış, 2017-2-2 nolu hat 35,42 gr ile h gurubuna girerek sonuncu olmuştur.

Merkez lokasyondaki hatların ve standart çeşitlerin verim ve 100 tane ağırlıklarına ait veriler şekil-8 de verilmiştir.



Şekil 8. Hat ve Çeşitlere Ait Merkez Lokasyonundaki Verim ve 100 Tane Ağırlıkları(2020)

Şekil 8 incelendiğinde verim bakımından bütün standart çeşitleri geçen hat olmadığı, iki standart çeşidi bir hattın(2017-2-1) geçtiği, ve bir standart çeşidi ise bütün hatların geçtiği görülmüştür. 100 tane ağırlığı bakımından da yine bütün standart çeşitleri geçen hat olmamıştır. Çınar (2015), bazı kuru fasulye çeşit ve genotiplerinin Erzurum ekolojisine adaptasyonları, verim ve bazı tarımsal özelliklerinin belirlenmesi için yaptığı çalışmada bitki boyu 37,7-50,5 cm, bitkide dal sayısı 2,1-3,6 adet, bitkide bakla sayısı 6,5-14,6 adet, bakla uzunluğu 8,6-11,5 cm, ilk bakla yüksekliği 12,9-19,7 cm, baklada tane sayısı 3.27-4.83 adet, tane verimi 92,4-195,4 kg/da, 100 tane ağırlığı 18,0-99,8 g arasında değiştiğini tespit etmiştir. Yine Elkoca ve Çınar (2015), Erzurum koşullarında bazı kuru fasulye çeşit ve hatlarının adaptasyon, bazı verim ve kalite özelliklerini araştırdıkları çalışmada ortalama bitki boyunu 43.6 cm, ilk bakla yüksekliğini 18.1 cm, bitkide dal sayısını 2.9 adet, bitkide bakla sayısını 9.9 adet, baklada tane sayısını 4.18 adet, 100 tane ağırlığını 43.4 g, tane verimini 133.2 kg/da, olarak tespit etmişlerdir. Çizelge 15, 16 ve Şekil 7, 8 incelendiğinde çeşitlerle yarıştırdığımız hatlardan 2017-6-3, 2017-6-2, 2017-3-2, 2017-2-2, ve 2017-2-1 nolu hatların çeşit adayı olacağı Kanaat'ına varılmıştır. Bu hatlar 2022 yılında bölge verim denemesi için koordinatör enstitüye gönderilmiştir.

5. SONUÇ

Erzincan yöresi kuru fasulye ıslah projesi kapsamında 2010 yılında Karadeniz Tarımsal Araştırma Enstitüsü'nün göndermiş olduğu F 5 kademesindeki açılan kuru fasulye materyalleriyle başlayan projemiz ilk dilimi 2016 yılında sonuçlandırılmıştır. Projeye 2017-2021 yılları arasında devam edilmiştir.



Erzincan yöresi kuru fasulye ıslah projesi kapsamında 2017 yılından itibaren 5 yıl süre ile Karadeniz Tarımsal Araştırma Enstitüsü tarafından gönderilen F 5 kademesindeki açılan kuru fasulye materyalleriyle projemiz devam etmiştir. Bu kapsamda 2017 yılında ekilen 11 açılan materyalden 28 tek bitki, 2018 yılında ekilen 10 açılan materyallerden 151 tek bitki, 2019 yılında ekilen 15 açılan materyallerden 157 tek bitki, 2020 yılında ekilen 10 açılan materyallerden 76 tek bitki, 2021 yılında ekilen 7 açılan materyallerden 65 tek bitki seçilmiştir. Seçilen tek bitkiler bir sonraki yıllarda tek bitki sıralarını oluşturmak üzere depoya kaldırılmıştır.

Tek bitki sıraları bir önceki yıllarında seçilen tek bitkilerin ekimi ile devam etmiştir. İsteğimize uygun(ilk çiçeklenen, erken olgunlaşan, tip 1 formunda olan vb. gibi) bitki sıraları seçilmiştir. Bu kapsamda 2017 yılında ekilen 30 tek bitki sırasından 10 tek bitki sırası, 2018 yılında ekilen 28 tek bitki sırasından 20 tek bitki sırası, 2019 yılında ekilen 151 tek bitki sırasından 37 tek bitki sırası, 2020 yılında ekilen 157 tek bitki sırasından 42 tek bitki, 2021 yılında ekilen 76 tek bitki sırasından 30 tek bitki sırası seçilmiştir. Seçilen bu tek bitkiler seçilen yılları takip eden yıllarda gözlem bahçelerini oluşturmuştur.

Projenin gözlem bahçeleri denemeleri 2016 yılında tek bitki sıraları seçilemediğinden 2017 yılında gözlem bahçesi kurulamamıştır. 2018 yılında gözlem bahçesine ekilen 10 hattan 8 hat, 2019 yılında gözlem bahçesine ekilen 20 hattan 14 hat, 2020 yılında gözlem bahçesine ekilen 37 hattan 17 hat, 2021 yılında gözlem bahçesine ekilen 42 hattan 17 hat seçilerek ön verim denemesine aktarılmıştır. Ön verim denemeleri bir önceki yıllarında gözlem bahçelerindeki seçilmiş olan hatlarla 3 standart çeşit (Göynük-98, Önceler-98 ve Sururbey) Tesadüf Blokları Deneme Desenine göre 3 tekerrürlü olarak ekilerek devam edilmiştir. 2017 yılında standart çeşitler ekilemediğinden bütün hatlar(6 hat) seçilerek verim denemesine aktarılmıştır. Çalışmamızda 2018 yılında bir önceki yıl gözlem bahçesinden hat seçilemediğinden ön verim denemesi kurulamamıştır. Çalışmamızın 2019, 2020 ve 2021 yıllarında sırasıyla 8 hattan 8'i 14 hattan 9'u ve 17 hattan 9'u seçilerek verim denemesine aktarılmıştır. Verim denemeleri bir önceki yıllarında ön verim denemesinden seçilen hatla 3 standart çeşit(Göynük-98, Önceler-98 ve Sururbey) ve 2 lokasyonda(Bahçeliköy, Merkez) kurulmuştur. Verim denemelerinden 2017 yılında ekilen 6 hattan standart çeşitleri geçen hatlar olmadığından 2019 yılında ise bir önceki yıl ön verim denemesi kurulamadığından verim için hat seçilmediğinden çeşit adayları seçilememiştir. 2018 yılında ekilen 6 hattan 3 hat(3, 17, 26 nolu hatlar), 2020 yılında ise ekilen 8 hattan 3 hat(2016-10, 2016-5 ve 2016-1) çeşit adayı olarak belirlenmiştir. 2018 yılında bölge verim denemesine gönderilen hatlarda 17 nolu hat çeşit adayı olarak belirlenmiş 2023 yılında



tescile müracaat edilmiştir. 2020 yılında seçilen 3hat(2016-10, 2016-5 ve 2016-1) 2021 yılında, 2021 yılında seçilen 5 hat(2017-6-3, 2017-6-2, 2017-3-2, 2017-2-2, ve 2017-2-1) ise 2022 yılında bölge verim denemesi için koordinatör enstitüye gönderilmiştir.

Yapılan bu çalışma sonucunda elde edilen çeşitler çoğaltılarak veya tohum firmalarına devri yapılarak bölge çiftçisinin hizmetine sunulacaktır.



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THE USE OF *Chromolaena odorata* TO TREAT POLYCHLORINATED BIPHENYLS CONTAMINATED SOIL IN PHYTOREMEDIATION

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ABSTRACT

This study entails the phytotreatment ability of *Chromolaena odorata* propagated by stem cuttings and grown for six weeks in the greenhouse to thrive in soil containing different concentrations of PCB congeners found in Aroclor 1254, by possible remediation as was studied under greenhouse conditions. *Chromolaena odorata* plants were transplanted into soil containing 100, 200, and 500 ppm of Aroclor in 1L pots. The experiments were watered daily at 70 % moisture field capacity. Parameters such as fully expanded leaves per plant, shoot length, leaf chlorophyll content as well as root length at harvest were measured. PCB was not phytotoxic to *C. odorata* growth but plants in the 500 ppm treatment only showed diminished growth at the sixth week. Percentage increases in height of plant were 45.9, 39.4 and 40.0 for 100, 200 and 500 ppm treatments respectively. Such decreases were observed in the leaf numbers, root length and leaf chlorophyll concentration. The control sample showed 48.3 % increase in plant height which was not significant from the treated samples, an indication that *C. odorata* could survive such PCB concentration and could be used to remediate contaminated soil. Mean total PCB absorbed by *C. odorata* plant was between 6.40 and 64.60 ppm per kilogram of soil, leading to percentage PCB absorption of 0.03 and 17.03 % per kilogram of contaminated soil. PCBs were found mostly in the root tissues of the plants, and the Bioaccumulation factor were between 0.006-0.38. Total PCB absorbed by the plant increases as the concentration of the compound is increased. With these high BAF ensured, *C. odorata* could serve as a promising candidate plant in phytoextraction of PCB from a PCB-contaminated soil.

Keyword: Phytoremediation, Bioremediation, Soil restoration, Polychlorinated biphenyls (PCB), Biological treatment, Aroclor.



Introduction

The unprecedented growth in agriculture, chemical industries, oil production, transportation, military activities and mining has contributed in the intensive generation of pollution to the environment (Graham and Ramsden, 2008). The concentrations of these anthropogenic toxic substances in the environment have risen beyond set limits; although quantification of such increases had been difficult to ascertain. However, annual estimation of the spread has been reported to be in billions of tons (USEPA, 1997, Anyasi and Atagana, 2022). This sudden rise in waste generation leads to nature cycling and environmental degradation. Environmental degradation causes loss in biodiversity and the ecosystem which eventually impacts on human health if proper measures are not employed to address the consequences (Pilon-Smith, 2005; Mosaddegh *et al.*, 2014). There are different types of contaminants found in the environment. The most dangerous among them are those that have high capabilities to persist, bioaccumulate, and be toxic to man in the food chain e.g. polychlorinated biphenyls (PCBs). Polychlorinated biphenyls (PCBs) are a family of compounds produced commercially by direct chlorination of biphenyls. As a result of its dielectric nature, the compound is used for various activities, example as a component of the transformer oil. Through its use and incessant disposal, PCB finds its way into the environment and its sink is the soil from where it contaminates other part of the environment (Graham and Ramsden, 2008).

Knowledge of the environmental occurrence of PCB emanated from the discovery of extremely high level of PCBs in a white-tailed sea eagle found dead in Stockholm archipelago reported by Jenson in 1966 (Andersson, 2000). Today, PCBs can be found in all environmental compartments including water, soil and air even in the Polar Regions. They spread into the environment from dumps, landfills, combustion process, and from their use in various open and close systems leading to their toxic effects in wildlife and human (Low *et al.*, 2009). The effects of toxicity of PCB were brought to public awareness by the Yusho incident in Western Japan in 1968, where more than 1800 persons suffered from toxicity due to consumption of contaminated rice oil (Xu *et al.*, 2010). Subsequently, the production of PCBs in Sweden and many other industrial countries have been strictly restricted since the 1970s. The most widely accepted method for the destruction of PCBs is incineration (Rodriguez and Lafuente, 2002). However, incineration is an expensive practice and often produces more toxic compounds as by-products (Andersson, 2000). Current chemical remediation techniques were developed as a result of the demerits of incineration.



The ability of PCBs to be degraded or be transformed in the environment depends on the degree of chlorination of the biphenyl molecule as well as isomeric substitution pattern (Bhandary, 2007). As a result biochemical abilities of microorganisms became one of the leading strategies in the biological treatment of PCB contaminated sites (Idris and Ahmed, 2003). This nascent shift into biological means of PCB remediation came into place because of the disadvantages of chemical and physical methods and the method is referred to as bioremediation. Bioremediation is the use of living organisms to reduce or eliminate environmental hazards resulting from accumulations of toxic chemicals or other hazardous waste (Lee, 2013). Bacteria are generally used for bioremediation, but fungi, algae and plants could also be used as is the case in this study. When plants are used in bioremediation, it is usually referred to as phytoremediation. Phytoremediation is the use of vegetation for *in situ* treatment of contaminants in soil and water bodies. It is a promising technique that is made up of different forms depending on the technique involved. Available research investigations into phytotreatment of PCB contaminated soil used mostly food crops, with interests in the members of the *Cucurbita* family (Zeeb et al., 2006; Mattina et al., 2007; Ficko et al., 2011). These however will add pressure into the already crippling world food security since such plant should not be consumed for its adversity. For phytoremediation of organic contaminants to be effective there should be maximum possession of plants phytoremediation abilities as indicated in Ficko et al, (2011). Weeds have been shown to possess such abilities which include amongst other factors the ability to be propagated and cultivated with simple agronomic measures; they are relatively inexpensive, self-sustainable, have unique root system and also have the ability to grow in a diverse environment (Singh et al., 2009).

Chromolaena odorata (L) R.M. King & H. Robinson (Asteraceae) is an invasive bushy shrub of Neotropical origin and has been described as one of the world's worst tropical weeds (Tanhan, 2011). The plant is a member of the tribe Eupatoreae in the sunflower family Asteraceae. *Chromolaena odorata* is described as a perfect competitor in its physiology; this means that it scavenges for available nutrients in the soil, as a result suppresses the growth of other plants even the weeds of its category (De Rouw, 1991). Plants should be considered for phytoremediation studies if they possess a number of growth characteristics which include and not limited to plants ability to survive under stress, accumulates high biomass as well as the potential to dominate native vegetation at any new environment (Tanhan, 2011). *Chromolaena odorata* possesses most of these qualities, some of which are responsible for its success as an invasive plant in new environments. These factors therefore present *Chromolaena odorata* as a



potential plant for phytoremediation of PCB-contaminated soil (Anyasi and Atagana, 2023). This study involves an investigation of the capabilities of *C. odorata* plants to grow in Aroclor contaminated soil and reduce the concentration of the compound under greenhouse conditions.

Materials and methods

Chromolaena odorata plants were transplanted directly into a 1 kg of soil containing different concentrations of Aroclor in PVC pots, noting the initial length and mature leaf per plant (MLPP). The experiment which was translated into treated soil with plants (T) made in three different concentrations of 100, 200 and 500 ppm and treated soil without plants (control=C), was monitored for six weeks at prevailing environmental conditions, maintaining other agronomic procedures. Measurements were made over time of plant growth parameters including length of plants, MLPP, leaf colour (Chlorophyll content) and root length which was measured on the day of harvest. Harvested plant samples were analyzed for total PCB (tPCB) using GC-MS while the residual soil was analyzed to ascertain the reduction rate of PCB at the end of the experiment. They were no application of inorganic manures to the soil mixes, but animal compost was used during soil preparation. After six weeks of experimentation, the soil and plants were harvested, measured and sampled for analysis

Initial length of plant was measured on the day of contamination using strings and meter rule and subsequent measurements were taken at weekly intervals. MLPP was also measured on Day one of contamination and subsequently at weekly intervals using manual counting of the leaves. The same measurement sequence was employed in leaf chlorophyll using Chlorophyll meter from the UNISA Unit for Horticulture (SPAD-502Plus Konica Minolta, Japan-). Root length was measure first on the day of contamination and finally on the day of harvest using strings and meter rule to get the initial and final measurements respectively. Soil and plant samples were thoroughly homogenized for analysis and sub-sampled for the determination of wet and dry weight ratio. The samples for biomass determination were dried at 50°C until constant mass using Lancon industrial oven (Labcon South Africa) with heating integration of 40-100°C and were measured to obtain the dry mass. The dried plant samples were then ground using commercial blender, sieved at 2 mm and were stored prior to extraction while the soil samples were ground using a commercial mortar and was sieved at 2 mm. The extraction process adopted was 'Soxhlet Extraction Method 3540' (US EPA, 1997), USEPA Method 3630B: for cleaning, and USEPA modified 8089/8081 method was used for the determination of total PCB. The analysis was conducted according to Anyasi (2012). The whole values presented from the analyses of samples were the mean values of three replicates. General linear



model of analysis of variance (ANOVA) was used at $P = 0.05$ level of significance difference (SPSS) (version 11.0 for windows).

Results and discussion

The properties of the soil in which the plant was grown indicated slightly acidic clayey sandy soil, other parameters indicated compatibility with optimal growth of plants [7ppm of TOC, N=0.03 %wt, P=9 ppm, K=15.5 ppm, Ca=83 ppm, Mg=1.2, and moisture content was 4.8 %]. The low value of total nitrogen in the soil compared to carbon and phosphorus indicated the need for a nitrogen impacted manure. However, the CNP ratio of the soil in relation to the manure was 233:1:300 and 1:2:1 respectively. There was progressive growth of *C. odorata* throughout the duration of the study in both the treated and the control experiment. After six weeks of growth in Aroclor treated soil, there was no sign of lethal phytotoxicity to *C. odorata*, except at the 500 ppm treatments where chlorosis was observed towards the end of sixth week. Plant growth measured from the difference between the initial and final length of *C. odorata* and deduced in percentage as the percentage growth rate is as presented in Table 1.

Table 1. Percentage growth rate of *C. odorata* at different concentrations of Aroclor in soil

Treatments (ppm)	% growth rates		
	100µg/ml (cm)	200µg/ml (cm)	500µg/ml (cm)
T	45.89 ±0.13	40.01 ±1.12	39.41 ±0.24
C	NP	NP	NP

Values with the same * in the same column were not significant at 5% level according to Bonferoni test. T=Treatments, C=Control, NP=Not planted.

Mean percentage growth rate was highest at 100 ppm (45.9), least in 500 ppm (39.41). Meanwhile, the growth of *C. odorata* was found to be negatively correlated with increase in concentration of Aroclor in soil. Percentage growth rate at untreated control was slightly lower than that in 100 ppm treatments, this was not significant ($p = 0.02$) at $p = 0.05$. MLPP of *C. odorata* at any interval of time was observed to be influenced by the presence of Aroclor in its tissues. MLPP followed the same trend as seen in growth rate as well as increase in root length. At 100 ppm MLPP increased from initial 28 leaves to final 50 leaves, leaving a mean percentage increase of 78.6. Mean percentage increases at 200 and 500 ppm were 45.1 and 24.2 respectively (Table 2).

Table 2. Percentage change in mature leaves per plant in different concentrations of Aroclor.

Treatments (ppm)	% increase in mature leaves per plant		
	100 (mg/kg) soil	200 (mg/kg) soil	500 (mg/kg) soil
T	78.57 ±0.43*	45.16 ±1.04*	24.24 ±0.31*
C	NP	NP	NP

Values with the same * in the same column were significant at 5 % level according to Bonferoni test. T=Treatments, C=Control, NP=Not planted.



Mean Percentage change in MLPP at untreated control (C1) was 86.9; this was not significant from the 100 ppm treatments but significantly different from the 200 and 500 ppm treatments respectively. Root lengths of *C. odorata* at different concentrations of Aroclor 1254 and 1260 were equally synonymous with what was observed in growth rate and MLPP. Percentage change in root length was high at 100 ppm (78.3), but reduced considerably at 200 and 500 ppm (59.1 and 56.1) respectively Table 3.

Table 3. Percentage change in root length at different concentrations of Aroclor.

Treatments (ppm)	Percentage change in root length		
	100 ppm	200 ppm	500 ppm
T	78.28 ±0.33 [*]	59.13 ±0.08	56.12 ±0.89
C	NP	NP	NP

Values with the same alphabets in superscript in the same column were significant at 5% level according to Bonferoni test. T= Aroclor 1254, C=Control, NP=Not planted

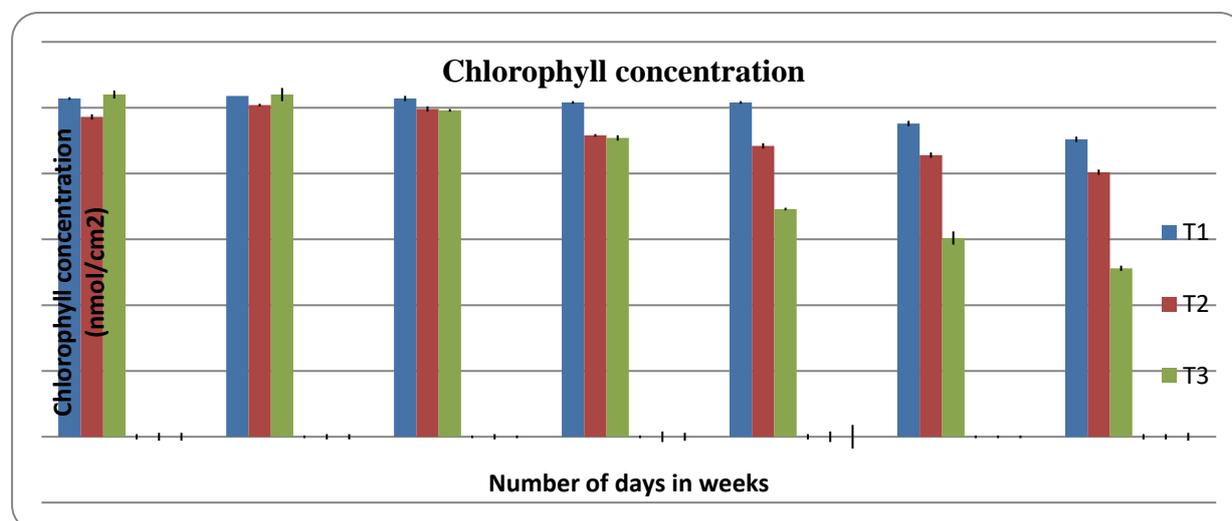


Figure 1: Leaf chlorophyll concentration (Error bars indicate standard error of the mean), T₁= T at 100 ppm, T₂= T at 200 ppm, T₃= T at 500 ppm

Table 4. Percentage change in leaf chlorophyll concentration (Values are means of three replicates)

Treatments	Initial (Day 1) nmol/cm ²	Final (Week 6) nmol/cm ²	Percentage change in chlorophyll concentration (%)
T ₁₀₀	2.57 ±0.02	2.26 ±0.06	12.06 ±0.37
T ₂₀₀	2.43 ±0.14	2.01 ±0.07	17.28 ±0.16
T ₅₀₀	2.60 ±0.11	1.28 ±0.19	50.76 ±0.25 [*]
C	NP	NP	NP

Values with the same * in the same column were significant at 5% level according to Bonferoni test. T₁₀₀= T at 100 ppm, T₂₀₀= T at 200 ppm, T₅₀₀= T at 500 ppm, C= Control, NP=Not planted



Although the leaves of *C. odorata* at 100 and 200 ppm treatments showed no observable colour change throughout the duration of the experiment when compared with untreated control, chlorophyll measurement chart however indicated alternatively. At 100 ppm, mean initial chlorophyll measurement was 2.57 nmol/cm², it increased slightly to 2.59 nmol/cm² at the first week and reduced from the second week (2.57 nmol/cm²) to the sixth week (2.26 nmol/cm²) Figure 1. Differences existed between chlorophyll concentration of the initial and final measurements of the chlorophyll meter; this is depicted as the change in percentage leaf chlorophyll concentration Table 4. The mean percentage change in chlorophyll throughout the six weeks of experimentation was 12.06, 17.28, 50.76, in their respective treatments (T₁₀₀, T₂₀₀, T₅₀₀). However, pale green colour change was observed at the 500 ppm treatment towards the sixth week of experimentation as was shown by their high percentage change in chlorophyll concentration.

Phytoremediation of soil contaminants is attributed to amongst other factors to the ability of plants to grow rapidly in the contaminated soil so as to be able to exert the physiological processes involved in the translocation of the contaminants in solutes through the plants tissues. *Chromolaena odorata* demonstrated this characteristic by its ability to grow in the PCB-contaminated soil throughout the period of the experiment. In this experiment, PCB concentrations of 100 and 200 ppm treatments were not phytotoxic to *C. odorata* as the plant was able to complete the growth duration of the experiment in those treatments or that the plant was able to manage such effects. At 500 ppm PCB concentrations, *C. odorata* was slightly affected by phytotoxicity of the pollutant towards the sixth week of growth in the treated soil, although it completed the experimental period. PCB contamination between 0-260 ppm has been reported not to be phytotoxic to various plants tested for its phytoremediation ability, but higher concentration of PCB was seen to cause stress to the plants (Lee, 2013; Zeeb *et al.*, 2006; Ficko *et al.*, 2011). The response showed by *C. odorata* towards 500 ppm of PCB may have been the cause of the stress; it could also be attributed to other factors not measured.

2.1 Residual PCB recovered from the soil and plant

Mean total PCB concentration in plants tissues were 6.4, 11.7 and 55.8 µg for 100, 200 and 500 ppm treatments respectively, while the control was zero. Final soil PCB concentrations were measured to be 2.06, 3.01, and 4.05 ppm for 100, 200, and 500 ppm treatment concentrations respectively. At same time, the residual PCB concentration at control was 15.76 ppm/kg of soil. Results of total PCB recovery in soil and plants tissues are presented in Table 5. PCB concentration factors also know as bioaccumulation factors (BAFs) were 0.022, 0.032, and



0.065 for the respective treatments. In author's previous unpublished study, a comparative study was set out to test the impending effects of volatilization and microorganisms in soil PCB remediation. The mean values observed were higher than the corresponding values obtained at uninhibited treatments. This shows that the inhibition of volatilization as well as microbial actions accounted for PCB retention by the soil. However, such effect was higher in former than in later, and the reduction was however, not significantly different from the reduction of the treated and planted. This is in agreement with Aslund *et al.*, (2008), which reported that the primary uptake pathway of PCB into plants should be root uptake and possible translocation and consistent with other studies on other POP uptake in plants (Mattina *et al.*, 2007). Other scholars have also reported on the influence of microbes on uptake of PCB by plants (Xu *et al.*, 2010; Anyasi 2012).

Table 5: PCB recovery results: Initial soil PCB concentration, Residual soil PCB concentration, total PCB concentration, percentage PCB absorbed, percentage change in PCB, and PCB concentration factor

Treatments	Initial soil PCB conc. (ppm)	Final soil PCB conc. (ppm)	Total PCB in plants tissue (µg)	% PCB absorbed	% change in PCB	PCB concentration factor (PCB-RF)
T100	10.5 ±0.20*	2.06 ±0.04	6.40 ±0.12*	2.10 ±0.00	80.4 ±0.60*	0.022 ±0.00
C	9.4 ±0.02	8.50 ±0.11	NP	NP	9.6 ±0.30	NP
T200	19.8 ±0.00*	3.01 ±0.02	11.70 ±0.15*	0.03 ±0.00	84.8 ±0.06*	0.032 ±0.00
C	18.5 ±0.03	15.76 ±0.13	NP	NP	14.8 ±0.10	NP
T500	27.2 ±0.20	4.05 ±0.08	55.80 ±0.70*	11.98 ±0.12*	85.1 ±0.20*	0.065 ±0.00*
C	18.5 ±0.20*	5.76 ±0.00	NP	NP	14.8 ±0.00*	NP

Values with the same * in the same column were significant at 5 % level according to Bonferoni test. T= Aroclor 1254, C=Control, NP=Not planted

2.2 Total PCB recovered from plant

Absorption of PCB by *C. odorata* occurred mostly at the root tissues of the plant. For example at 100 ppm, the concentration of PCB in the root was found to be 0.22 µg/g of soil with a total root biomass of 7.25 g, resulting to a total root PCB of 1.6 µg. Although the stem and leaf biomass were above 10 g respectively which was higher than what was obtained in the root, the total PCB in both the stem and leaf was still not applicable because there was no PCB dictated in the stem and leaf tissues. Total PCB concentrations found in the tissues of *C. odorata*, ranges from 3.1 to 64.6 ppm, the value was seen to increase as the concentration of the treatment was increased. This is in agreement with the study of Pinsker, (2011), which reported that initial soil



PCB has a great effect on the amount of PCB absorbed by plants, its translocation as well as the concentrations of the residual PCB in the soil at the end of a phytoremediation study. There was percentage reduction of PCB concentration from 80.4 to 86.6 within the six weeks of experiment. These values are appreciable when compared with the mean reduction of PCB per month of other plants species that were used for various PCB phytoremediation studies. The mean PCB reductions were reported to be in the range of 0.1-14.8 % (Dzantor *et al.*, 2000; Ficko *et al.*, 2010). Although total PCB concentration in most of the plant tissues of the Aroclor-treated experiments was not applicable, there was still reduction in the amount of PCB in soil at the end of the experiments. Such effect was also observed in the unplanted control samples (C2=14.8 %) and could be attributed to natural attenuation and perhaps other parameters not measured (Anyasi and Atagana, 2022).

2.3 PCB reduction in the soil after six weeks of growth with *C. odorata*

Highest reduction in PCB concentration was found in soil with 500 ppm concentrations as observed in T₂₀₀, T₅₀₀, C₄ and C₃ where they was reduction of PCB of about 85.1, 84.8, 84.1 and 82.6 % respectively. Treatment with initial concentration of 100 ppm had percentage reduction of 80.4. However, the control sample without plant (C) only reduced by 14.8 ppm, this may have been aided by nature (Table 5). In this study, greater amount of PCB found in the plants tissue were concentrated in the roots, it could be as a result of the diffuse root system of the plant; an importance feature of any phytoremediation plant. Total root concentrations of PCB were reported to be in the range of 0.26-17.85 ppm (Result not shown). Increased root concentration of PCB leads to a synonymous increase in bioaccumulation factors (BAF). Bioaccumulation factor determines plants ability to accumulate and concentrate a greater quantity of PCBs than the surrounding soil. This phenomenon is important as it provides one with the idea on how to measure the ability of plants to draw PCB towards the roots when it absorbs water and nutrients from the soil known as imbibition. The measurement of BAF in *C. odorata* was in range of 0.01 to 0.4 which is greater than what was observed with Alfalfa by Zeeb *et al.*, (2006), and some other studies (Low, 2009; Aslund *et al.*, 2007/8). From this, it can be explained that *C. odorata* was able to draw PCBs towards its root with its BAF value within the range of measured value of BAF of other PCB phytoremediation plants. This generates a new interest in the use of *C.odorata* in the phytoextraction of PCB.

3 Conclusions

This study has been able to demonstrate that *C. odorata* is able to reduce the concentrations of PCB at the 100, 200 and 500 ppm of Aroclor treated soil significantly than unplanted control.



At the end of six weeks of experiment, there was sustenance of growth of the plant which causes phytotreatment of soil PCB from a PCB contaminated soil. The fact that *C. odorata* was able to survive this different contaminant regime of Aroclor, is an evident that the plant is a promising candidate for uptake of PCB from a PCB-contaminated soil and such effect could be enhanced with soil amendments (bioaugmentation) that aids microbial presence in the rhizosphere as well as growing the plants for a longer duration in the contaminated soil. The major weakness of the method that was used in this study was that the reduction of the PCB in the soil may have been aided by other factors but such was measured in the author's other unpublished study.

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HESPERIDIN: A PROMOTING AGENT OF HEALTH

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ABSTRACT

Functional foods reduce the risk of disease by showing one or more functions in the body. Foods that can have health-promoting benefits should be often included in the diet. Nowadays, the demand for natural and accessible functional foods is increasing. The most well-known properties of flavonoids, which are known today and have many types, are their ability to scavenge free radicals and reactive oxygen species. Flavonoids are important for human health and must be taken in the daily diet. Commonly found in fruits and vegetables, flavonoids are found in coffee beans, wine, and many plant sources. Belonging to the flavanone group, hesperidin is a powerful antioxidant source. It is an important research topic for researchers. In addition, hesperidin is a photoactive compound and both abundant and economical dietary bioflavonoid with many medicinal and biological benefits. Hesperidin is found in high amounts in orange and lemon species, while it has been reported in blueberry species. Bitterness in citrus fruits is caused by hesperidin. Due to the aglycon and hydroxyl in its composition, its antioxidant capacity is high. There are many health benefits due to antioxidant capacity of hesperidin. With the ingestion of hesperidin, radical scavenging activity and cellular defense increase. Hesperidin has many biological and pharmacological health benefits, especially antioxidant, anti-cancer, anti-inflammatory. Additionally, other health effects can be listed as psychological disorders, skin diseases, cardiovascular diseases, anti-hypercholesterolemic effect. In this review, it is aimed to ensure an overview of hesperidin and the importance of health effect will be discussed by mentioning some of its health benefits.

Keywords: Citrus Fruits, Functional Food, Health Benefit, Hesperidin



1. Introduction

Derived from the Latin of flavus, meaning yellow, flavonoids are composed of phenolics with variable structure. Currently, there are more than 8000 known species, and the number is increasing day by day (Kuntić et al., 2014). An important and well-known properties for each flavonoid are scavenging free radicals and reactive oxygen species, and acting as powerful antioxidants properties that protect the health of the human body (Wilmsen et al., 2005). Flavonoids are an important component of the human diet. Considering the human diet for health, the importance of consuming 1 g of flavonoids the point to be emphasized (Bigoniya and Singh, 2014). Many foods have flavonoids in their composition. Fruits, vegetables, coffee and beans, wine, herbal sources can be listed as products. Flavonoids are examined in six groups. These; flavones, flavanones, flavonols, isoflavonoids, anthocyanins and flavanols (Atinc and Kalkan, 2018).

Flavanone glycosides are in the main found in citrus fruits and leaves. Considering their effects on health, hesperidin flavanone comes to mind first. Hesperidin was first discovered by Lebreton in 1827. Prior to his discovery, Lebreton found the presence of hesperidin by isolating it from the white interior found in the citrus peel. Hesperidin is absorbed as a glycoside or by breaking glycoside bonds (Kahraman et al., 2002; Kuntić et al., 2014). It is found in lemons, oranges [e.g., *Citrus sinensis* L. (sweet orange), *Citrus aurantium* L. (bitter orange)], and in lesser amounts of other citrus fruits (Patel et al., 2018). The peel and membranes of these fruits contain high concentrations of hesperidin. For example, in one study, the amount of hesperidin in pulp-containing orange juice was found to be higher than in pulp-free orange juice (Kahraman et al., 2002). However, the content of hesperidin obtained from lemon seed of methanol extraction to be higher than the amount of hesperidin in the Florida orange juice (Man et al., 2019). Another study shows that the content of the hesperidin (Hesperetin-7-rutinoside) in orange juice changes from 200 to 590 mg/l (Manach et al., 2003). Within all findings, both the treatments applied, and the origins of the citrus species change the hesperidin content (Man et al., 2019). Generally, hesperidin has been decelerated to have anti-inflammatory, anti-obesity, antihypertensive, antiallergenic, anticarcinogenic and antimicrobial effects in previous studies (Wilmsen et al., 2005). Hesperidin has been shown to be important for its safe to use and health in in vitro and in vivo studies (Devi et al., 2015). In this review, an overview of hesperidin will be presented and mentioned to importance its health benefits.



2. Chemistry of hesperidin

Hesperidin is a bitter-tasting flavanone found in some of citrus fruits. It can also be isolated from Papilionaceae, Betulaceae, Lamiaceae, Zanthoxylum and Acanthopanax species, in lesser amounts (Hajialyani et al., 2019). Hesperidin has an aglycone linked to rutinose and hesperetin. Rutinose, which is a disaccharide in the hesperidin, consists of rhamnose (6-deoxy-L-mannose) and glucose sugars (Erlund et al., 2001). It is also known as 3',5,7-Trihydroxy 4'-methoxyflavanone 7-rutinoside, hesperetin-7-rutinoside, and (S)-7- [[6-0-(6-deoxy-alpha-L-mannopyranosyl)-beta-D-glucopyranosyl]oxy]-2,3-5-hydroxy-2-(3-hydroxy-4-methoxyphenyl)-4H-1-benzopyran-4-one. It is a slightly water-soluble solid. Its molecular formula is C₂₈H₃₄O₁₅. The molecular weight of hesperidin is reported as 610.57 daltons (Devi et al., 2015). Hesperidin has an average melting point of 252.5 °C and a boiling point of 576.16 °C. It preserves its composition for 2 years if it is stored at -20 °C and below (Man et al., 2019). The hydroxyl part of hesperidin is affecting the biological activities and aromas of hesperidin. The hydroxyl part, which changing with its presence and number, directly affects the antioxidant capacity (Devi et al., 2015; Hiraishi et al., 2017). Antioxidant capacity increases with hydroxyl parts in hesperidin and promotes the human health (Hemanth Kumar et al., 2017).

3. Health effects of hesperidin

Flavanones are known to have a protective effect on the prevention of many diseases with antioxidant activities (Choi et al., 2022). The studies have shown that the hesperidin has a protective effect through various mechanisms. The antioxidant property of the hesperidin is explained directly by increasing radical scavenging and cellular defense (Parhiz et al., 2015). The water-soluble aglycon structure contributes to antioxidant activity (Choi et al., 2022). Hesperidin, whose biological and pharmacological effects have been reported, is known to have antioxidant, anti-cancer, anti-inflammatory, anti-obesity and anti-hypercholesterolemic effects (Ortiz et al., 2022). So, these benefits with its antioxidant activity, it has been stated that it has a neuroprotective effect by penetrating the brain barrier (Devi et al., 2015). In a study on the use of hesperidin as a drug, it was observed that it is non-toxic, digestible, and non-allergenic reactions (Wilmsen et al., 2005). Studies show that hesperidin has positive effects on cardiovascular diseases, psychological disorders, and skin diseases etc. (Yatao et al., 2018). Other studies on the effects of hesperidin on health are given in Table 1.

3.1. Anti-cancer effect

Due to the mechanism by which hesperidin activates the cellular protection mechanism against oxidative stress and the radical scavenging effect, its anticancer affect can be observed (Kim et



al., 2019). Studies have indicated that it has an anticancer effect and an inhibitory effect on cancer cells with the intake of hesperidin (Aggarwal et al., 2020). There are many studies showing the anticancer effect of the hesperidin. Çatmakaş et al., (2018), have tried to observe the apoptotic effect on the treatment of neuroblastoma of the hesperidin. Results were observed by giving the hesperidin supplement to the cells at certain proportions (2.5 µm and 5 µm). As a result, the apoptotic effect of the hesperidin on cells, a minimum of 38.9%, and maximum 53.6% compared to the control group, was observed. Kamaraj et al. (2010), in a study of mice with lung cancer, a certain amount of hesperidin was added to their diet. It has been reported that it has a positive effect on carcinogenesis by suppressing the metastasis of tumor cells. In the study, it was concluded that hesperidin had a positive effect on lung cancer. Aranganathan et al. (2009) was added hesperidin to the diets of rats for 15 weeks. In the study on colon cancer, it was seen that hesperidin has positive effects on the incidence of intestinal tumors with its strong antioxidant activity. In the Natarajan et al. (2011)'s study on human breast carcinoma, 20, 40, 60, 80 and 100 µm hesperidin was added to diets for 24 hours. It has been observed cell apoptosis. The mechanism of apoptosis was studied upon expression of caspase-3 protein. As the concentration of hesperidin increased, it significantly inhibited the proliferation of tumor cells. The study concluded that hesperidin showed a positive effect on breast cancer with the positive effect of caspase-3 protein on the apoptosis mechanism.

3.2. Anti-inflammatory effect

The anti-inflammatory effects of flavanones have been studying for a long time. Inflammation is a process that includes the mechanisms of different signals (Parhiz et al., 2015; Kim et al., 2019). It has been stated in previous studies that the hesperidin has a bowel protective effect. In the study conducted by Guo et al. (2019), the intestinal inflammation was added to the diets of mice observed. With the antioxidant activity of the hesperidin, it showed a strong anti-inflammatory effect against inflammation by developing intestinal epithelial cells (Guo et al., 2019). In another study conducted by Ribeiro et al. (2018), the mice induced by carrageenan were examined. With the supplement of hesperidin, it was seen that the edema seen at the end of 3 hours decreased by 33 %. Rotelli et al. (2003), in the study to observe the effect of anti-inflammatory effect on inflammation, many flavonoid effects were studied. In mice with an ear inflammation, it has been determined that the supplement of the hesperidin has significantly reduced inflammation and has a more effective anti-inflammatory effect than many flavonoids. In the study conducted by Yeh et al. (2007), mice with lung inflammation were observed.



Hesperidin was injected into their bodies. While reducing some inflammatory mediators, it has been seen that it reduces inflammation by tonifying cytokine with anti-inflammatory effect.

3.3. Anti-obesity effect

Studies on functional foods and components to prevent obesity are increasing day by day (Xiong et al., 2019). Research studies that the human body has positive effects on digestion with the supplement of the hesperidin (Mas-Capdevila et al., 2020). It is carried out in many drug studies for obesity problem. In this context, in the study conducted by Peng et al. (2016), the effect of the hesperidin on fat cells was investigated. It has been seen that the hesperidin reduces fat accumulation and leads to expression on fat cells. It has been reported to have a positive effect on fat metabolism by reducing the oleic acid/stearic acid content. In another study conducted by Ohara et al. (2015), the effects of caffeine-hesperidin combination on obesity were studied. As a result of the study, it significantly reduced the fat accumulation of the combination ($\alpha < 0.05$). It was concluded that it could be a strong agent to control obesity.

Table 1. Studies on The Health Effects of Hesperidin

	Results	References
Alzheimer's disease	Hesperidin fortified at doses of 10, 25, and 50 μ M. Protects against Alzheimer's-induced neurotoxicity via mitochondrial apoptotic.	(Wang et al., 2013)
Epilepsy	Hesperidin was injected into the diets of mice at 200 mg daily for 12 days. At the end of 12 days, behavioral, biochemical, and mitochondrial changes were preserved and reduced.	(Kumar et al., 2013)
Stress	Hesperidin supplements were taken at doses of 50 and 100 mg/kg for 14 days. At the end of 14 days, it was seen to ameliorates behaviors and dysfunction by modulating the nitrergic pathway.	(Viswanatha et al., 2012)
Hypertension	Hypertensive rats were injected with 5 mg/kg body weight. Vasodilator and anti-inflammatory activity have been seen by regulating the hypotensive state.	(Yamamoto et al., 2013)
Breast cancer	Hesperidin was supplemented at doses ranging from 20-40 mg/ml to patients with breast cancer. It accelerated cell apoptosis.	(Magura et al., 2022)
Gall bladder carcinoma	People with gallbladder tumors have been given hesperidin in a dose range of 25-200 μ M. Caspase-3 activation occurred and induced apoptosis.	(Pandey et al., 2019)
Dermatologic	Aged mice received 2% hesperidin topical twice daily for 9 days. Acute barrier healing was achieved by decreasing the pH of the skin surface.	(Man et al., 2015)
Raw wound	Hesperidin (10-80 mg/kg body weight) was given orally for 20 days for wound seen in diabetic rats. Faster healing of wounds was seen compared to control rats.	(Wang et al., 2018)
Cardiovascular diseases	Hesperidin was studied to examine renal functions. A decrease in urea level was seen. it was also concluded that renal functions improved.	(Pla- Pagá et al., 2019)

4. Conclusion

Flavonoids are natural phytochemicals that can have a therapeutic effect and contribute to the prevention of various diseases. Hesperidin is a citrus flavonoid with significant anti-inflammatory and antioxidant potential. Hesperidin is a natural antioxidant. In this way, it has effects such as anticancer, anti-inflammatory, anti-obesity, cholesterol-lowering. The health



effects of hesperidin have been the subject of numerous studies in recent years. Clinical studies of hesperidin and its metabolites, including their bioavailability, doses, efficacy, and tolerability should continue been researching.



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HEALING FROM THE PLANT: BERBERINE

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ABSTRACT

Chemical compounds (flavonoids, alkaloids, etc.) obtained from plants have been utilized in the treatment of diseases since the existence of humanity. Among the plant extracts that come to the fore in traditional medicine are alkaloids with strong activity. One of them is berberine, known as a natural isoquinoline alkaloid, which has biological and pharmacological activity. Berberine, which was used extensively in the treatment of diseases in Ayurveda and Chinese Medicine in the past, was first obtained from the rhizome and root of the *Coptis chinensis* plant. In addition to *C. chinensis*, the stem, bark, rhizome and root parts of *Berberis aquifolium*, *Hydrastis canadensis*, *Berberis aristata* and *Berberis vulgaris* plants are sources of berberine. The concentration of berberine can change depending upon the plant source and the extraction method. Today, extracted berberine is utilized as a raw material in both oral tablets and capsules in clinical applications. It has a characteristic bitter taste and low toxicity. In addition, berberine, a potential bioactive agent, is odorless and has beneficial health effects. It attracts attention with its anticancer and anti-inflammatory effects based on many biochemical pathways. Berberine is reported to have a therapeutic effect against prostate, breast, thyroid, bone, colon, liver, pancreatic and intestinal cancers. Moreover, it has a neuroprotective effect in anxiety, schizophrenia and Alzheimer's diseases. It has also a significant effect against such diseases as obesity, hypertension and diabetes. In the study, information about berberine alkaloid was given, and a literature review was conducted on its chemical structure, extraction methods and health effects.

Keywords: Alkaloids, Berberine, *Berberis vulgaris*



1. Introduction

Plants, which have existed since the Devonian period, have faced many difficulties, such as aggressors such as bacteria, fungi, viruses, and plant-eating animals until today. They needed a defense mechanism to combat these herbivores and aggressive microbes and started to produce metabolites (Wink, 2020). In addition to the defense mechanism, metabolites have several functions like inhibitory, cofactor effect and stimulating. Most plants produce a variety of organic compounds, traditionally called secondary metabolites (Tiwari and Rana, 2015). These metabolites are classified as terpenes and steroids, phenolics, flavonoids and alkaloids in terms of their composition (containing nitrogen), chemical structure (containing sugar, having a cyclic structure), synthesis and solubility in solvents (Tiwari and Rana, 2015; Velu et al., 2018). Alkaloids, which have low molecular weight and constitute 20% of plant-based secondary metabolites, are compounds that have nitrogen atoms in the heterocyclic ring. Alkaloids have profoundly affected human history with their various physiological and pharmacological effects (Kaur and Arora, 2015).

Medicinal plants, which have functional diversity since ancient times, have been used by turning them into a therapeutic resource with appropriate modifications. These medicinal plants, used as a medicine substitute, are the richest sources of phytochemicals that treat diseases (Milani et al., 2021; Xiong et al., 2022). Alkaloids synthesized as secondary metabolites in plants are also employed in traditional medicine for the treatment of various diseases (Guamán Ortiz et al., 2014; Och et al., 2020). Plants belonging to the families Berberidaceae, Rutaceae, Ranunculaceae and Annonaceae get attention due to their antimicrobial effects (Milani et al., 2021). Berberine (BBR), especially belonging to the Berberidaceae family, is a yellow quaternary isoquinoline alkaloid of natural origin (Man et al., 2001; Habtermariam, 2020). In this study, brief information about berberine was given and a literature review was conducted about its chemical structure and health effects.

2. Berberine

BBR, which has an important place in Traditional Chinese Medicine for about 1000 years, is a bioactive compound found in the roots, stems, rhizomes and bark of medicinal plants (Guan et al., 2020; Koperska et al., 2022). Originally isolated from the rhizome and root of the goldenthread (*Contis chinensis*) plant, this alkaloid is also found in some parts of plants such as goldenseal (*Hydrastis canadensis*), barberry (*Berberis vulgaris*), Oregon grape (*Berberis aquifolium*) and tree turmeric (*Berberis aristata*) (Rauf et al., 2021; Koperska et al., 2022). In addition to these, Berberine can also be extracted from the plant genera, such as, *Annickia*



(Annonaceae), *Sinopodophyllum* (Berberidaceae), *Coelocline* (Annonaceae), *Tinospora* (Menispermaceae), *Argermone*, *Zanthoxyllum* (Rutaceae), *Xanthortiza* (Ranuunculaceae), *Rollinia* (Annonaceae), *Evodia* (Rutaceae), *Xylophia* (Annonaceae), *Caulophyllum* (Berberidaceae). However, the species richest in berberine are *B. vulgaris* and *H. canadensis*, native to Asia and the America (Rauf et al., 2021). In addition to being extracted from some plant parts, it can also be produced by chemical synthesis. At the same time, Bbr has no side effects and low toxicity when used in appropriate doses (Koperska et al., 2022). Berberine, a secondary metabolite of Berberis, shows antimicrobial activity against various microorganisms such as fungi, bacteria (Gram-negative and Gram-positive), and protozoa (Milani et al., 2021). It is thought that this valuable component with strong pharmacological activities may be a promising treatment for current diseases (Och et al., 2022).

3. Chemical structure and extraction of berberine

BBR is a quaternary ammonium salt from the group of isoquinolein alkaloids (2,3-methylenedioxy-9,10-dimethoxyprotoberberine chloride) with a molecular weight of 336.37 g/mol and a molecular formula of $C_{20}H_{18}NO_4^+$ (Caliceti et al., 2016; Xu et al., 2021). BBR and its derivatives, which have a bitter taste, have a dominant yellow color and have been used for dyeing wood, leather and wool since the past. The color index value is specified as 75,160 under ultraviolet (UV) light (Çınar and Filiz, 2022). Although there is no clear information about the acid-base value, it has been reported in the literature that there are two different pKa values of BBR, 15.7 and 2.47 (Caliceti et al., 2016). Free BBR, which is a crystalline powder, dissolves easily in hot ethanol and dissolves slowly in water. It is almost insoluble in organic solvents such as benzene and chloroform. Solvents such as ethanol, methanol, acidified/aqueous methanol are commonly used to extract BBR from medicinal plants (Xu et al., 2021). Current methods such as ultra-high pressure extraction, supercritical fluid extraction and microwave assisted extraction are also used for the isolation of berberine instead of classical extraction methods (soxhlet extraction, percolation, maceration) (Çınar and Filiz, 2022). The extracted BBR is utilized as a raw material in capsules or tablets for use in clinical applications (Caliceti et al., 2021). In addition, *C. chinensis* has the highest berberine content among medicinal herbs. In general, the concentration of berberine in plants ranges from 0.05 to 96.10 mg/g (Xu et al., 2021). Some studies in which BBR was extracted from different parts of plants are given in Table 1.



Table 1. BBR contents of different plant sources

Plant source	Used part	Extraction method	Content of BBR	Reference
<i>H. canadensis</i>	Rhizome	Microwave assisted extraction with hexane-ethanol-phosphoric acid mixture (50:50:0.1 v/v)	16.76 mg/g	(Kamath et al., 2009)
<i>C. chinensis</i>	Rhizome	Microwave assisted extraction with methanol-phosphoric acid mixture (100:0.1 v/v)	10.60 mg/g	(Kamath et al., 2009)
<i>Coptis trifolia</i>	Rhizome	Microwave assisted extraction with methanol-phosphoric acid mixture (100:0.1 v/v)	3.80 mg/g	(Kamath et al., 2009)
<i>Berberis vulgaris L.</i>	Root	Ultrasonication (45 °C, 45 m) with %96 (v/v) ethanol	0.805-1.424 % (w/w)	(Kosalec et al., 2009)
<i>Berberis croatica</i> Horvat	Root	Ultrasonication (45 °C, 45 m) with %96 (v/v) ethanol	1.120-1.217 % (w/w)	(Kosalec et al., 2009)
<i>Berberis darwinii</i> Hook	Stem bark	Extraction with methanol (two weeks)	4.57 % (w/w)	(Habtemariam, 2011)
<i>Coptis teeta</i> Wall.	Rhizome	Ultrasonication (30 m) with hydrochloric acid-methanol solution (v/v)	81.06 mg/g	(Lv et al., 2016)

4. Biological activity of berberine

The functional components in the structure of medicinal plants constitute a paramount area of study (Milani et al., 2021). Alkaloids found in plants affect cellular metabolism and are used in the treatment of many diseases. BBR, an isocholine quaternary alkaloid, has a wide range of uses against diseases (Guamán Ortiz et al., 2014). BBR, which has a strong anti-inflammatory and antioxidant effect, especially has antidiabetic, neuroprotective, antiobesity, hypoglycemic, antihypertensive, hypolipidemic and antiobesity effects. In addition, it shows antiarrhythmic, antiatherosclerotic, antiviral and antibacterial properties (Guan et al., 2020; Çınar and Filiz, 2022). The studies in the literature on the biological effects of BBR are made mention to below. They have been carried on the effectiveness of berberine on various cancer types such as breast, colorectal, leukemia, pancreatic, hepatoma, prostate, melanoma, tongue, nasopharyngeal, oral-intraoral soft tissue, uterine leiomyoma, and epidermoid. Berberine has been found to have cytotoxic activity on many cancer cells (Imenshahidi and Hosseinzadeh, 2019; Çınar and Filiz, 2022). BBR inhibits cancer cell proliferation by inducing apoptosis and controlling autophagy. Also, it prevents tumor cell invasion and metastasis by inhibiting the expression of metastasis proteins (Rauf et al., 2021). According to Yan et al. (2021), it was reported that the cell cycle arrested in G0/G1 phase in bladder cancer cells T24 and BIU-87 cell lines after exposure to berberine. Likewise, BBR, Jantová et al. (2003), it was stated that the cell cycle arrested in the



G0/G1 phase in the lymphocytic leukemia L1210 cell line. Zhao et al. (2016), it was observed that the cell cycle was induced in the G2/M phase in hepatoma cells stimulated with BBR. At the same time, it was stated that BBR can be used in the regulation of cell cycle in Exo70 and HNF4 α hepatic cancer cells. Effect of BBR on gastric cancer cell Pandey et al. (2015) researched by. It has been reported that BBR inhibits survivin expression and suppresses the activation of epidermal growth factor receptor (EGFR) in gastric cancer tumors.

It has been reported that BBR, which also has an effect on the cardiovascular system, increases left ventricular function in congestive heart failure and has an antiarrhythmic effect (Zeng et al., 2003). In some cases, it is known to decrease blood pressure by reducing cholesterol, stimulate bile acid formation in the liver, reduce cholesterol absorption in the bowels (Li et al., 2015; Barrios et al., 2017; Wang and Zidichouski, 2018). It has been stated that BBR, which has the ameliorate to improve hyperglycemia and hyperlipidemia, has a protective effect on the central nervous system and is a promising agent in conditions like cerebral ischemia, schizophrenia, depression, and Alzheimer's disease. BBR easily crosses the blood-brain barrier and has become a potential agent in the treatment of neurological diseases (Kulkarni and Dhir, 2010; Ahmed et al., 2015; Lin and Zhang, 2018; Singh and Sharma, 2018; Och et al., 2020). BBR acts as a catalyst for lipid peroxidation by chelating iron, scavenging free radicals and protecting the liver and kidneys from toxicity. Protects against mercury-induced damage to the kidneys and liver by boosting the expression of the Bcl-2 protein (Othman et al., 2014; Gholampour and Keikha, 2018; Purwaningsih et al., 2023).

5. Conclusion

With metabolic diseases becoming an important problem worldwide, the interest in functional plant components has increased. Bioactive components obtained from different parts of such medicinal plants as roots, stems and leaves come to the forefront due to their therapeutic effects. The berberine compound, which can be obtained from medicinal plant sources, is an alkaloid used in Chinese traditional medicine. Extracted berberine concentration may vary depending on the plant source, extraction method and solvent. More work is needed to determine the most suitable method and solvent for extraction. In addition, berberine, which has many pharmacological and biochemical effects, has potential health effects such as anticarcinogenic, antiviral, antidiabetes, antiobesity and antihypertensive. Although it is a promising agent in the treatment of metabolic diseases like this, berberine does not have high bioavailability and absorption level. Therefore, more long-term and large-scale studies are needed to see the effectiveness of berberine.



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SİVAS İLİ PATATES EKİLİŞ ALANLARINDA ZARARLI OLAN Patates güvesi [*Phthorimaea operculella* ZELLER (LEPIDOPTERA:GELECHIIDAE)]'NİN POPÜLASYON TAKİBİ¹

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ÖZET

Ülkemizde geniş ekiliş alanına sahip olan patatesin endüstride kullanılması ve ihraç imkanının bulunması ülke ekonomisinde önemli bir yer almasını sağlamıştır. Patates tarımını etkileyen en önemli zararlılardan biri Patates güvesi [*Phthorimaea operculella* (Zeller) (Lep.: Gelechiidae)]'dir. Patates güvesinin ana konukçusu patatestir. Yeşil aksamda ve yumrulara beslenerek önemli ürün kayıplara neden olmaktadır. Bu çalışma Sivas ilinin Patates güvesi ile bulaşık olup olmadığını belirlemek için ele alınmıştır. Çalışma 2022 yılında Sivas'ın Hafik, Gemerek ve Merkez ilçelerinde yürütülmüştür. Deneme yapılacak patates alanlarına bitki çıkışından hemen sonra zararlıya ait eşeysel çekici feromon tuzağı yerleştirilmiştir. Tuzak kontrolleri haftalık olarak yapılmış ve tuzağa yakalanan erginler kaydedilmiştir. Çalışma sonuçlarına göre, Gemerek ilçesinde, ilk ergin çıkışı 7.06.2022 tarihinde olmuştur. En yüksek ergin sayısı 16 adet ile 23.08.2022 tarihinde belirlenmiştir. Son ergin 27.09.2022 tarihinde görülmüştür. Hafik ilçesinde, ilk ergin 21.06.2022 tarihinde tespit edilmiştir. En son ergin çıkışı ise 20.09.2022 tarihinde olmuştur. En fazla ergin sayısı 09.08.2022 tarihinde belirlenmiştir. Merkez ilçede, ilk ergin çıkışı 2 adet ergin ile 21.06.2022 tarihinde olmuştur. En fazla ergin sayısı aynı tuzakta 4 adet ergin ile 5.07.2022 tarihinde belirlenmiştir. En son ergin tarihi 23.08.2022 tarihinde tespit edilmiştir. Yapılan çalışma ile Sivas ilinin Patates güvesi ile bulaşık olduğu ortaya konulmuştur. Tohumluk üretimi yapılan alanlarda toleransı sıfır olan bu zararlı ile mücadelenin çok dikkatli bir şekilde yapılması büyük önem arz etmektedir.

Anahtar Kelimeler: Patates güvesi, Popülasyon takibi, Sivas

¹Sivas ili patates ekiliş alanlarında zararlı olan Patates güvesi [*Phthorimaea operculella* Zeller (Lepidoptera: Gelechiidae)]'nin popülasyon takibi ve *Lantana camara* L. bitki ekstraktının insektisit etkisi" adlı (Proje No:2022-YLTP-TBT-0002) yüksek lisans tezinin bir bölümüdür.



**POPULATION MONITORING of Potato tuber moth [*Phthorimaea operculella*
ZELLER [LEPIDOPTERA: GELECHIIDAE)] on POTATO CULTURAL AREA in
SİVAS PROVINCE**

ABSTRACT

The use of potatoes, which has a wide field of cultivation in our country, has made an important place in the national economy. One of the most important pests affecting potato agriculture is potato tuber moth [*Phthorimae operaculella* (Zeller) (Lep.: Gelechiidae)]. The main host of potato moth is potato. It is fed in green parts and tubers and causes significant products losses. This study was carried out to determine whether Sivas province is infected with potato moth. The study was carried out in Hafik, Gemerek and Merkez districts of Sivas in 2022. The sexual attractive pheromone trap of the pest was placed in the potato fields to be tested immediately after plant emergence. Trap controls were checked weekly and the adults caught in the trap were recorded. According to the results of the study, the first adult emergence was on 7.06.2022 in Gemerek district. The highest number of adults was determined on 23.08.2022 with 16 adults. The last adult was determined on 27.09.2022. In Hafik district, the first adult was identified on 21.06.2022. The last adult emergence was on 20.09.2022. The maximum number of adults was determined on 09.08.2022. In the central district, the first adult emergence was on 21.06.2022 with 2 adults. The maximum number of adults was determined on 5.07.2022 with 4 adults in the same trap. The last adult date was determined on 23.08.2022. With the study, it was revealed that Sivas province is infected with potato moth. It is of great importance that the control of this pest, which has zero tolerance in seed production areas, should be conducted very carefully.

Keywords: Potato tuber moth, population monitoring, Sivas



1.GİRİŞ

Dünyada bazı tropik ülkeler dışında hemen hemen her ülkede tarımı yapılan patates, insan beslenmesinde kullanılan buğday ve pirinç gibi temel besin maddelerden biridir. Ülkemizde geniş ekiliş alanına sahip olan patatesin endüstride kullanılması ve ihraç imkânının bulunması ülke ekonomisinde önemli bir yer almasını sağlamıştır. Son verilere göre ekiliş alanı 1.391.716 ha ve üretim miktarı 5.200.000 ton olduğu belirlenmiştir (Anonim, 2022).

Patates tarımını etkileyen en önemli zararlılardan biri Patates güvesi [*Phthorimae operculella* (Zeller) (Lep.:Gelechiidae)]'dir. Patates güvesi ilk kez 1873 yılında *Gelechia operculella* (Zeller, 1873) Amerika'da olarak belirlenmiştir. Daha sonra cins *Phthorimae operculella* olarak kaydedilmiştir. Tütün gebesi olarak da adlandırılan bu zararlının 1800 yılının ortalarında Tazmanya, Avustralya ve Yeni Zelanda'da patates yumruları üzerindeki zararı kaydedilmiştir (Berthon, 1855). Daha sonra bütün dünyaya yayılmıştır.

Patates güvesi ülkemizde ilk kez 1965 yılında Marmara bölgesinde tespit edilmiş ve bulaşma oranının %2-3 arasında olduğu belirlenmiştir (Göksu ve ark., 1971; Kayder ve Ataman, 1965,). Daha sonra yapılan sürvey çalışmaları ile bazı bölgelerinde zararlı ile bulaşık olduğu belirlenmiştir. Ege bölgesinde yapılan çalışmada tütünün en önemli zararlılardan biri olduğu ve mücadele yapılmadığı durumlarda %50-75 oranında ürün kaybına neden olduğu belirtilmiştir (Zümreoğlu, 1978). Orta Anadolu bölgesinde yapılan sürvey çalışmalarında zararlının daha çok depoda bulunduğu, tarla döneminde ise hiç bulunmadığı tespit edilmiştir (Çalışkaner ve ark., 1989).

Patates güvenin ana konukçusu patatestir. Solanaceae familyasına bağlı patates, domates, patlıcan, biber, tütün ve yabancı otlarda beslenmektedir (Rondon, 2010). Hem tarla döneminde hem depoda yumrulara beslenerek önemli kayıplara neden olmaktadır. Tarlada erginler yumurtalarını yapraklara veya yumrulardaki gözlerin kenarına bırakmakta, yumurtadan çıkan larva yapraklarda ve dallarda düzenli galeri açarak beslenmektedir. Bulaşık olan depolarda patatesin yemeklik ve tohumluk özelliğini bozmakta, kalite ve ağırlık kaybına neden olmaktadır. Yumrulara bulaşması durumunda mücadele yapılmadığı takdirde kayıp %100'e kadar yükselmektedir. Ayrıca yumruların enfekte olduğu kısımlarda bakteri ve fungusların daha hızlı üremesini sağlamakta ve sonuçta yumruların tamamen çürümesine neden olmaktadır (Fenemore, 1988; Sileshi and Teriessa, 2001). En önemli zararı depolanan yumrulara yaptığını ve depoda 2-4 ay içinde önemli kayıplara neden olduğu belirlenmiştir (Radcliffe, 1982).



Patates güvesi'nin karşı eşeyssel çekici feromon tuzakların bulunmasından sonra, monitor amaçlı ve popülasyon takibi çalışmalarında kullanılmaya başlanmıştır (Voerman and Rotschild 1978).

Orta Anadolu bölgesinde yapılan sürvey çalışmalarında Patates güvesinin İzmir, Sakarya, Bolu ve Düzce İllerinin bulaşık olduğu ortaya konulmuştur (Çalışkaner ve ark. 1989). Son yıllarda yapılan çalışmalarda söz konusu zararlı ile patates yetiştiriciliği yapılan Afyonkarahisar, Konya, Niğde, Nevşehir ve Kayseri illerinde bulaşık olduğu belirlenmiştir (Erdoğan and Hassan, 2017). Patates güvesinin gün geçtikçe yayıldığı ve patates ekilişi yapılan illerde sorun olmaya başladığı yapılan gözlemler ile ortaya konulmuştur. Tohumluk patates üretimi yapan firmaların Sivas iline yönelmeleri bu ilde tohumluk üretimde toleransı sıfır olan Patates güvesi varlığının tespiti büyük önem taşımaktadır.

Bu çalışma Sivas ilinin Patates güvesi ile bulaşık olup olmadığı ve zararlıının popülasyon takibini ortaya koymak için ele alınmıştır.

2. MATERYAL ve YÖNTEM

Çalışmanın materyalini, Patates ekiliş alanları, Patates güvesine ait eşeyssel feromon tuzak+kapsülleri oluşturmuştur. Feromon ve tuzaklar ilgili firmasından temin edilmiştir.

2.1. POPÜLASYON TAKİBİ

Çalışma Sivas iline bağlı, Merkez, Gemerek ve Hafik ilçelerinde bulunan patates ekiliş alanlarında yapılmıştır. Deneme patates bitkileri çıkışı olduktan sonra kurulmuştur. Bitki çıkışından hemen sonra zararlıya ait feromon+tuzak kombinasyonu bitkinin 25 cm üzerinden tahta bir kazık yardımıyla asılmıştır. Tuzak kontrolleri haftalık aralıklarla yapılmış ve sayılan erginler kaydedilmiştir. Sayımlara patates hasadı sonuna kadar devam edilmiştir. Deneme süresince kirlenen tuzaklar yenileri ile değiştirilmiştir. Bunun dışında deneme alanındaki her 1 da için 30 bitki seçilerek bitkinin tüm aksamı (yaprak, çiçek, gövde ve sap) kontrol edilmiştir. Deneme süresince iklim verileri (sıcaklık, yağış ve nem) en yakın meteoroloji istasyonundan alınmıştır. Çalışma sonunda zararlıının popülasyon yoğunluğu ve bulaşma oranı ortaya konulmuştur. İlave olarak zararlıının mücadelesine esas biyolojik kriterleri (İlk ergin çıkış tarihi, popülasyonun en yoğun olduğu tarih, çıkış süresi vb.) tespit edilmiştir. Çalışma yapılan süre içerisinde patates alanında herhangi bir pestisit uygulaması yapılmamıştır.

3. BULGULAR VE TARTIŞMA

3.1. POPÜLASYON TAKİBİ

Her deneme alanında kontrol edilen patates bitkilerinde Patates güvesine ait, yumurta, larva ve zararına rastlanmamıştır.

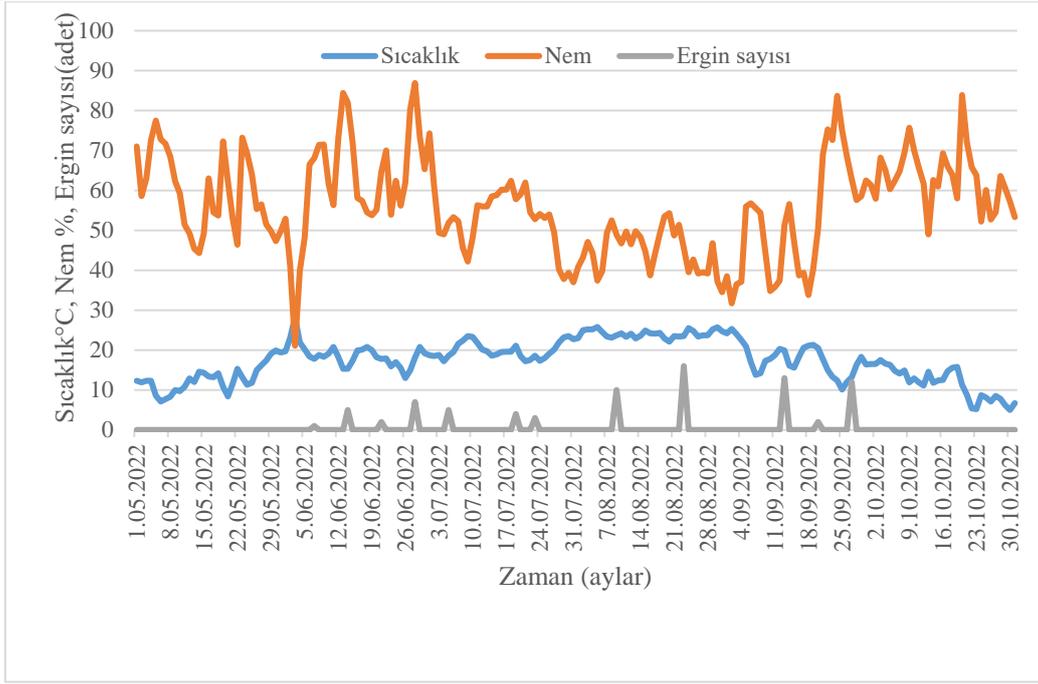


Patates güvesi popülasyon takibi çalışmaları Sivas ilinin Gemerek, Merkez ve Hafik ilçelerinde yapılmıştır.

Gemerek ilçesinde ilk ergin çıkışı 7.06.2022 tarihinde belirlenmiştir. Bu tarihte sıcaklık ve nem değerleri sırasıyla 17,8°C ve %68,1 olarak kaydedilmiştir. Ergin sayısının en yüksek olduğu tarih 16 adet ile 23.08.2022'de olmuştur (Sıcaklık, 23,5°C ve nem %45,6) Gemerek ilçesinde en son ergin görülme tarihi 27.09.2022 tarihinde olmuştur. Bu tarihte sıcaklık ve nem değerleri sırasıyla 13,2°C ve %62,8 olarak belirlenmiştir (Çizelge 1, Şekil 1).

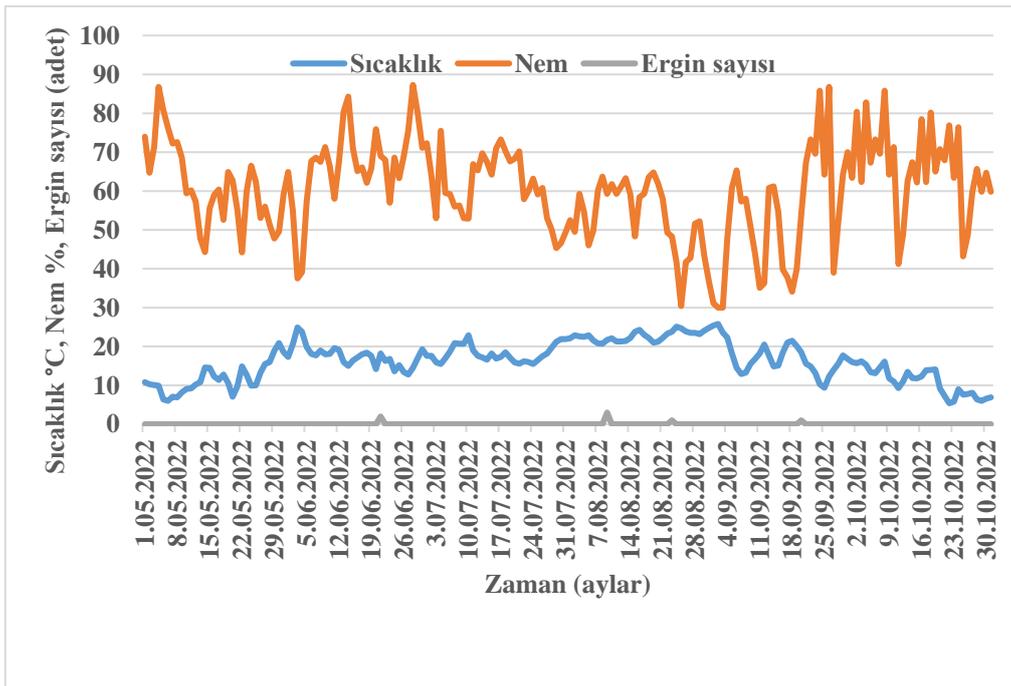
Çizelge 1. Sivas İli Gemerek, Hafik ve Merkez ilçeleri tuzaklarında yakalanan Patates Güvesi ergin sayıları (adet)

Sayım Tarihleri	Ergin sayısı (Tuzak/hafta Gemerek (10 da)	Ergin sayısı (Tuzak/hafta Hafik (6 da)	Ergin sayısı (Tuzak/hafta) Merkez (4 da)
24.05.2022	0	0	0
31.05.2022	0	0	0
07.06.2022	1	0	0
14.06.2022	5	0	2
21.06.2022	2	2	0
28.06.2022	7	0	0
05.07.2022	5	0	4
12.07.2022	0	0	0
19.07.2022	4	0	0
26.07.2022	0	0	0
02.08.2022	0	0	0
09.08.2022	10	3	0
16.08.2022	0	0	0
23.08.2022	16	1	3
30.08.2022	0	0	0
06.09.2022	0	0	0
13.09.2022	13	0	0
20.09.2022	2	1	0
27.09.2022	12	0	0
04.10.2022	0	0	0
11.10.2022	0	0	0
18.10.2022	0	0	0



Şekil 1. Sivas İli Gemerek ilçesi ergin uçuş eğrisi ve iklim verileri.

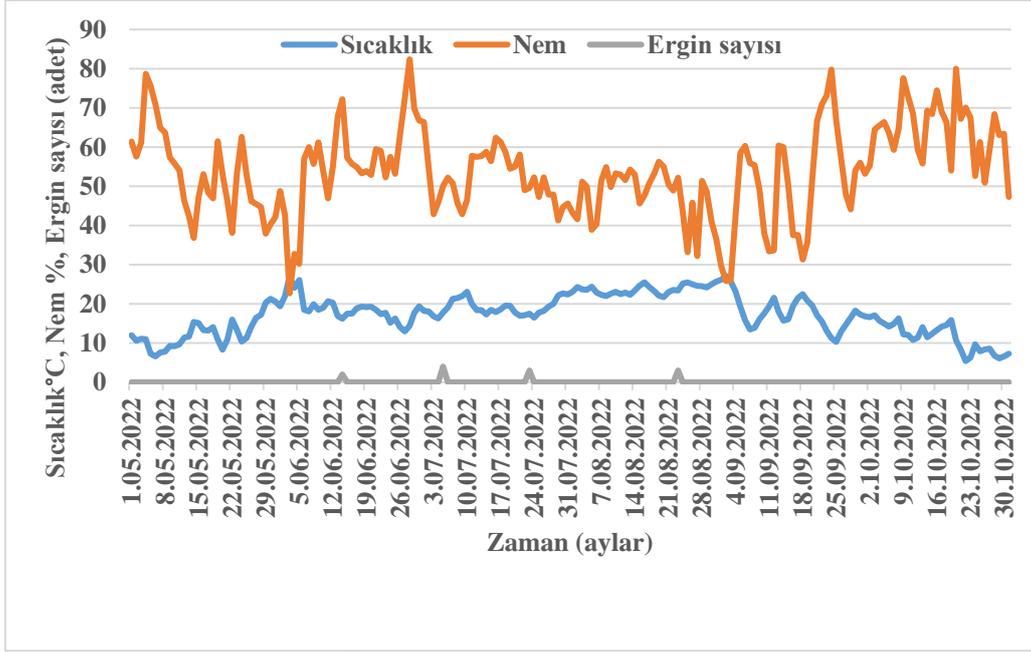
Hafik ilçesinde yapılan çalışmalarda elde edilen sonuçlar Çizelge 1 ve Şekil 2’de verilmiştir. Buna göre, ilk ergin (2 adet ergin/Tuzak/hafta) 21.06.2022 tarihinde tespit edilmiştir. Bu tarihte sıcak ve nem değerleri sırasıyla 18,2°C ve %69,0 olarak belirlenmiştir. En son ergin çıkışı ise 20.09.2022 tarihinde tespit edilmiştir (18,5°C sıcaklık ve %54,0 nem). En fazla ergin sayısı 09.08.2022 tarihinde 3 adet ergin sayısı ile belirlenmiştir. Bu tarihte sıcaklık ve nem değerleri 21,7°C ve %59,3 olmuştur.



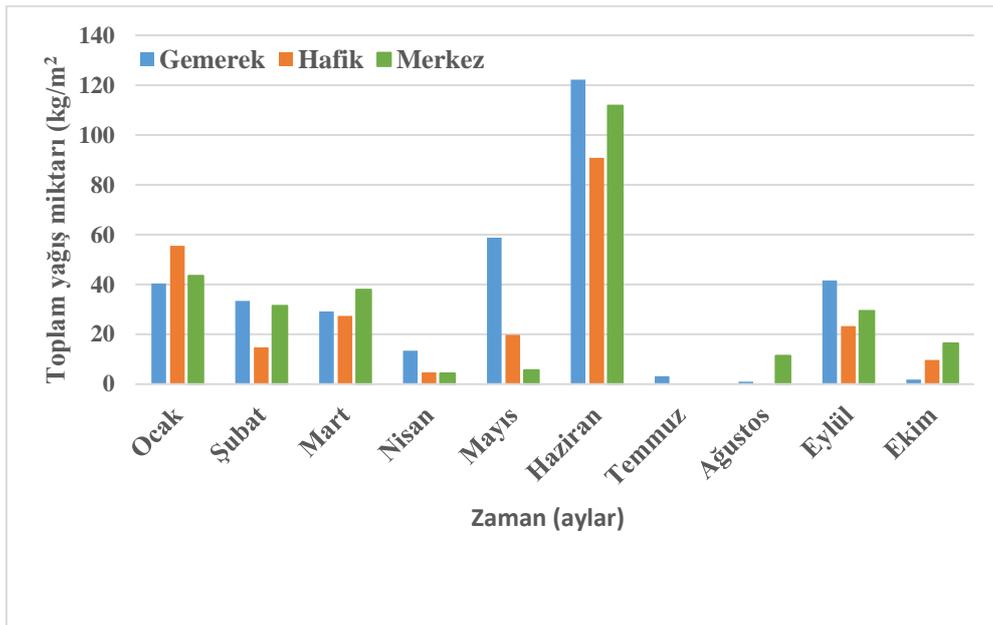
Şekil 2. Sivas İli Hafik ilçesi ergin uçuş eğrisi ve iklim verileri.



Merkez ilçede elde edilen veriler Çizelge 1 ve Şekil 3'te verilmiştir. Buna göre, ilk ergin çıkışı 2 adet ergin ile (tuzak/hafta) 21.06.2022 (17,5°C, %59,5) tarihinde olmuştur. En fazla ergin sayısı aynı tuzakta 4 adet ergin ile 5.07.2022 tarihinde belirlenmiştir. Bu tarihte sıcaklık ve nem değerleri sırasıyla 17,8°C ve %50,1 olarak kaydedilmiştir. En son ergin görülme tarihi 3 adet ile 23.08.2022 (23,4°C, %52,2) tarihinde olmuştur.



Şekil 3. Sivas İli Merkez ilçesi ergin uçuş eğrisi ve iklim verileri.



Şekil 4. Sivas ili Gemerek, Hafik ve Merkez ilçelerine ait aylık toplam yağış miktarları.



Orta Anadolu bölgesinde yapılan srvey alıřmalarında zararlının daha ok depoda bulunduęu, tarla dneminde ise hi bulunmadıęı tespit edilmiřtir (alıřkaner ve ark. 1989). Tohumluk patates üretiminde toleransı sıfır olan Patates güvesi karantina etmeni olup “Bitki Karantinası Ynetmelięi”nin “Trkiye’de sınırlı olarak bulunan karantinaya tabi zararlı organizmalar” listesinde yer almaktadır.

Yapılan alıřma ile Sivas ilinin de Patates güvesi ile bulařık olduęu belirlenmiřtir. Son yıllarda zararlı ile bulařık tohumlukların kullanılması zararlıdan arı olan blgelerin zararlı ile bulařmasına neden olmuřtur. İlave olarak Nevřehir ve Nięde gibi tohumluk patates üretim alanlarının nemli patates hastalıęı (patates sięil hastalıęı, *Synchytrium endobioticum*) nedeni ile tohumluk üretiminin bu illerde yasaklanması tohumluk patates üretimi yapan firmaların hastalıktan ari alanlara kayması da patates güvesinin yayılmasında nemli rol oynamıřtır. Bu konuda yapılan alıřmalarda, bitkilerin yayılması ile birlikte zerinde beslen bceklerin yeni alanlara yayılmasına neden olduęu belirlenmemiřtir (Reilly, 1996). Gnmzde Afyonkarahisar, Bolu, Dzce, Sakarya, Ankara, Nevřehir, Kayseri, Nięde ve Kırřehir illerinin patates güvesi ile bulařık olduęu ortaya konulmuřtur (Erdoęan and Hassan, 2017). Sz konusu alıřmada her  ilede de ilk ergin ıkıřının haziran ayında olduęu belirlenmiřtir. Bu sonuca benzerlik gsteren alıřmalar bulunmaktadır. Nitekim Erdoęan ve Hassan (2017)’na gre Kırřehir ve Bolu illerinde ilk ergin ıkıřlarının haziran ayında olduęu kaydedilmektedir. Bu dnemde ortalama yaęıř miktarlarının yılın en yksek seviyede olduęu belirlenmiřtir. Dięer aylarda ok dřk hatta bazı aylarda hi yaęıř olmadıęı kaydedilmiřtir (řekil. 4). Endonezya’da ıřık tuzakları ile yapılan bir alıřmada yaęıř miktarı ile tuzaęa yakalanan bcek sayısının doęru orantılı olduęu, yakalanan bcek sayısının yaęıř miktarının fazla olduęu zamanlarda bcek sayısında yksek olduęu ortaya konulmuřtur (Rees, 1983).

Zararlıının bu derece hızlı yayılmasının nedeninin iklim deęiřiklięi ve kresel ısınmanın da etkili olabileceęi dřnlmektedir. Quarles (2007) yaptıęı alıřmada, bcek trlerinin yayılma sınırlarının her on yıl iin yaklařık 6,1 km ve 6,1 km ykseęe doęru hareket ettięini ortaya koymuřtur. Buna baęlı olarak Avrupa’da bulunan 35 kelebek trnn yayılıřının 35-240 km kuzeye doęru kayma gsterdięi gzlenmiřtir (Parmesan et al., 1999). Stewart et al., (2007) tarafından yapılan bařka bir alıřmada ise, bceklerin sıcaklık ve nemdeki deęiřimlere karřı olduka hassas olmaları nedeni ile daęılımlarının oęu zaman iklimle yakından iliřkili oldukları ortaya konulmuřtur.

Yapılan alıřmada ilk erginin ıkıřının ve en fazla ergin sayısının Gemerek ilesinde olduęu belirlenmiřtir. Kayseri il sınırlarına yakın olan bu ilenin iklim kořullarının Kayseri iline benzer



olduğu ve ayrıca Kayseri ilinin Patates güvesi ile bulaşık olması (Çalışkaner ve ark. 1989) zararının yakın alana geçiş yaptığı düşünülmektedir. İlave olarak küresel ısınma nedeni ile Sivas ilinde de sıcaklığın artmış olabileceği düşünülmektedir. Bazı çalışmalarda, sıcaklık artışının günümüzde dağılımı sınırlı olan böcek türlerinin yayılım alanlarının daha soğuk bölgelere doğru olduğu ortaya konulmuştur. Çünkü bu bölgelerin küresel ısınma sonucunda daha sıcak olacağı düşünülmektedir (Harrington et al., 2001).

4. SONUÇLAR VE ÖNERİLER

Çalışma sonucunda, Sivas ilinin Patates güvesi ile bulaşık olduğu ortaya konulmuştur. Tohumluk patates üretiminde toleransı sıfır olan bu zararlı ile mücadelede gerekli özenin gösterilmesi zararının diğer patates yetiştirilen alanlara yayılması açısından büyük önem arz etmektedir.



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ÖZET

Meralar, ucuz ve kaliteli kaba yem kaynağı olmasının yanında, erozyonu azaltması, toprağın iyileştirilmesinde katkı sağlaması, yabancı bitki ve hayvanlara barınak olması gibi görevleri üstlenerek oldukça büyük önem arz etmektedirler. Ülkemizde 14.6 milyon hektar çayır- mera mevcuttur, ülkemiz kara topraklarının %18.8'ini oluşturmaktadır. Bu kadar öneme sahip olmasına karşın mera amenajman kurullarına uyulmaması nedeniyle verimleri düşmüş ve tahrip olmuştur. Bu durum hayvansal ürün fiyatlarının artışına neden olarak ülke ekonomisini olumsuz etkilemektedir. Oysaki ülkemizde hayvancılığın büyük bir bölümü mera hayvancılığı olarak yapılmaktadır. Meralardan elde edilen yeşil ot, botanik kompozisyonuna ve çevre şartlarına göre değişmekle birlikte kaliteli yem kaynağı olup vitaminler ve mineral içeriği yüksektir. Merada otlayan hayvanlar daha sağlıklı ve huzurlu olmaktadır. Ayrıca meradan beslenen hayvanlara ait ürünler daha lezzetli ve insan sağlığı açısından daha faydalıdır. Doğu Anadolu Bölgesi ülkemiz çayır-meralarının %37'sini barındırması münasebeti nedeniyle büyük önem taşımaktadır. Bölgenin kaba yem ihtiyacını karşılamada önemli yere sahip illerden biri de 366 bin ha çayır mera varlığıyla Muş ilidir. İl genelinde Tarım ve Orman Bakanlığı tarafından 2022 yılı itibarıyla 51 köyde 65 bin ha alanda mera ıslah ve amenajman çalışmaları tamamlanmıştır. Genetik açıdan da büyük önem arz eden bu alanlarda ıslah yapılması umut verici olarak görülmektedir. Islah edilen bu alanların sürdürülebilirliği açısından tarla tarımı içerisinde yem bitkileri tarımının yapılması hayvancılığımızın gelişimine şüphesiz katkı sağlayacaktır. Üreticilere 4342 sayılı kanun eğitimlerle özümsetilmeli, 4342 sayılı Mera Kanunu'nun uygulama noktasında ki sorunları giderilmelidir.

Anahtar Kelimeler: Muş, Mera, Çayır, Hayvancılık, Sorun, Çözüm



PROBLEMS AND SOLUTIONS RELATED TO MUŞ PROVINCE RANGELANDS

ABSTRACT

In addition to being a source of cheap and high quality roughage, pastures are of great importance by undertaking tasks such as reducing erosion, contributing to soil improvement, and sheltering wild plants and animals. There are 14.6 million hectares of meadows in our country, constituting 18.8% of our country's land lands. Although it is of such importance, its yields have decreased and been destroyed due to non-compliance with the pasture management boards. This situation affects the country's economy negatively by causing an increase in animal product prices. However, a large part of animal husbandry in our country is done as pasture livestock. The green grass obtained from the pastures varies according to its botanical composition and environmental conditions, but it is a quality feed source and has a high vitamin and mineral content. Animals grazing in the pasture are healthier and more peaceful. In addition, the products of animals fed from pasture are more delicious and more beneficial for human health. The Eastern Anatolia Region is of great importance because it contains 37% of our country's meadows and pastures. One of the provinces that has an important place in meeting the roughage needs of the region is the province of Muş with 366,000 ha of meadow pasture. As of 2022, rangeland improvement and management works have been completed in 65 thousand hectares of land in 51 villages by the Ministry of Agriculture and Forestry throughout the province. Breeding in these areas, which are also of great importance in terms of genetics, is seen as promising. In terms of the sustainability of these improved areas, the cultivation of forage crops in field agriculture will undoubtedly contribute to the development of our livestock. Law No. 4342 should be assimilated to producers with trainings, and the problems in the application of Pasture Law No. 4342 should be resolved.

Keywords: Muş, Pasture, Meadow, Livestock, Problem, Solution



GİRİŞ

Çayır meralar, hayvanların beslenmesinde buna bağlı olarak da insanların gıda ihtiyacını karşılamada tarihin tüm dönemlerinde önemli rol oynamıştır. Hayvanlar için önemli ve ekonomik yem kaynağını çayır meralar oluşturmaktadır. Çayır meralar ekonomik faydalarının yanında erozyonu engellemede, toprak verimliliğini artırmada, yaban hayvanlarına ev sahipliği yapması, taban sularını ve akarsuları beslemesi, rekreasyonel alan oluşturma, hava kalitesine olumlu etkisi gibi fonksiyonlarıyla, ormanlarımız fosil enerji kaynakları madenler gibi en başta gelen doğal kaynaklarımızdan biridir. Son derece önemli olan bu doğal kaynağımızın korunması, bakımı, ıslahı ve yem veriminin artırılması çayır mera varlığının bugün ve geleceği için son derece önemlidir.

Merada otlayan hayvanların yem kaynaklarından daha kolay yaralanması için ve yem kaynaklarının veriminin, kalitesinin artırılması, mera üzerinde özel işlemler yapılması, geliştirici önlemler alınması ve bazı tesislerin inşa edilmesine mera ıslahı denilmektedir (Bakır, 1976). İslahta başarının temel şartlarından en önemlisi meranın iyi tanınmasıdır. Ülkemiz farklı iklim ve toprak özelliklerine sahiptir bu nedenle farklı bölgelerde yapılan çalışmalar büyük önem taşımaktadır (Gökkuş ve ark. 1993). Bu çalışmalar iki grup altında incelendiğinde çayır-mera botanik kompozisyonu, mera durumunun tespiti ve çeşitli ıslah yöntemleri (yabancı otlarla mücadele, gübreleme, yakma vb.) konuları karşımıza çıkmaktadır (Büyükburç 1999).

Çayır meralar 14,6 milyon ha ile kara alanlarımızın yaklaşık %18'ini kaplamakta ve bu alanlar hayvanlar için yem kaynağı oluşturmaktadır. Doğu Anadolu bölgesi 5.5 milyon hektar ile ülkemizin çayır-mera alanının yaklaşık %37'ine sahiptir. Doğu Anadolu bölgesinde yer alan Muş ilinde yaklaşık 366 bin ha çayır mera varlığı bulunmaktadır (Anonim 2022). Muş ili ekonomik yapısı incelendiğinde başlıca geçim kaynaklarının arasında hayvancılık yer almaktadır. Hayvancılığında en önemli üretim maliyetini yem giderleri oluşturmaktadır.

Muş ilinde de ülkemizin diğer bölgelerinde olduğu gibi çayır ve mera alanlarının bitki örtüsü yönünden çok zayıf olması, hayvansal üretimde verimin azalmasına neden olarak ülkemiz ekonomisini etkilediği gibi topraklarımızın erozyonla taşınmasını, yer altı ve yer üstü su kaynaklarımız içinde sorun teşkil etmektedir. Mera bitki örtüsü ile erozyonun doğrudan ve kuvvetli bir ilişkisi vardır (Erkan 1971).

Muş İli Çayır-Mera Varlığı

Muş ili toprak yapısı, su kaynakları ve sahip olduğu geniş ovalarıyla tarımsal açıdan önemli bir potansiyel taşımaktadır ve bir çok bitkinin kültürel olarak yetiştirilmesine olanak tanımaktadır.



İLÇE	TESPİT (ha)	TAHDİT (ha)	TAHSİS (ha)
Merkez	1.146.245	1.158.673	53.322,5974
Bulanık	775.691	716.857	35.219,7285
Hasköy	54.511	50.729	4.260,497
Korkut	311.224	264.762	28.109,5074
Malazgirt	615.550	598.378	6.241,4099
Varto	757.285	757.978	71.438,7436
TOPLAM	366.051	354.132	198.592,484

İlimizde tespit, tahdit ve tahsis işlemleri yapılan mera varlığının ilçelere göre çayır mera varlığı dağılımı Tablo 1 de verilmiştir (Anonim 2022).

Tablo 1. Muş ili ilçelerinin mera durumları dağılımı

2022 yılı itibariyle Muş ilinde ıslah ve amenajman çalışmaları 51 köyde 65.972 bin ha alanda tamamlanmıştır. 65 köyde yürütülen arazi toplulaştırma projesi kapsamında 57 köyün mera toplulaştırma işlemleri tamamlanmış olup 8 köy içinde çalışmalar devam etmektedir (Anonim 2022).

İlin Hayvan Varlığı

Muş il genelinde ki hayvan sayıları Tablo 2. de verilmiştir. İl genelinde 292.157 baş sığır, 8843 baş manda, 1.004.492 baş koyun, 200.508 baş keçi varlığı bulunmaktadır (Tüik 2022).

Tablo 2. Hayvan Cinsine Muş ili Hayvan Varlığı

Hayvan Cinsi	Muş İli Varlığı (Baş)	Türkiye Varlığı (Baş)	Muş (%)
Sığır	292157	17875672	% 1.63
Manda	8843	182717	% 4.80
Koyun	1004492	46122627	% 2.17
Keçi	200508	12324928	% 1.62
Toplam	1506000	76505944	% 1.96

Muş ilinde halk elinde manda ıslahı projesi yürütülmektedir. Ülkemizin manda varlığının %4.80'i ilimizde yer almaktadır (Tüik 2022). Bölgede ki su kaynakları mera potansiyeli ve yetiştiricilerde manda yetiştirme kültürü olması mandanın ilde ki ekonomik önemini artırmaktadır.



Çayır Meraların Geliştirilmesine Yönelik Çalışmalar

Mera, yaylak ve kışlak alanları ile ilgili bir yasanın olmaması uzun yıllar boyunca tahrip olmasına neden olmuştur (Çomaklı ve ark. 2008). 28 Şubat 1998 yılında 4342 sayılı mera kanununun çıkarılması somut bir adım olmuş ve bu yasa ile;

- Kadimden beri mera, yaylak ve kışlak olarak kullanılan yerler ile, aynı amaçla kullanılmak üzere köy ve belediyelere tahsis ya da terk edilen yerler,
- Devletin hüküm ve tasarrufunda veya hazinenin mülkiyetinde bulunan arazilerden etüt sonucu mera, yaylak ve kışlak olarak yararlanılabileceği anlaşılan yerler,
- Mera, yaylak ve kışlak olarak kullanılmak amacıyla kamulaştırılacak yerler,
- Tapu kayıtlarında mera, yaylak ve kışlak olarak görülen ve halen işgal edilen yerlerin kesin sınırlarının belirlenip amacına uygun şekilde daha verimli kullanımının sağlanması amaçlanmıştır.

Ayrıca bu mera kanunu ile üreticilere ve teknik personele eğitim verilmesi uygun bulunmuş bu kapsamda mera yaz okulları düzenlenmektedir. 2023 yılı itibariyle ilimizde 366.051 ha alanda tespit çalışması, 354.132 ha alanda tahdit çalışması, 198.592 ha alanda tahsis çalışması tamamlanmıştır (Anonim 2022).

Mera Verimine İlişkin Sorunlar

Meralarımızın bilinçsiz kullanımı meralarımızda ağır tahribatlar oluşturmuştur. Hayvanlar için değerli olan azalan türler ortamı terk etmiş yerini çoğalıcı ve istilacı türlere bırakmıştır. Bu durum meraya dayalı hayvancılığı ekonomik olmaktan uzaklaştırmakta ve vejetasyonun iklimakstan ayrılmasına neden olmuştur (Çomaklı 2001).

Muş ili merkezinde kıybaşı köyü merasında yapılan çalışmada lup yöntemiyle botanik kompozisyon belirlenmiştir (Kökten ve Tanrıverdi 2020).



Tablo 3. Lup Metoduna Göre Kıyıdaş Köyü Merası Bitkilerine Ait Tür Adları, Ait Oldukları Cins Ve Familyalar

Bitki İsmi	Cinsi	Familyası
<i>Elytrigia repens</i> L.	<i>Elytrigia</i>	Poaceae
<i>Alopecurus pratensis</i> L.	<i>Alopecurus</i>	Poaceae
<i>Aegilops umbellulata</i> Zhuk.	<i>Aegilops</i>	Poaceae
<i>Taeniatherum caput-medusae</i> L.	<i>Taeniatherum</i>	Poaceae
<i>Bromus tectorum</i> L.	<i>Bromus</i>	Poaceae
<i>Festuca rubra</i> L.	<i>Festuca</i>	Poaceae
<i>Agropyron intermedium</i> Host.	<i>Agropyron</i>	Poaceae
<i>Poa bulbasa</i> L.	<i>Poa</i>	Poaceae
<i>Bromus erectus</i> L.	<i>Bromus</i>	Poaceae
<i>Aegilops cylindrica</i> Host.	<i>Aegilops</i>	Poaceae
<i>Stipa lagascae</i> Roem.&Schult.	<i>Stipa</i>	Poaceae
<i>Lolium perenne</i> L.	<i>Lolium</i>	Poaceae
<i>Gundelia tournefortii</i> L.	<i>Gundelia</i>	Asteraceae
<i>Achillea biebersteinii</i> Afan.	<i>Achillea</i>	Asteraceae
<i>Crepis sancta</i> L.	<i>Crepis</i>	Asteraceae
<i>Centaurea depressa</i> L.	<i>Centaurea</i>	Asteraceae
<i>Helichrysum plicatum</i> DC.	<i>Helichrysum</i>	Asteraceae
<i>Taraxacum androssovii</i> S.	<i>Taraxacum</i>	Asteraceae
<i>Picnomon acarna</i> L.	<i>Picnomon</i>	Asteraceae
<i>Achillea wilhelmsii</i> L.	<i>Achillea</i>	Asteraceae
<i>Tripleurospermum oreades</i> Boiss.	<i>Tripleurospermum</i>	Asteraceae
<i>Astragalus microcephalus</i> Willd.	<i>Astragalus</i>	Fabaceae
<i>Onobrychis sativa</i> L.	<i>Onobrychis</i>	Fabaceae
<i>Lathyrus sativus</i> L.	<i>Lathyrus</i>	Fabaceae
<i>Vicia cracca</i> L.	<i>Vicia</i>	Fabaceae
<i>Trigonella corniculata</i> L.	<i>Trigonella</i>	Fabaceae
<i>Medicago rigidula</i> L.	<i>Medicago</i>	Fabaceae
<i>Medicago minima</i> L.	<i>Medicago</i>	Fabaceae
<i>Trigonella monantha</i> C.A.	<i>Trigonella</i>	Fabaceae
<i>Trigonella corniculata</i> L.	<i>Trigonella</i>	Fabaceae
<i>Trigonella foenum-graecum</i> L.	<i>Trigonella</i>	Fabaceae
<i>Lallemantia peltata</i> L.	<i>Lallemantia</i>	Lamiaceae
<i>Marrubium vulgare</i> L.	<i>Marrubium</i>	Lamiaceae
<i>Ziziphora capitata</i> L.	<i>Ziziphora</i>	Lamiaceae
<i>Salvia verticillata</i> L.	<i>Salvia</i>	Lamiaceae
<i>Thymus vulgaris</i> L.	<i>Thymus</i>	Lamiaceae
<i>Scutellaria orientalis</i> L.	<i>Scutellaria</i>	Lamiaceae
<i>Teucrium chamaedrys</i> L.	<i>Teucrium</i>	Lamiaceae
<i>Euphorbia virgata</i> Waldst et Kit.	<i>Euphorbia</i>	Euphorbiaceae
<i>Euphorbia stericta</i> L.	<i>Euphorbia</i>	Euphorbiaceae
<i>Verbascum lasianthum</i> Boiss.	<i>Verbascum</i>	Scrophulariaceae
<i>Scrophularia olympica</i> Boiss.	<i>Scrophularia</i>	Scrophulariaceae
<i>Roemeria refracta</i> Stev.	<i>Roemeria</i>	Papaveraceae
<i>Papaver orientale</i> L.	<i>Papaver</i>	Papaveraceae
<i>Alyssum desertorum</i> Stapf.	<i>Papaver</i>	Brassicaceae
<i>Erysimum alpestre</i> Kotschy.	<i>Erysimum</i>	Brassicaceae
<i>Anchusa officinalis</i> L.	<i>Anchusa</i>	Boraginaceae
<i>Anchusa azurea</i> ssp.	<i>Anchusa</i>	Boraginaceae
<i>Anchusa leptophylla</i> L.	<i>Anchusa</i>	Boraginaceae
<i>Consolida orientalis</i> J. Gay	<i>Consolida</i>	Ranunculaceae
<i>Ranunculus kotschy</i> Boiss.	<i>Ranunculus</i>	Ranunculaceae
<i>Ranunculus polyanthemus</i> L.	<i>Ranunculus</i>	Ranunculaceae
<i>Scandix pecten-veneris</i> L.	<i>Scandix</i>	Apiaceae
<i>Torilis arvensis</i> L.	<i>Torilis</i>	Apiaceae
<i>Silene conoidea</i> L.	<i>Silene</i>	Caryophyllaceae
<i>Gypsophila bicolor</i> Freyn&Sint.	<i>Gypsophila</i>	Caryophyllaceae
<i>Minuartia hamata</i> Mattf.	<i>Minuartia</i>	Caryophyllaceae
<i>Allium roundum</i> L.	<i>Allium</i>	Alliaceae
<i>Blasmus compressus</i> L.	<i>Blasmus</i>	Cyperaceae
<i>Carex pendula</i> Hudson	<i>Carex</i>	Cyperaceae
<i>Legousia pentagonia</i> L.	<i>Legousia</i>	Campanulaceae
<i>Linum mucronatum</i> L.	<i>Linum</i>	Linaceae
<i>Scabiosa argentea</i> L.	<i>Scabiosa</i>	Dipsacaceae
<i>Asperula orientalis</i> Boiss.	<i>Asperula</i>	Rubiaceae
<i>Hypericum scaprum</i> L.	<i>Hypericum</i>	Hypericaceae
<i>Sanguisorba minor</i> Scap.	<i>Poterium</i>	Rosaceae



Yabancı Ot Sorunu

Hayvanlara zarar veren yada otlatma konusunda isteksiz davrandıkları türler yabancı ot olarak nitelendirilmektedir. Ayrıca bu ot grubu hayvansal ürünlerin kalitesinin düşmesine de neden olmaktadır (Altın ve ark 2021). Çayır meralarda genel olarak yabancı otların özellikleri, Hayvanların sağlığına zararlılardır bazıları zehirli bile olabilmektedir, Hayvansal ürünlerin kalitesini olumsuz etkileyen (kokulu, dikenli), Dikenli, tüylü sert yapılı hayvanların otlamak istemedikleri bitkiler, Azalıcı bitkilerin gelişmesini engelleyen (çalı türleri), Mera amenajmanını zorlaştırıcı vejetasyon dönemine sahip bitkilerdir. Muş ili meralarında yabancı ot ile yapılan mücadeleler mera vejetasyonun iyileşmesine katkı sağlamıştır (Anonim 2022).

Otlatma Sorunu

Meralarımız üzerindeki otlatma baskısının kaldırılması ve mera alanlarından faydalanmada en fazla hayvan ürünü temini ve meranın verimliliğinin uzun yıllar içinde artarak devamlılığı esas ilke olarak belirlenmelidir (Tosun 1981).

Koruma Sorunu

Çayır mera arazilerinin vasfını değiştirmek beraberinde birçok problemi de beraberini getirmektedir. Meralardan faydalanmanın en uygun ve ekonomik yönü bu alanlarda mera hayvancılığı yapılmasıdır (Tarman 1972).

Göçer Sorunu

İlimiz meraları göçerler tarafından tahrip edilmektedir. Ünitiform ve kontrollü otlatma sağlanamamakta kontrol mekanizması yetersiz kalmaktadır. Göçerler aynı zamanda ısınma ihtiyaçları için çalılıarı yakarak ekolojik dengeye zarar vermektedirler. Bölge dışından gelen hayvanlar bulaşıcı hastalıklar da taşımaktadırlar. Ayrıca güzergahında yer alan tarlalara da zarar vermektedirler.

Çayır Mera Sorunlarına İlişkin Öneriler

- ✓ Meralar vejetasyonuna en uygun hayvan cinsi ile, düzenli şekilde, zamanında ve kapasitesine uygun şekilde otlatılmalıdır.
- ✓ Meralarda otlatma baskını azaltmak için yem bitkileri yetiştiriciliği teşvik edilmeli (Açıkgöz 2001), tarla arazilerinde rotasyon meraları oluşturulmalıdır.
- ✓ Mera ıslahı ve amenajmanı konusunda üreticilere eğitim verilip iş birliği içerisinde çalışmalıdır.
- ✓ Mera ıslahlarında kullanılmak üzere makine ekipman tedariki yapılmalıdır.



- ✓ Yüzeide bulunan taşlar, kapladıkları alan kadar ot miktarını azaltmaktadır. Toplanabilecek taşlar düzlüklerde yığınlar halinde, eğimli arazilerde ise belirli aralıklarda hayvanların geçişini engellemeyecek, erozyonu ise engelleyecek şekilde toplanmalıdır.
- ✓ Bölgemiz meralarında baklagil bitkilerinin yoğunluğunun az olduğu meralarda 7,5-10 kg/da N, mevcut vejetasyonda %10'nun üzerinde baklagil bitkileri varsa azota ek olarak 5kg/da P₂ O₅ atılması ile olumlu sonuçlar elde edilmiştir (Altın 1975; Koç ve ark. 2003).
- ✓ Sürülüp terk edilmiş meralarda toprak ve iklim faktörleri göz önünde bulundurularak uygun tür seçimi yapılarak karışım halinde suni mera tesis edilmelidir.
- ✓ Meralarımız göçerlerden önce yöre halkına tahsis edilmelidir.
- ✓ Çayırlar özellikle ilkbaharda otlatılmamalıdır biçilerek değerlendirilmelidir.
- ✓ Çayır vejetasyonlarında yabancı ot mücadelesi yapılarak ot kalitesi artırılmalıdır.
- ✓ Çayırlar verim ve kalitenin en yüksek olduğu dönemde yapılmalı hasat geciktirilmemelidir.
- ✓ Çayır biçimlerinde mekanizasyona geçilerek hasat kayıpları azaltılmalıdır.

SONUÇ

Hayvanlara ucuz ve nitelikli kaba yem sağlayan, gen kaynağı niteliği olan çayır-mera alanlarında birçok sorun ile karşılaşmaktadır. Ülkemizin diğer illerinde olduğu gibi Muş ilinde de ağır, erken ve düzensiz otlatma yapılmaktadır. Bu durum çayır-mera verimlerini olumsuz yönde etkilemektedir. Bu problemlere 4342 sayılı yasada belirtilen çayır-mera yönetim ilkelerine uyulmalıdır.



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STUDYING THE GROWTH OF CHROMOLAENA ODORATA IN TWO SOIL SAMPLES UNDER GREENHOUSE CONDITION

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ABSTRACT

Chromolaena odorata is known to invade different types of soil as a result of the abundance of certain soil nutrients. However, there is very little information as to the evaluation of soil conditions that causes invasion of those specific soil by the plants. In this experiment, the components of two soil samples used in the greenhouse for the propagation of *Chromolaena odorata* was assessed, the physical condition of the greenhouse evaluated followed by the determination of the ability of the weed to grow under such conditions. Textural analysis of the two soil samples indicated clay and sandy loam soil. Meanwhile measured growth parameters in clay soil were significantly different from that sandy loam soil at 0.05 degree of freedom. Optimal growth of *Chromolaena odorata* was observed with the prevalent conditions and the physico-chemical parameters of the soil were improved upon throughout the duration of growth of the plant. The best stage for cross transplanting of the weed was found to fall within the range of 4weeks after sprouting in the nursery as was noted by the highest percentage of survival of the plants within that interval of time. Discovering the drivers of *Chromolaena odorata* invasiveness would enable its control to be planned for as well as provides aid to its propagation in an environmental condition deficient of the plant.

Keywords: *Chromolaena ododrata*, siam weed, soil, green house study



Introduction

Nutrients availability and its absorption by plant are regarded as the greatest driver of plants growth. Plants grow due to the nature of the soil, available nutrients, prevailing environmental conditions, pH, and the particular plants in question (Kirmani *et al.*, 2011). Depending on its location, soils are made up of some combination of particles which include; sand, silt, clay, and organic matter. Soil texture also referred to as the makeup of the soil, as well as the pH, determines nutrient availability to plants (Parry, 2010), while the former determines how well nutrient is retained in soil as well as water, the later tend to affect the availability of nutrients in the soil. Macronutrients seem to be less available at low pH while micronutrient appreciates such conditions and vice vaser. An ideal soil should therefore be able to contain an equivalent component of the nutrient for an optimal growth of the plants. However, this does not naturally occur, providing for soil variation in nutrients and texture thereby making some soils more productive than the other. High level of nutrients in the soil causes contamination and in agriculture generally, optimal water supply as well as nutrient conditions are usually chosen for an optimal plants growth (Mackova *et al.*, 2009).

Chromolaena odorata (Siam weed) is an invasive shrub of the neotropical origin, but have been introduced to other parts of the world including Africa. *C. odorata* has been implicated in its pharmacological and medicinal properties (Che Man, 2010; Taiwo *et al.*, 2001; Anyasi, 2011), it has also been involved in the remediation of soil pollution (Singh *et al.*, 2009, Tanhan *et al.*, 2007, 2011). *C. odorata* as a plant grows in several soil types because it tolerates a broad range of soil pH. It also prefers well drained soil but is affected by water logging and saline soils (Gareeb, 2007). When waterlogged, *C._odorata* becomes very much susceptible to pathogenic fungi (root disease), which include yellow leaves, stem blacken as well as a situation known as die back (Mcfadyen, 2007). The plant enjoys nutrient-rich soil, but when it finds itself in a nutrient-poor soil, though it may grow, the growth however will be retarded (Robinson, 2006). *C. odorata* triumphs in an open and undisturbed area with appropriate light and temperature range of about 20-37°C (Gareeb, 2007). A key survival strategy of this plant is the total non-structural carbohydrates, which is its source of carbon stored in the root and is used for the survival of the plants especially during disturbance as well as in winter (Kizlowski, 1992). The quantity of such reserves determines plants ability to grow and reproduce (Robinson, 2006). It also enables the plant to survive during competition with surrounding vegetation allowing rapid invasion, response to stress, as it uses the energy made available to the plant when the carbohydrate is metabolized. *C. odorata* therefore have a very spontaneous growth when the



plants have efficient allocation of such resources, and its plasticity towards environmental changes enables its presence in a variety of habitat (Sivagnanam and Swamy, 2010).

The amount of nutrients in the soil affects the rate of growth of plants. For example, excess microelements cause stunted growth, upset minerals, and affects membrane structure and permeability. However, high tolerance of plants to some micronutrients toxicity is based on reduced metal uptake or increased internal sequestration in the plants genotype (Garg and Aggarwal, 2010). Other physical features of soil also determine the yield of the plants for example, water logging of soil according to literature, causes reduction in the oxygen level in the soil. This results from the closure of air spaces by the water leading to less aeration of the soil. When this happens in the soil, even the growth of microorganism in the soil is affected which in return, will affects the total plants yield. For this reason it is imperative that the conditions needed for an appropriate plant growth is studied to enable good yield. The ability of an organism in a given environment to function actively is attained through favourable and allocation of the limited resources available to the diverse life purposes that include maintenance, growth and reproduction. Therefore any specie that tends to colonize a particular niche, should however allocate more of its resources to rapid growth and multiplication (Crime, 1979 in Sivagnanam and Swamy, 2010). Consequently, the ability of plants to access the elements present in any given soil is determined by its chemical form and its location within the soil.

Free-living soil bacteria that are beneficial to the environment are referred to as plant growth promoting rhizobacteria. These are found in close relationship with the root of plants. Bacteria are found in their high numbers around the rhizosphere of plants. These bacterial occurs because of the availability of high level of nutrients which include sugars, amino acids and organic acids exuded from the roots of plants. The exudation is used to support the growth of bacteria and its metabolism. PGPR influences the growth and development of plants, this it does by preventing the effects of phytopathogenic organisms. It also helps the plant by the compounds it synthesized through its bioactivities (Anyasi, 2011).

The main objective of this study was to analyze soil conditions for the growth of *Chromolaena odorata* in the greenhouse with view to measuring the growth performance under two soil samples. These were achieved through the measurement of soil components/minerals, measurement of pH of the soil, evaluation of rate of survival (RS value) of *C. odorata* as well as growth rate (GR value). However, age model to transplant was also studied for optimal survival of transplanted *C. odorata* cuttings.



Materials and method

Soil

Two soil types was used, the first soil sample was collected at the garden of the main campus of the University of South Africa, Pretoria, the soil was dug from the ground from a depth of about 30cm using spade and fork. The second soil type was collected from a heap of sand at a construction site at the University of South Africa. The soil were homogenized with hand to remove pebbles of stone and gravel, air dried, and were filled in plastic cellophane bags before been stored at 4°C. Sub-samples of the soil (250g) each were taken and used for soil characterization

Plants

C. odorata plants were collected from Agronomy department of the University of KwaZulu-Natal. The plants were immediately made into stem cuttings of between 5-10cm with kitchen knife leaving at least a node and leaf bud within the cuttings. The knife was constantly sterilized with acetone between each plant. Organic manures collected from the Veterinary Department of the University of Pretoria containing animal manures, characterized by an independent laboratory were mixed with soil. The plants cuttings were transplanted into nursery bed in order to establish the plant before transplanting the cutting after it has sprouted.

Procedure

Mature plants identified from the beds were first pruned out and made into cuttings of between 5-10cm in such a way that it will contain both a node and antinodes. The top and the bottom sections of the cuttings were usually noted to avoid dipping the top of the cuttings into the soil. The bottom of the cuttings was moistened by dipping into deionized water, then into the rooting hormone making sure excess powder was tapped off while openings was made in the PVC pots and cellophane bags containing 1kg of soil samples with the knife. The cutting was then inserted into the hole at the side dipped into the hormone allowing about half of the stem cutting into the soil. The cuttings were usually allowed in a slanting position because such position enables the cuttings to root properly, and it was usually done at an angle below the node to give the cuttings large surface area for rooting which increased chances of survival. The entire set up was arranged on the rack in the greenhouse and allowed to sprout, this usually take about two weeks. Water was sprinkled on the cutting to enable the soil moisten at 70% field capacity and, this process was done during the early hours of the day or late in the evening when the mature plants are turgid as to avoiding the cuttings to shrivel and will not be able to survive. Sprouted cuttings were transplanted into 2L PVC cups containing 2kg of soil after two weeks of



propagation and the plants were monitored and allowed for six weeks in the greenhouse maintaining normal agronomic procedures within the two soil samples. Control samples were set up containing equal weight of perlite and vermiculate in planting cups. Soil parameters including mineral components, pH, growth rate, survival rate as well as the age bracket of plants that supports optimal transplant into the soil were monitored at interval of weeks. The experiment involved a factorial treatment model in complete randomized design; each soil sample was made in triplicates and was duplicated. So a total of thirty six samples were set up, meaning that each soil samples has eighteen set ups. In each planting cups, a three cuttings of *C. odorata* was used hence a total of one hundred and eight cuttings were used in the entire experiment. This experiment was carried out for six weeks in the green house facility at the University of South Africa in Pretoria (25^o46'1"S, 28^o12'2"E) and 1439m above sea level (Anyasi, 2011). During the course of the experiment, sub samples of the soil was collected and analysed for nutriends at interval of weeks, growth parameters measured were compared with that of the control. Soil texture was determined using the sedimentation and decantation method (Walpola and Arunakumara, 2011), pH was measured with the use of standard electrode pH measurement (Mettler Toledo pH meter FE20/FG2), in measuring the TOC, the method employed was the Loss on Ignition (LOI) by (ASTM, 2000). Total nitrogen was estimated calorimetrically using phenoldisulphonic acid, exchangeable potassium was measured using atomic absorption spectrophotometer (Blackmore et al., 1987). Soil phosphorus was extracted by borax method and determined using spectrophotometer (Dick and Tabatabai, 1977). Fluoro-boric acid dilution method with spectrophotometer was used to determine the content of calcium in the soil samples. In the analysis for metals, Inductively Coupled Plasma spectrometer (ICP) was employed while acid digestion (Aqua-regia) was used for extraction. Soil moisture content was determined through the gravimetical method. Thermal needle probe procedure (single method) was used for the determination of thermal conductivity.

Statistical analysis

The results were subjected to one way analysis of variance (ANOVA) to determine if there is statistical significance between the two soil samples and the parameters tested using SPSS version 13.

3.3 Results and Discussion

3.3.1 Textural analysis

From the soil texture analysis, it was discovered that the two soil samples analyzed were of different texture as shown by their high percentage of clay and sand respectively as shown in



Table 1.0. The percentage of clay and sand of the samples in the textural analysis indicated that the soil textures were of clay soil and sandy loam soil respectively.

Table 1.0: Percentage (m/m) of clay, silk and sand in the uncontaminated soil samples collected from the greenhouse site.

Factor	Unit of measurement	Values	
		Soil 1	Soil 2
Clay	%wt	72.0	19.5
Silk	%wt	18.5	15.0
Sand	%wt	9.5	65.5
Texture		Clay	Sandy loam

Soil1=clay, soil2=sandy loam

In the greenhouse indigenous soil sample, the percentage of silk and sand textures varied from 9.5 to 18.5, these values were very low compared to the percentage of clay which was 72%. On the other hand, the percentages of clay and silt textures on the other soil samples were very little compared to the sand substitute, 19.5 and 15 compared to 65.5 of sand, although the value was not enough to describe the texture as sand when compared with textural triangle.

Soil texture influences the growth of plants by its direct effects on the aeration of the soil, water infiltration, cation exchange capacity (CEC), and erodibility of the soil. Infiltration and permeability are rapid in sandy soil, very slow in clayey soil and intermediate in loamy soil. Soils that are granular, with a large diversity of particle size have many large and small pores. These are desirable characteristics for a good plant yield. Therefore, soil texture is a very good factor which should always be putting into consideration in agronomy.

3.3.2 Soil pH.

The pH of the soil samples ranged from 6.87 of the sandy loam soil known to be partially acidic and 7.75 in the indigenous green house clay soil also seen to be fairly alkaline. The pH of soil1 was static throughout the first week with *C. odorata* but soil 2 changed to 6.73. At the second week however, soil 1 joined soil 2 to become more alkaline, such trend continued till the sixth week. The result is presented in Table 2.0. The pH was seen to be within the optimal range that has been found by research to be the best in the growth of plants; such pH is found to range from 5.0 – 8.5. It has been proven that soils with higher pH generally have lower availability of micronutrients and those nutrients may not be available at sufficient levels. According to Hamlin, (2001), the pH of the soil influences the availability of the elements in the soil for plant uptake. The presence of *C. odorata* in soil has been implicated in the shift of soil pH towards alkalinity (Jebril and Yahaya, 2010). Therefore the result of this study is in agreement with this postulate. It has been reported that the presence of *C. odorata* causes hydrogen ion (H⁺) to displace metal cations from the cation exchange complex of soil components thereby causing metals to be released from sesquioxides and variably charged clays to which they have been



chemisorbed (McBride, 1994). Retention of soil organic matter (SOM) is also another factor that is influenced by pH, it could also be weaker at low pH, leading to high availability of contaminants in the soil solution for root adsorption. The pH of my water supply in the greenhouse was measure to be 7.7 According to the U.S Environmental Protection Agency (US EPA, 2004), pH 7.7 is within the safe drinking water range proposed in 2004. Therefore the water pH range is appropriate for the growth of plants and the provision of nutrient necessary for efficient biomass increase.

Table 2.0: pH values of soil and water samples as was used in the greenhouse

pH in days	Tape water	Soil 1	Soil 2
Day 1	7.70	7.75	6.72
Week 1		7.75	6.73
Week 2		7.77	6.77
Week 3		7.81	6.86
Week 4		7.83	6.94
Week 5		7.83	6.99
Week 6		7.89	7.13

Soil1=clay, soil2=sandy loam

Total organic carbon (TOC)

Total organic carbon measured in percentage weight of the soil samples were 6.35 and 0.46 for clayey soil and sandy loam respectively at the first day of the experiment, this was found to increase throughout the six weeks of experimentation. TOC was increased to 6.42 and 0.56ppm for soil1 and 2 respectively (see Table 3.0). Soil organic carbon (SOC) is one of the most important constituent of the soil, due to its capacity to affect plants growth as both source of energy and a trigger for nutrient availability through mineralization (Walpolo and Arunakumara, 2011). A direct effect of poor soil SOC is a reduced microbial biomass activity and nutrient mineralization due to a shortage of energy sources (Tanhan *et al.*, 2007). From the values of the total organic carbon of the two soil samples, the sample with greater TOC will be much better for the growth of plant as well as in biomass increase. Therefore soil 1 was significantly different at $p=0.05$.

Soil total nitrogen (STN)

From the analysis carried out on the soil samples, the initial mean percentage value of nitrogen in the clay soil was 0.074, while that in the sandy loam was 0.026. It signifies however, that there was greater level of nitrogen in the clay soil than in the sandy loam. The values increased to 0.080 and 0.030 at the end of the experiment. STN increased in the same order as the TOC, this could perhaps be attributed to the ability of *C. odorata* to fix nitrogen in the soil. Nitrogen which is usually available in the form of nitrate (NO_3^{-1}) is an important element in plant growth. It is usually found in its activities in plants proteins, chlorophyll, nucleic acids, and other plant structures (SSSA, 2009). Larger, healthy and increased yield of plants is a good indication of adequate level of nitrogen in the soil. However, rapid



changes in the level of nitrogen do occur as a result of leaching of the element from soil especially in coarse soil (Wheet, 2004). Increased N and P has been linked with microbial immobilization as well as in nutrient input resulting from atmospheric precipitation (Tripathy and sing, 1992; Berg, 2000; Jebril and Yahaya, 2010)

Soil total phosphorus (STP)

Phosphorus (P) is a naturally occurring element in the environment that can be found in all living organisms as well as in soil. It is an important component of a lot more physiological processes when it has to do with energy utilization in both plants and animals (Daniels *et al.*, 1998). Soil test from phosphorus is usually not an indication of total phosphorus in the soil but amount of the element that is available for plant use. The concentration of phosphorus in the soil is usually a function of the particle size of the soil. This is because phosphorus is liable for leaching during run off that occurs during rainfall. It is usually expressed in part per million (ppm). Phosphorus occupies the nucleus of plants cell where it controls growth and cell divisions in the plant. It also plays a role in energy storage and chemical transfer within the plant. In the analysis of soil carried out to determine STP, the concentration of phosphorus in the soil samples at the beginning of the experiment were 9.0 and 4.2 for clayey sample and sandy loam respectively. Those values were increased to 9.37 and 4.25 for the two soil samples respectively. The results showed an indication that STP depended on the colloidal structure of the soil particles and in agreement with the report of Jebril and Yahaya, (2010), refer to Table 3.0.

Total potassium in the soil.

Potassium is quite abundant in soils, with its range dependent on the type of soil. Of this, only a small part is present in water-soluble and exchangeable forms, and sparsely available for plant uptake, usually less than 1% of the total potassium (Incite pivot, 2005). Sandy soils have the lowest potassium content, clay and alluvial soils the highest. However, even clay soils can become depleted in potassium where considerable quantities are removed in farm produce, eg. hay and silage. Potassium in the soil solution is subject to leaching. It is more readily leached than phosphorus, less so than nitrate nitrogen. However, STK and STC are usually correlated with increased in STN and STP as well as other factors in the presence of *C. odorata* (Isaak and Nair, 2005; Jebril and Yahaya, 2010). The total soil concentration of potassium in the samples analyzed were 15.5 and 2.9ppm respectively for both clay and sandy loam soils. These values were decreased though at irregular trend to 15.28 and 2.60 for soil1 and 2 respectively. The reason behind this reduction could be unraveled but is believed to be linked with the physiology of the plant. The result of this study however is in agreement with the fact that sandy soils possess lower concentrations of potassium than clay soil (Norgrove, 2008). Potassium is found in its importance in the biochemical functions of the plants, which include cell division and resistance to diseases (Wheet, 2004).



Total calcium

Valuable biological processes in the soil are depended upon the stabilizing effects of the elements in the soil without which the process of nitrification would render the soil acidic (Devendra, No date; Wheat 2004; Housa and Mekoa, 2008). Soil that are low in humus and clay, usually gives higher values of calcium than those with higher concentrations of colloidal clay and organic matter unless the organic matter have had its calcium constituents replaced by hydrogen ions. The soil samples at the beginning of the experiment indicated an 83.0ppm of calcium in clay sample and about 61.0ppm in the sandy loam sample. It then increased to 84.08 and 61.70ppm at the end of the study. Such increase agrees with the postulates of Isaak and Nair, (2005), that the amount of calcium contained in soil at the presence of *C. odorata* depended on amongst other factors, the concentration of N and P.

Table 3.0: physic-chemical characteristics of soil

Intervals	TOC (ppm)		STN (%)		STP (ppm)		STK (ppm)		STC (ppm)	
	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1	Soil 2
Day 1	6.35	0.46	0.074	0.026	9.00	4.22	15.52	2.93	83.01	61.00
Week 1	6.29	0.46	0.072	0.019	9.13	4.17	15.47	2.78	83.00	61.12
Week 2	6.33	0.47	0.075	0.019	9.16	4.18	15.44	2.76	83.29	61.16
Week 3	6.36	0.49	0.076	0.023	9.31	4.18	15.39	2.76	83.37	61.21
Week4	6.37	0.49	0.079	0.025	9.33	4.23	15.30	2.62	83.59	61.34
Week 5	6.41	0.53	0.080	0.027	9.37	4.24	15.33	2.60	83.72	61.39
Week 6	6.42	0.56	0.080	0.030	9.37	4.25	15.28	2.60	84.08	61.70

Soil1=clay, soil2=sandy loam, TOC=total organic carbon, STN=soil total nitrogen, STK=soil total potassium, STC=soil total calcium

Metals

Metals are regarded as the micronutrients in the soil (Piper, 1977; Berrow, 1999). The term micro came as a result of the fact that there are required in minute amounts by plants. When the micronutrients are available in larger concentrations, it is regarded as toxic (Al-Yemeni and Hashim, 2006; Escarre *et al.*, 2011). In the analysis of the soil samples, it was seen that Mg, Mn, Fe, Pb, Cu, and Zn, were in their decreasing order of magnitude in the clay soil while the arrangement in the sandy loam were Mg, Fe, Mn, Zn, Pb and Cu etc. The concentration of the minerals in the clay soil was greater than in the sandy loam. Magnesium maintained the highest spot in the two samples though its value was greater in clay compared to sandy sample. Cesium was not detected in the two samples. Table 4.0 below will help to explain the concentration of individual minerals in the samples analyzed.



Table 4.0: Mineral content (ppm) of soil samples used in the greenhouse

Interval	Cu (ppm)		Fe (ppm)		Mg (ppm)		Mn (ppm)		Pb (ppm)		Zn (ppm)	
	Soil1	Soil2	Soil1	Soil2	Soil1	Soil2	Soil1	Soil2	Soil1	Soil2	Soil1	Soil2
Day 1	35.20	0.50	58.50	77.70	112.0	88.3	76.10	10.30	46.20	1.20	20.10	3.16
Week 1	35.14	0.50	58.55	77.56	112.0	88.3	76.07	10.31	46.19	1.19	20.12	3.13
Week 2	35.09	0.53	58.52	77.51	111.6	88.0	76.07	10.31	46.13	1.19	20.13	3.13
Week 3	35.03	0.51	58.00	77.45	111.3	87.6	76.05	10.28	46.12	1.18	20.12	3.12
Week 4	34.87	0.48	58.00	77.41	110.5	87.2	76.04	10.19	46.06	1.15	20.12	3.07
Week 5	34.72	0.46	57.89	77.27	110.0	86.9	76.04	10.17	46.01	1.11	20.09	3.05
Week 6	34.77	0.43	57.88	77.11	109.9	86.1	76.05	10.15	45.87	1.04	20.07	2.91

Soil1=clay, soil2=sandy loam, Cu=copper, Fe=IRON, Mg=magnesium, Mn=manganese, Pb=lead, Zn=zinc

3.3.9 Moisture content of the soil

It was inferred that thermal conductivity of the two soil samples was increased as the saturation level of water of the soil was increased. Moisture was seen to coat the soil particles partially at low saturation level. With more water, the void gaps between the particles were filled and the thermal conductivity risen accordingly. As the one hundred percent saturation level of the soil is approached, the voids fill completely and the heat flux or the thermal conductivity reaches its highest flow for that soil sample (Ambika, 2002). A saturated soil has a thermal conductivity level near that of pure water. The results however explained the fact that moisture content determines thermal conductivity of soil as was seen in the Table 5.0 and 6.0 (Robertson and Morgan, 1995). Therefore, clay sample has lower moisture content than the sandy loam sample.

Table 5.0: Percentage amount of dry weight and moisture content of the soil samples used in the study

Soil samples	Initial weight	Final weight	% dry weight
Clay	5.025	4.782	95.2
Sandy loam	5.052	4.717	93.4

Thermal conductivity of the soil samples

Measurement was made on the soil samples; clay and sandy loam according to the method of Abu-Hamdey, (2001), using a single probe of the two sieved and repacked soils as a function of bulk density and water content as shown in Table 6.0 below. The sandy loam had higher thermal conductivity values than the clay soil at all bulk densities. Thermal conductivity increased with increasing bulk density because particle contact was enhanced as porosity was decreased. In the clay sample, thermal conductivity did not increase continually with bulk density increase at various water contents. There was however rapid increase at first increment in bulk density, but further increase in bulk density only caused a slight increase in the conductivity (Ambika, 2002). Such phenomenon was very much absent in the sandy loam sample; this was perhaps because increase in bulk density in the sandy loam to a certain point did improve contact between the relatively larger sand particles than the silt and clay. Beyond



this point, higher values of moisture content increased thermal conductivity less rapidly in the case of clay than the sandy loam. This means that increasing water content completed water films around larger particles relatively than silt and clay thereby increasing the contact area between sand particles that caused rapid increase in thermal conductivity.

Table 6.0: moisture content, density and thermal conductivities of soil samples used in the greenhouse

Interval	% moisture content		Density (g/cm ³)		Thermal conductivity (W m ⁻¹ K ⁻¹)	
	Soil1	Soil2	Soil1	Soil2	Soil1	Soil2
Day 1	4.8	6.6	1.25	1.33	0.19	0.39
Week 1	4.8	6.4	1.33	1.36	0.31	0.41
Week 2	4.6	6.4	1.39	1.21	0.27	0.41
Week 3	4.5	6.4	1.43	1.38	0.28	0.42
Week 4	4.6	6.5	1.44	1.43	0.29	0.42
Week 5	4.6	6.4	1.47	1.50	0.29	0.43
Week 6	4.7	6.4	1.52	1.52	0.30	0.42

Soil1=clay, soil2=sandy loam

Propagation of the weed in the greenhouse

The propagation period took in total, eight weeks and that ran successively within the period as the plants were seen to thrive with an average growth percentage of above 90% within the trials. This was unlike the growth observed when the trials were done with ordinary soil substitutes of planting soil, perlite and vermiculate. This is shown in Table 7.0. Soil samples were mixed with animal manure prior to propagation with *C. odorata*. About 200g of manure was mixed with soil sample resulting in the ratio of 9:1 of soil to manure. The components of the animal manure as well as tap water used in the green house was analysed to contain enough components for optimal growth of plants.

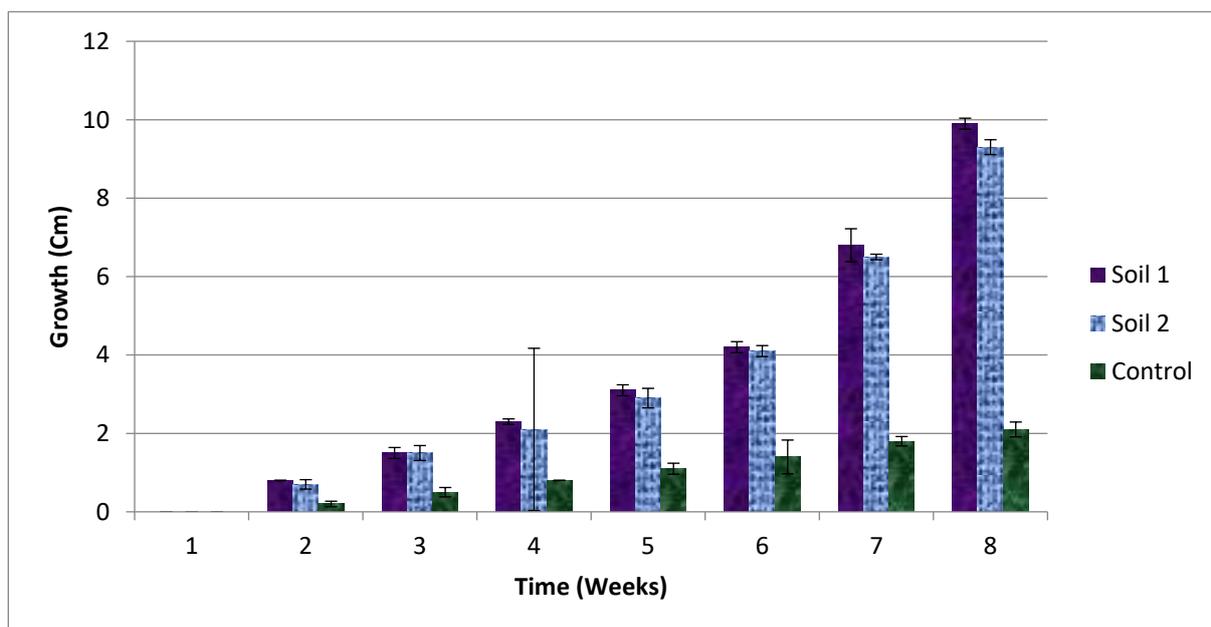


Figure 1.0: Growth chart (GR value) of soil samples mixed with organic manure as was used in the greenhouse for the trial propagation of *C. odorata* (Values are average of 3 S.E.).



The soil samples 1 and 2 were seen to maintain the normal growth curve (GR value) which was seen to be hyperbolic in nature when extrapolated, while the control samples maintained very low values in their growth curve. The nature of the curve in soil sample 1 and 2 is synonymous with the exponential of the *C. odorata* at developmental (Logarithmic) phase. The two soil samples 1 and 2 though started at different values in their first week of growth, got to same growth length at the second week, continued with the difference in the third week until the sixth week. However, the soil 1 maintained a higher growth level which could be attributed to having the prepared nutrient requirements than soil 2, though the difference was not significant at 0.05 degree of freedom. In determining the rate of survival (RS value) of the weed on different soil samples, sample 1 maintained a percentage survival of 100, sample two contended with about 80% while the control survived below 40%. The tables indicating survival rates is as shown in Table 7.0.

Table 7.0: Survival rate (RS value) of *C.odorata* propagated in soil samples 1 and 2 with Control in the greenhouse (x = survival, – = non survival) (values are average of three replicates).

Plants samples	Soil sample 1	Soil sample 2	Control
1	X	X	–
2	X	X	–
3	X	X	X
4	X	–	–
5	X	X	–
6	X	–	–
7	X	–	–
8	X	X	–
9	X	X	–
10	X	–	–
11	X	X	–
12	X	X	X
Percentage survival (%)	100.00	66.67	16.67

In comparing the survival rate of the weed at growth interval of 3, 5, and 7 weeks of growth after sprouting , plants after 3 weeks of growth was seen as the best stage prior to propagation to transplant as survival at this stage was about 96% as in Table 8.0. This means that almost the entire plants in the entire set up survived. However, plants in 5 and 7 weeks survived at 50 and 25% respectively. It simply means that cross transplanting of *C. odorata* could be done effectively at a tender age of between 3-5 weeks after sprouting; this according to Pujar *et al*, (2006) is the vegetative stage of the plants growth and supports regrowth after any kind of stress



to the plants. Generally, plants growth depends on cell division followed by cell elongation, these primary physiological processes are involved in growth of plants (Davender *et al.*, No date). Cell division belongs to the logarithmic growth phase which was found to increase exponentially with time according to the study of Devender *et al.*, (No date), at this period, plants are found to direct every of its stored energy for growth and repair. After the logarithmic phase comes the linear phase which is the cell elongation stage, here high exponential growth is witnessed even more than the logarithmic phase, but repair of body parts in not normally done by the plants hence they find it difficult to survive stress at that stage (Pujar *et al.*, 2006).

Table 8.0: Comparism of the survival rate of *C. odorata* at different intervals of growth in soil samples 1 and 2 in the greenhouse (x = survival, – = non survival) (values are average of three replicates)

Plants samples	3 Weeks old	5 Weeks old	7 Weeks old
1	–	X	X
2	X	–	–
3	X	–	–
4	X	–	–
5	X	X	–
6	X	X	–
7	X	–	–
8	X	–	X
9	X	–	X
10	X	X	–
11	X	X	–
12	X	–	–
Percentage survival (%)	95.67	50.00	25.00

In this green house propagation of *C. odorata*, prevailing environmental condition like temperature and pressure was used and therefore requires that other conditions be taking note of. Various literatures has continued to confirm the ability of *C. odorata* to thrive in a wide range of soil types with soil fertilizer being less important to their growth and invasion (Wen *et al.*, 2000; Huang *et al.*, 2000; Wang *et al.*, 2003; Vanderwoude *et al.*, 2005; Zang and Wen, 2009). Light, water and nutrients are the basic resources that help to regulate the plants survival, growth as well as its distribution in its ecosystem. According to previous studies, *C. odorata* is light favoring specie though drought could sometimes affects its growth (Wen *et al.*, 2000; Wang *et al.*, 2003; Yang *et al.*, 2005). Plants under great light intensity suffer a lot more drastic reduction in assimilation of CO₂ especially when subjected to drought stress (Holmgren, 2000). This according to the study could lead to photo-inhibition, as compared with plants under covered condition. In this present study therefore, there was direct exposure to sunlight and other atmospheric condition, water was constantly supplied to a moisture content of 70% which is optimal to the growth of *C. odorata*. Nutrients also were in correct order and could not inhibit



the plants growth and therefore will help to argue the fact that *C. odorata* does not just invade any particular type of soil but the one that posses its absolute nutrient requirement a witness to the variation of its invasion.

Nutrients behavior in the soils and the ability of plants to absorb them depend on the organic matter content of the soil as well as the pH (Okoye *et al.*, 2008). This behavior so to say, varied according to the nature of the nutrients, the physic-chemical properties of soil and the plants species (Tuzen, 2003; Kidd *et al* 2007). The soil organic matter could be derived from the total organic carbon values which were 6.35 and 0.46% for clay and sandy loam soils respectively, by multiplying the TOC values by the conversion factors which is 1.724. Therefore, organic matter content of the soil samples was 10.95 and 0.79ppm respectively. The value was within the range for optimal growth of plants. The soil acts as long-term sink for nutrients especially the heavy metals. Most of these metals have history of long residence times and sometimes are found to depend on the elements and the characteristics of the soil (Alloway, 1995). The heavy metals in the soil could find their way into the organisms at various trophic level through their organs, this is referred to as bioaccumulation. Bioaccumulation assists in the determination of the plants ability to perform other physiological tasks like phytoremediation. From the results of the soil analysis of the samples, it was envisaged that *C. odorata* would grow much better in the clay soil than the sandy loam, because of its higher content of organic matter and its ability to retain water much more than the later.

Nutrients availability in the soil harboring *C. odorata* however manages the response factor of the weed since nutrients like carbon enables the plant to carry out various physiological activities. For example, the ability of plants to delineate its biomass into shoot, root, reproduction or fruiting is aided by the physical and perhaps the chemical condition of the soil. Higher nutrient uptake by *C. odorata* growing in a certain modified ecosystem may be as a result of relative growth rate (RGR) (Chandrasekaran and Swamy, 2010). It means then that plants with relative high RGR, requires lots of nutrient to support the new tissue production, rapid root growth in addition to the leaf shields as was witnessed in the soil sample 1 of this experiment. This is the reason why the plant thrives well in area that is invaded by wild fires. According to Houser and Meko, (2008), *Chromolaena odorata* absorbed more nutrients in a burned secondary forest, therefore fires make the specie more competitive than its associated plants in an ecosystem.

Chromolaena odorata does not require a particular type of soil for its growth but tends to survive in any kind of environment it finds its way. Therefore it can easily be inferred that



nutrient make up of any soil does not really determined the kind of growth exhibited by *C. odorata* but only as a part of other effects (Meyer *et al.*, 1973). The soil samples 1 and 2 as was used in the experiment though have variations of nutrient constituents, texture, and ability to retain water, but were able to support the growth of *C. odorata*. Therefore, it can be argued that though *C. odorata* have been reported to travail in any particular type of soil, that there is still specificity in its invasion. Take for instance in South Africa, the weed can only be found invading the KwaZulu-Natal area which is known to be highly fertile and have comparatively good rainfall thereby making agriculture central to its economy (www.southafrica.info/geography/kwazulunatal). It means that there is particular interest to the geography of the soil in that area. However, there is need that the physico-chemical characteristics of soil that is to be used in any laboratory study be known so it can be used to describe the phenomena that would be studied.

Conclusion

In the study of growth of siam weed within two soil samples of clay and sandy loam particles, inferences drawn signifies that essential nutrients that is required for optimal yield of plants is found in soil containing *C. odorata*. It was also discovered that growth conditions was maintained throughout the period of experimentation an indication that *C. odorata* sustains the condition of the soil suitable for optimal crop yield thereby reducing the over dependency on inorganic fertilizers which usually increases the cost of food production. This study will also enable ecologists on their quest for successful weed control as it is indicated that one of the drivers of *C. odorata* invasion is nutrient availability in soil. It is therefore recommended that soil conditions be incorporated in the study of the control of invasive weeds.

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ULTRASONİK EKSTRAKSİYON TEKNİĞİ İLE ÜRETİLEN SİYAH ÇAY EKSTRAKTLARINA TANNAZ ENZİMİ UYGULAMASI: RENK VE DUYUSAL ÖZELLİKLERİ ÜZERİNE ETKİSİ

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ÖZET

Bu çalışmada, farklı çay: su oranları ve ekstraksiyon süreleri kullanılarak ultrasonik ekstraksiyon yöntemi ile elde edilen Türk siyah çay ekstraktlarına tannaz enzimi uygulanmasının, ekstraktların renk ve duyusal özellikleri üzerine olan etkisi araştırılmıştır. Bu amaçla ultrasonik ekstraksiyon yöntemi ile, 70°C demleme sıcaklığında farklı süre (5, 10, 20 ve 40 dakika) ve çay:su oranları (1:100; 2.5:100, 5:100 ve 10:100) uygulanarak elde edilen ekstraktlar, tannaz enzimi ile muamele edilmiştir. Çalışmada elde edilen ekstraktlarda suda çözünür kuru madde (SÇKM), pH, renk analizleri ile duyusal olarak değerlendirilmesi yapılmıştır. Tannaz enzimi uygulaması örneklerin SÇKM değerlerinde artış meydana getirirken, pH değerlerinde azalmaya yol açmıştır. Tannaz enzimi uygulanan örneklerde genellikle pH değerinde meydana gelen düşüşlerin epikateşin gallat (ECG), epigallokateşin gallat (EGCG) gibi gallatlı kateşinlerin hidrolizi sonucu artan gallik asit miktarına bağlı olduğu düşünülmektedir. Çay ekstraktlarına tannaz enzim ilavesinin örneklerin L değerlerinde genellikle artış sağladığı gözlemlenmiş ve enzim uygulanmış ve uygulanmamış örneklerin L değerleri arasındaki farklılıkların istatistiksel olarak da genellikle önemli ($p<0.05$) olduğu belirlenmiştir. Siyah çay ekstraktları; aroma, burukluk, dem rengi, dolgunluk ve genel değerlendirme gibi kriterler bakımından duyusal analiz için panelistler tarafından değerlendirilmiştir. Duyusal analiz sonuçlarına göre ise genel değerlendirme bakımından en yüksek puanı ultrasonik ekstraksiyon yönteminde 5:100 çay:su oranında, 70°C’de 40 dakikalık demleme koşullarında 3.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek alırken, en düşük genel değerlendirme puanı ise ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C’de 5 dakikalık demleme koşullarında 1.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek almıştır.

Anahtar kelimeler: siyah çay ekstraktı, tannaz, renk, duyusal değerlendirme



APPLICATION OF TANNASE ENZYME TO BLACK TEA EXTRACTS PRODUCED BY ULTRASONIC EXTRACTION TECHNIQUE: EFFECT ON COLOR AND SENSORY PROPERTIES

ABSTRACT

In this study, the effect of applying tannase enzyme to Turkish black tea extracts obtained by ultrasonic extraction method using different tea:water ratios and extraction times on the color and sensory properties of the extracts was investigated. For this purpose, tannase enzyme was applied to the extracts obtained by applying the ultrasound extraction method at 70°C brewing temperature for different times (5,10, 20, and 40 minutes), tea:water ratios (1:100;2.5:100; 5:100; 10:100). Water-soluble dry matter (WSDM), pH, color, and sensory analysis were made in the extracts obtained in the study. Tannase enzyme application caused an increase in the WSDM values, while it caused a decrease in the pH values of the samples. It is thought that the decrease in pH value in samples treated with tannase enzyme is due to the increased amount of gallic acid as a result of hydrolysis of gallate catechins such as epicatechin gallate (ECG), epigallocatechin gallate (EGCG). It was observed that the application of tannase enzyme to the black tea extracts generally increased the L values of the samples, and the differences between the L values of the samples with and without the application of the enzyme were found to be significant ($p<0.05$) statistically. It was evaluated the black tea extracts by the panelists for sensory analysis in terms of criteria such as aroma, astringency, brew color, fullness and general evaluation. According to the results of the sensory analysis, the highest score (3.50) in terms of the general evaluation was obtained for the sample with the tannase enzyme applied at the ratio of 5:100 tea:water, at 70°C for 40 minutes. The highest score in terms of aroma was obtained by not applying tannase enzyme with a score of 3.70 under 5:100 tea:water ratio and 5-minute brewing conditions at 70°C.

Keywords: black tea extract, tannase, color, sensory analysis



1. GİRİŞ

Gıda üreticileri, gıdaların raf ömrünü uzatabilmek ve besleyici değerini koruyabilmek için farklı teknoloji ve yöntem arayışlarına girerek bazı yeni teknolojileri uygulamaya başlamışlardır. Gıdaların genel kalitesine ve besleyicilik değerine daha az olumsuz etkisi olacak yeni gıda işleme yöntemlerinin tüketiciler tarafından talep edilmesi nedeniyle yeni ve alternatif pastörizasyon ve sterilizasyon yöntemleri önem kazanmaktadır. Son yıllarda, gıdaların ısı işlemlerle dayandırılmasında yüksek sıcaklıkların etkisiyle gıdanın yapısında açığa çıkan olumsuzlukların ortadan kaldırılması amacıyla "ısı olmayan yöntemlerle" gıdaların muhafazası önem kazanmıştır. Isıl olmayan alternatif teknolojilerden biri de ultrasonik ses dalgalarıdır (Ulusoy ve Karakaya, 2011). Genel tanımıyla ultrases, ses dalgalarının saniyede 20,000 veya daha fazla titreşimleri sonucunda üretilen bir enerjidir (Baysal ve İçier, 2012). Yüksek enerjili ses dalgaları bir sıvı içinden geçtikleri zaman baloncuk veya kavitasyon oluştururlar. Sıvı sistemlerde ultrasonik ses dalgalarının etkileri, başlıca kavitasyon olgusu ile ilişkilendirilir. Ultrasonik ses dalgaları, içerisinden geçtiği ortamdaki moleküllerin bir takım sıkıştırma ve basınç azalmaları sonucu açığa çıkan dalgalar şeklinde ortaya çıkar. Ultrasonik ses dalgalarının uygulanması sırasında oluşan etki, sıvı içinde hava kabarcıklarının oluşumu ile sonuçlanan mekanik etkidir. Bu işlem sırasında üründe çok az bir sıcaklık artışı meydana gelmekte ve bu nedenle sıcaklıktan kaynaklanan olumsuz etkiler önemli oranda azalmaktadır (Xia ve ark., 2006; Ulusoy ve Karakaya, 2011).

Ekstraksiyon, içecek çay üretimi için ilk önemli işlem aşamasıdır. Çay bileşenlerinin çözünürlüğünü ve kütle transfer oranını arttırmak için, içecek çayın geleneksel ekstraksiyon tekniği çoğunlukla ısıtma, kaynama veya geri akışla gerçekleştirilir. Uçucu bileşenler ve çay polifenoller gibi çaydaki birçok bileşen termal olarak kararsız olduğundan çayın lezzeti, tadı ve renk kalitesi termal özütleme sırasında bozulabilir. Ekstraksiyonda yüksek sıcaklık uygulaması, çayın duyu kalitesinde düşüşe neden olan çay kremasını oluşturan pektin ve proteinin artışına neden olabilmektedir. Soğuk ekstraksiyon ise, çayın kimyasal ve duyu kalitesini arttırmasına rağmen, ekstraksiyon süresinin uzunluğu ve ekstraksiyon veriminin düşüklüğü nedeniyle endüstriyel içecek çay üretimi için uygun bulunmamaktadır. İçecek çay üretiminde çaydaki temel bileşenlerin yüksek verimlilikle ekstraksiyonu ve çayın iyi bir duyu kaliteye sahip olması temel bir hedeftir. Bu nedenle, düşük sıcaklıklarda kısa bir işlem süresi ile etkin bileşenlerin en yüksek verimlilikle elde edilmesini sağlayacak bir prosedür ideal bir yöntem olacaktır. Ultrason tekniği işlem süresinin kısaltılması ve çözücü tüketiminin azaltılmasıyla ekstraksiyon verimliliğinin artırılmasına önemli katkı sağlayabilir. Ultrason



destekli ekstraksiyon, ekstraktta bulunan bileşenlerin termal hasarının ve uçucu bileşenlerin kaybının önlenmesiyle daha düşük sıcaklıklarda gerçekleştirilebilir (Wu ve Bird, 2010).

Xia ve ark. (2006), çay infüzyonunun kimyasal ve duyuşal özelliklerine ultrasonik ses dalgalarının etkilerini inceledikleri çalışmada, düşük sıcaklıklarda elde edilen çay ekstraktının kimyasal bileşiminin ve duyuşal özelliklerinin yüksek sıcaklıklarda elde edilen çay ekstraktına göre daha iyi korunduğunu; polifenol, amino asit ve kafein içeriğinin geleneksel ekstraksiyon yönteminden daha yüksek olduğunu bildirmişlerdir.

Tannaz (Tannin Açılhidrolaz (EC, 3.1.1.20)); hidrolize olabilen tanenlerin (tannik asit, metil gallat, etil gallat, n-propil gallat ve izoamil gallat gibi) ve gallik asit esterlerinin ester bağlarının yıkımını katalizleyen hidrolaz sınıfı hücre dışı bir enzimdir. Tannaz, tannik asidin ester bağlarına etki ederek tannik asidi gallik asit ve glikoza hidrolize etmektedir (Lekha ve Lonsane, 1997; Sariözlü ve ark., 2011). Tannaz enzimi, farklı uygulama alanlarına sahip olmakla birlikte, enziminin endüstride en çok kullanım alanı çözünebilir çay üretimidir. Enzim; çay kateşinlerinin biyotransformasyonunu kolaylaştırarak antioksidan özelliklerini arttırmak ve krema oluşumunu azaltarak, çay ürünlerinin renk ve duyuşal özelliklerini iyileştirmek için kullanılmaktadır (Simpson ve ark., 2001).

Bu çalışmada, farklı çay: su oranları ve ekstraksiyon süreleri kullanılarak ultrasonik ekstraksiyon yöntemi ile elde edilen siyah çay ekstraktlarına tannaz enzimi uygulanmasının, ekstraktların renk ve duyuşal özellikleri üzerine olan etkisi araştırılmıştır.

2. MATERYAL VE YÖNTEM

2.1. Materyal

Çalışmada hammadde olarak kullanılan siyah çay; Çay-kur firmasının Güneysu-Ulucami Çay Fabrikası Müdürlüğünden [nevi ve tipi: 5(BOP2)] temin edilmiştir. Ekstraksiyonda çözücü olarak destile (saf) su tercih edilmiştir. Çalışmada kullanılan tannaz enzimi (Aktivitesi 500 U/g veya daha yüksek; optimum pH 5.0-5.5; optimum sıcaklık 40 °C) Kikkoman, Japonya firmasından temin edilmiştir.

Belirlenen çay:su oranları (1:100, 2.5:100, 5:100 ve 10:100) için siyah çay örneklerinden beherlere (1000 ml) tartım yapıldıktan sonra, 70 °C demleme sıcaklığına uygun şekilde su ilavesi yapılmış, yaklaşık 30 sn boyunca iyice karıştırılan örnekler ultrasonik su banyosunda farklı sürelerde (5, 10, 20 ve 40 dakika) demlemeye bırakılmıştır. Süre sonunda örnekler iki kat kaba filtre kağıdından süzülerek ekstraktlar (İE= İlk ekstrakt) elde edilmiştir. Elde edilen ekstraktlar etekli santrifüj tüplerine eşit hacimlerde olacak şekilde (40 ml) ilave edilmiş ve üzerlerine 1.25 U/g olacak düzeyde tannaz enzimi çözeltisinden ilave edilmiştir. Enzim ilavesi



yapılan örnekler enzimin optimum çalışma sıcaklığı olan 40°C de 1 saat su banyosunda bekletilmiştir. Bir saatlik inkübasyon süresinden sonra örnekler önce 5 dakika boyunca bir ön soğutma işlemine tabi tutulmuş, daha sonra 2°C su banyosunda 2 saat boyunca bekletilmiştir. Süre sonunda örneklerin bulunduğu tüpler -2°C de, 9000 rpm hızında 20 dakika boyunca santrifüjlendikten sonra berrak kısım ayrılmıştır. Tannaz ilavesi yapılan ekstraktlar 'TAN' olarak belirtilirken, tannaz enzimi ilavesi yapılmayan ekstraktlar kontrol grubu (KNTRL) olarak adlandırılmıştır. Elde edilen berrak kısımda aşağıda belirtilen analizler yapılmıştır.

2.2. Uygulanan Analizler

Suda çözünrkuru madde tayini

Çay ekstraktlarının SÇKM miktarı Hanna HI 96801 (Romanya) marka dijital refraktometre (Hassasiyet: %0.2 °Briks) ile yapılmış ve değerler % olarak ifade edilmiştir (Cemeroğlu, 2010).

pH tayini

Çay ekstraktlarının pH değerleri, WTW marka (330/Set-1) pH metre ile yapılmıştır (Cemeroğlu, 2010).

Renk tayini

Çay ekstraktlarının renk değerleri (L, a ve b) Minolta renk ölçme cihazı (CR- 400) ile Hunter renk ölçme sistemine göre yapılmıştır (Cemeroğlu, 2010).

Duyusal değerlendirme

Çay ekstraktlarının duyusal olarak değerlendirilmesi 10 kişilik panelist grubu tarafından dem rengi, aroma, dolgunluk, burukluk ve genel özellikler açısından 5 puan üzerinden değerlendirilmiştir.

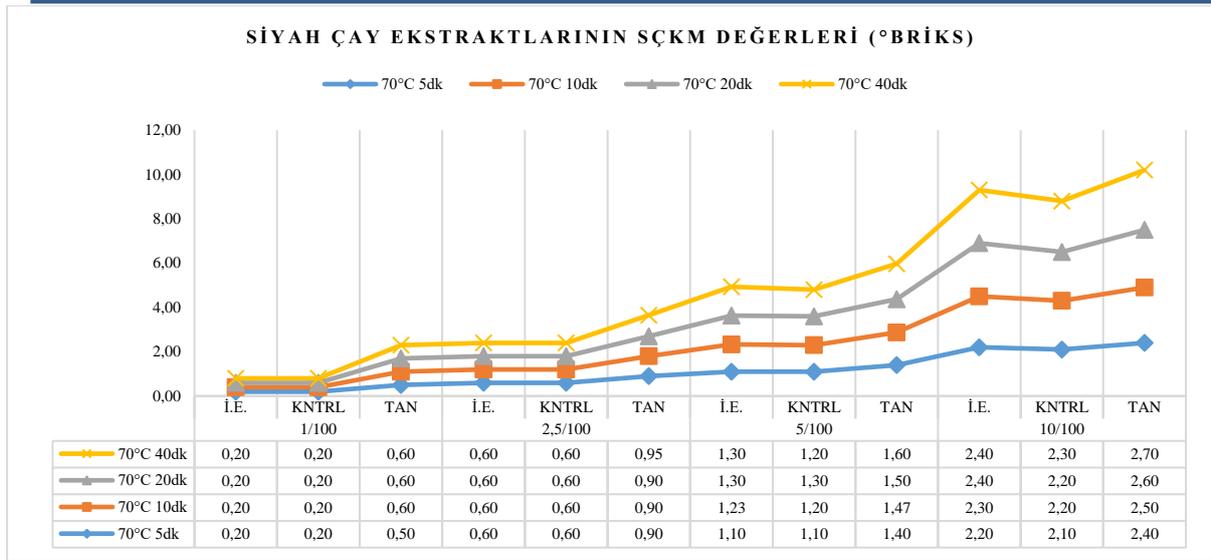
İstatistiksel analizler

Bulgular, faktöriyel deneme planına göre varyans analizi yapıldıktan sonra SPSS istatistik paket programı kullanılarak uygulama ortalamaları Duncan çoklu karşılaştırma testine göre 0.05 güven sınırında değerlendirilmiştir.

3. BULGULAR VE TARTIŞMA

3.1. Siyah Çay Ekstraktlarının Suda ÇözünürKuru Madde (SÇKM) Değerleri

Çalışmada farklı çay:su oranları, demleme süreleri kullanılması ve tannaz enzimi ilave edilmesiyle elde edilen siyah çay ekstraktlarının SÇKM değerleri Şekil 1'de verilmiştir. Ultrasonik ekstraksiyon yöntemi ile elde edilen ilk ekstraktlarda SÇKM değeri 0.20-2.40°Briks aralığında değişirken enzim uygulanmış ve uygulanmamış (kontrol) örneklerinde sırasıyla 0.50-2.70°Briks ve 0.20-2.30°Briks olarak belirlenmiştir.



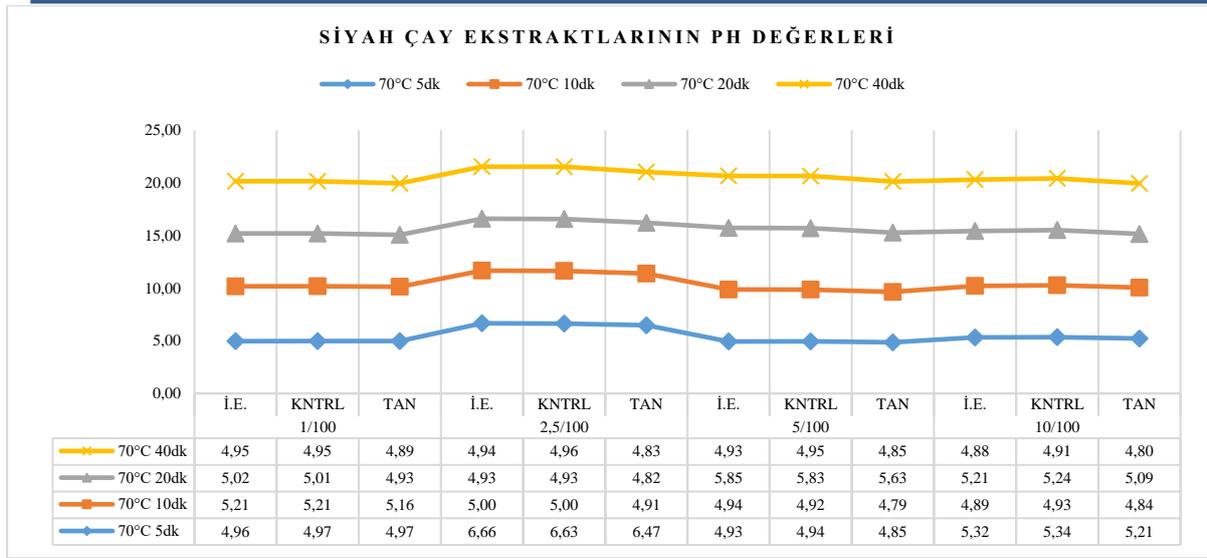
Şekil 1. Siyah çay ekstraktlarının SÇKM değerleri (°Briks)

Tüm çay:su oranlarında enzim uygulanan örneklerin SÇKM değerlerinde kontrol örneğine göre artış meydana geldiği ve kontrol örneği ile enzim uygulanan örneklerin SÇKM değerleri arasındaki farklılıkların istatistiksel olarak da önemli olduğu ($p<0.05$) belirlenmiştir. Demleme sürelerine bağlı olarak SÇKM değerlerinde genellikle artış meydana geldiği, demleme süresinin 20. dakikasından sonra ekstraktların SÇKM değerlerinde değişimin genellikle sona erdiği görülmektedir.

Both ve ark. (2014), Kenya siyah çay örneklerini ultrasonik yöntemle 90:10 oranında etanol:su kullanarak 40 °C’de ekstrakte ettikleri çalışmada örneklerin kuru madde içeriğinin % 2.9’dan % 4.3’e yükselerek geleneksel ekstraksiyon yöntemine göre % 30-35 daha fazla arttığını bildirmişlerdir.

3. 2. Siyah Çay Ekstraktlarına Ait pH Değerleri

Çalışmada farklı çay:su oranları, demleme süreleri kullanılması ve tannaz enzimi ilave edilmesiyle elde edilen siyah çay ekstraktlarının pH değerleri Şekil 2’de verilmiştir. Ultrasonik ekstraksiyon yöntemi ile elde edilen ilk ekstraktlarda pH değeri 4.88-6.66 aralığında değişirken enzim uygulanmış ve uygulanmamış (kontrol) örneklerinde sırasıyla 4.79-6.47 ve 4.91-6.63 olarak belirlenmiştir.



Şekil 2. Siyah çay ekstraktlarının pH değerleri

Bulgular incelendiğinde çay:su oranının ve demleme süresinin örneklerin pH değerleri üzerinde değişiklikler meydana getirdiği ve çay ekstraktlarının pH değerleri arasındaki farklılıkların istatistiksel olarak da önemli ($p<0.05$) olduğu; çay:su oranı ve demleme süresindeki artışa bağlı olarak ekstraktların pH değerinde genellikle azalmalar meydana geldiği belirlenmiştir. Tüm demleme sürelerinde enzim uygulanan örneklerin pH değerlerinde kontrol örneklerinin pH değerlerine göre azalmalar meydana geldiği ve bu farklılıkların genellikle istatistiksel olarak da önemli olduğu ($p<0.05$) görülmüştür. Tannaz enzimi uygulanan örneklerde genellikle pH değerinde meydana gelen düşüşlerin epikateşin gallat (ECG), epigallokateşin gallat (EGCG) gibi gallatlı kateşinlerin hidrolizi sonucu artan gallik asit miktarına bağlı olduğu düşünülmektedir.

Simpson ve ark. (2001), %1 w/v olarak hazırladıkları çay infüzyonunun pH değerini 4.9 olarak belirtmişlerdir. Kaczmarek (2004), %1 w/v olarak hazırladıkları çay infüzyonunun (kaynayan suda, 3 dakika demleme) pH değerinin 3.85-6.45 aralığında değiştiğini ortalama pH değerinin 5.24 olduğunu belirtmişlerdir. Ni ve ark. (2015), 2:100 çay:su oranı, 90°C ve 30 dakika demleme ile elde ettikleri Çin oolong çay ekstraktlarının tannaz enzimi ile muamele edilmesi sırasında kateşinlerin hidrolizi sonucu gallik asit miktarındaki artış nedeniyle pH değerinde azalma (5.3'den 4.8'e) meydana geldiğini bildirmiştir.

Çalışmada elde edilen bulguların Ni ve ark. (2015) ile benzerlik gösterdiği, enzim uygulanan örneklerde genellikle pH değerinde düşüşler meydana geldiği görülmektedir.

3.3. Çay Ekstraktlarının Renk Değerleri

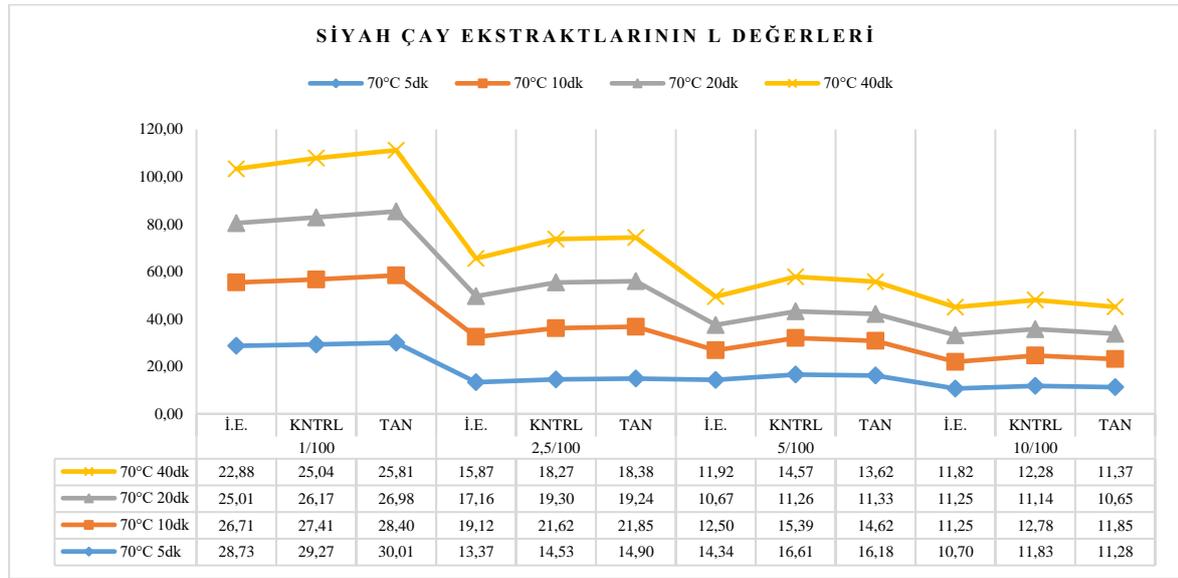
Çalışmada farklı çay:su oranları, demleme süreleri kullanılması ve tannaz enzimi ilave edilmesiyle elde edilen siyah çay ekstraktlarının L, a ve b değerlerine ilişkin bulgular sırasıyla



Şekil 3, Şekil 4 ve Şekil 5’de verilmiştir.

3.3.1. Siyah çay ekstratlarının L değerleri

Siyah çay ekstratlarının L değerlerine ilişkin bulgular Şekil 3’de verilmiştir. Ultrasonik ekstraksiyon yöntemi ile elde edilen ilk ekstraktlarda L değeri 10.67-28.73 aralığında değişirken enzim uygulanmış ve uygulanmamış (kontrol) örneklerinde sırasıyla 10.65-30.01 ve 11.14-29.27 olarak belirlenmiştir.



Şekil 3. Siyah çay ekstratlarının L değerleri

Bulgular incelendiğinde çay:su oranının ve demleme süresinin örneklerin L renk değerleri üzerinde istatistiksel olarak önemli ($p<0.05$) bir etkiye sahip olduğu; çay:su oranı ve demleme süresi arttıkça L değerinde azalma olduğu gözlemlenmiştir. Çay ekstratlarına tannaz enzim ilavesinin örneklerin L değerlerinde genellikle artış sağladığı gözlemlenmiş ve enzim uygulanmış ve uygulanmamış örneklerin L değerleri arasındaki farklılıkların istatistiksel olarak da genellikle önemli ($p<0.05$) olduğu belirlenmiştir.

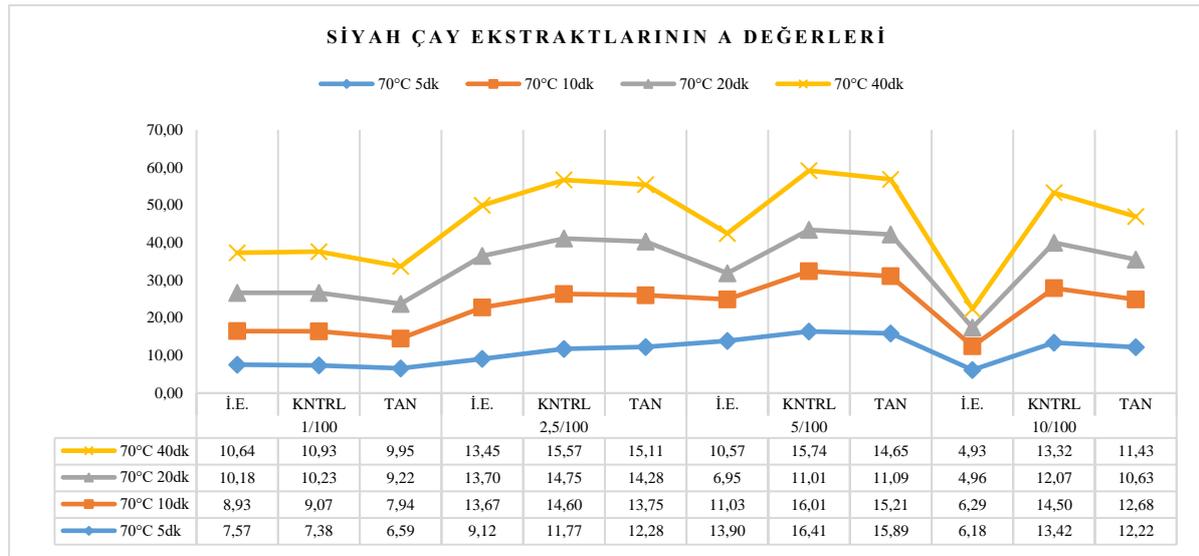
Chandini ve ark. (2011), 90°C de 0.25/200 çay:su oranı kullanarak elde ettikleri ekstraktların L değerini 10 dakikalık demleme için 30.21 olarak belirtirken 20, 30, 40, 60, 80, 100 ve 120 dakika için sırasıyla 28.83, 25.69, 22.25, 20.37, 15.37, 12.03 ve 10.69 olarak bildirmişler, ekstraksiyon süresi uzadıkça da fazla madde geçişine bağlı olarak L değerinde düşme gözlemlendiğini belirtmişlerdir. Chandini ve ark. (2011b), CTC tipi siyah çay kullanarak 2:100 çay:su oranında 90 °C de 40 dakika uyguladıkları ekstraksiyon işleminden sonra elde edilen ekstraktın kontrol örneğinde L değeri 22.3 olarak belirlenirken farklı dozajlarda (10 ve 20 U/g-siyah çay) tannaz ilave edilmiş örneklerin her ikisinde de 26.3 olarak belirlemişlerdir.



Araştırmacılar, enzim uygulamasının L değerinde artışa neden olduğunu bildirmiştir.

3.3.2. Siyah çay ekstratlarının a değerleri

Siyah çay ekstratlarının a değerleri değerlerine ilişkin bulgular Şekil 4’de verilmiştir. Ultrasonik ekstraksiyon yöntemi ile elde edilen ilk ekstraktlarda a değeri 4.93-13.90 aralığında değişirken enzim uygulanmış ve uygulanmamış (kontrol) örneklerinde sırasıyla 6.59-15.89 ve 7.38-16.41 olarak belirlenmiştir.



Şekil 4. Siyah çay ekstratlarının a değerleri

Bulgular incelendiğinde çay:su oranının ve demleme süresinin örneklerin a değerleri üzerinde istatistiksel olarak önemli ($p<0.05$) bir etkiye sahip olduğu gözlemlenmiştir. Demleme süresindeki artışa bağlı olarak ekstraktların a değerlerinde artış meydana geldiği; çay:su oranının artışına bağlı olarak enzim uygulanan örneklerin a değerlerinde kontrol örneklerinin a değerlerine göre azalma meydana geldiği gözlemlenmiştir.

Siyah çay ekstraktlarında a ve b değerlerinin pozitif olarak bulunması çay ekstraktının temel renklerinin kırmızı ve sarı olduğunu, negatif olarak bulunması çay ekstraktının temel renklerinin yeşil ve mavi olduğunu göstermektedir.

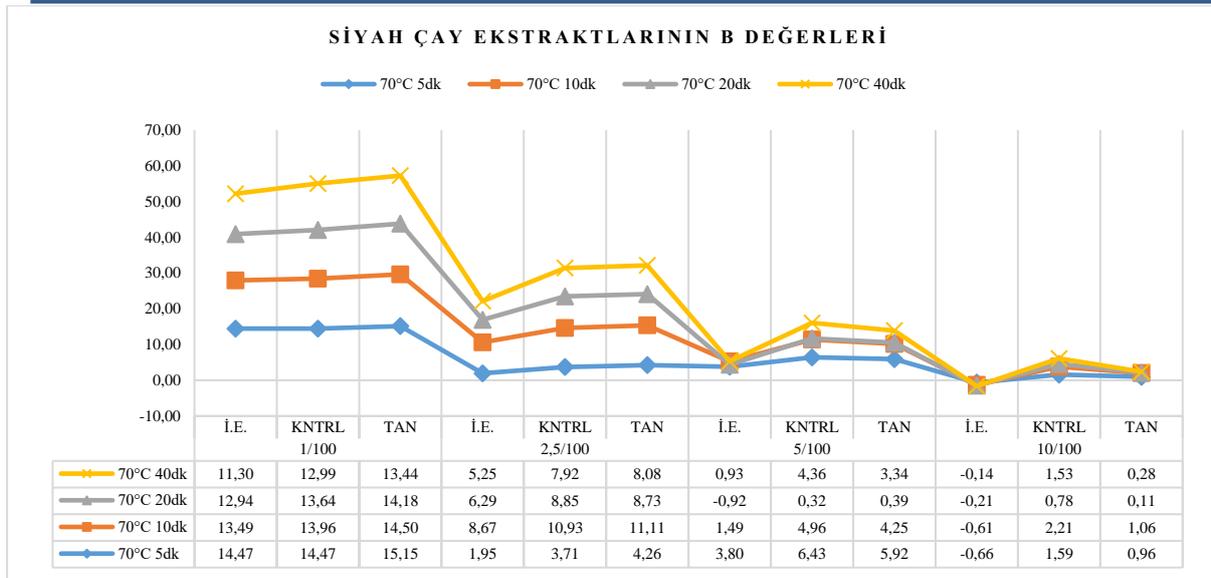
Liang ve Xu (2003), 1:100 çay:su oranında, 20-90°C, 5 dakika ile 3 saat arasında gerçekleştirdikleri ekstraksiyon işleminde son kuru madde konsantrasyonunu 4.3 g/L olacak şekilde ayarlamışlardır. Buna göre 20, 30, 40, 50, 60, 70, 80 ve 90 °C için a değerlerini sırasıyla 13.50, 19.00, 22.26, 23.91, 30.08, 30.85, 31.07 ve 32.08 olarak bildirmişlerdir. Araştırmacılar ekstraksiyon sıcaklığı arttıkça a değerinde artış olduğunu özellikle bu durumun ekstraksiyon sıcaklığının 50°C’den 60°C’ ye çıkarken olduğunu belirtmişlerdir. Ekstraksiyon sıcaklığının 50°C’ den 60°C’ ye çıkarken a değerinde meydana gelen artışın kırmızı renkten sorumlu olan



thearubijin (TR)' in yoğun olarak ekstrakte olmaya başladığı sıcaklık olduğunu düşündürmektedir. Hunter yöntemiyle a değerinin 13.50-32.08 arasında değiştiğini belirtmişlerdir. Liang ve ark. (2003), Çin'in farklı bölgelerinden topladıkları 17 farklı siyah çay ile yaptıkları çalışmada (3:150 çay:su oranı, kaynama sıcaklığındaki su, 10 dakika demleme) kontrol olarak saf su kullanmışlar ve örneklerin "Δa" değerini 6.42-44.03 ortalama 20.19 olarak belirtmişlerdir. Chandini ve ark. (2011b), 90°C de 0.25:200 çay:su oranı kullanarak elde ettikleri ekstraktların a değerini 10 dakikalık demleme için 18.42 olarak belirtirken 20, 30, 40, 60, 80, 100 ve 120 dakika için sırasıyla 19.04, 19.25, 20.28, 22.76, 21.27, 21.85 ve 22.32 olarak bildirmişler, çalışmada ekstraksiyon süresi uzadıkça daha fazla madde geçişine (TR) bağlı olarak a değerlerinde artış meydana geldiğini belirtmişlerdir. Chandini ve ark. (2011a). siyah çay ekstraktlarında kaliteyi artırmak amacıyla farklı enzim uygulamaları denedikleri çalışmada; CTC tipi siyah çay kullanarak 2:100 çay:su oranında 90 °C de 40 dakika uyguladıkları ekstraksiyon işleminden sonra kontrol örneğinde a değeri 20.3 olarak belirlenirken farklı dozajlarda (10 ve 20 U/g-siyah çay) tannaz ilave edilmiş örneklerde ise a değerini sırasıyla 20.4 ve 20.6 olarak belirlemişlerdir. Laddi ve ark. (2011), 0.5:25 çay:su oranında kaynama sıcaklığındaki su ile 6 dakikalık demleme süresi boyunca Hindistan-CTC-BP çay ekstraktlarından her 30 saniyede bir ölçüm almışlar ve a* değerinde zamanla çok az bir değişim meydana geldiğini, bunun sebebinin de 5 dakikaya kadar olan demlemelerde TR değerinin fazla değişime uğramamasından kaynaklanabileceğini, a* değerinin 35-45 arasında değiştiğini bildirmişlerdir.

3.3.3. Siyah çay ekstratlarının b değerleri

Siyah çay ekstraktlarının b değerlerine ilişkin bulgular Şekil 5'de verilmiştir. Ultrasonik ekstraksiyon yöntemi ile elde edilen ilk ekstraktlarda b değeri (-0.92)-14.47 aralığında değişirken enzim uygulanmış ve uygulanmamış (kontrol) örneklerinde sırasıyla 0.11-15.15 ve 0.32-14.47 olarak belirlenmiştir.



Şekil 5. Siyah çay ekstraktlarının b değerleri

Bulgular incelendiğinde çay:su oranının ve demleme süresinin örneklerin b renk değerleri üzerinde istatistiksel olarak önemli ($p < 0.05$) bir etkiye sahip olduğu; çay:su oranı ve süre arttıkça b değerinde azalma olduğu gözlemlenmiştir.

Liang ve Xu (2003), 1:100 çay:su oranında, 20-90°C, 5 dakika ile 3 saat arasında gerçekleştirdikleri ekstraksiyon işleminde son kuru madde miktarını 4.3 g/l olacak şekilde ayarlamışlardır. Buna göre 20, 30, 40, 50, 60, 70, 80 ve 90 °C için b değerlerini sırasıyla 78.44, 86.26, 87.75, 84.53, 63.08, 59.46, 69.12 ve 57.95 olarak bildirmişlerdir. Araştırmacılar örneklerin b değerinin 40°C'ye kadar artış gösterdiğini, ekstraksiyon sıcaklığı arttıkça b renk değerinin düşmeye başladığını belirtmiştir. Bu durum ekstraksiyon sıcaklığı arttıkça, elde edilen ekstraktın daha koyu ve daha kırmızı olduğunu, fakat b değerinin 50 °C' nin üzerinde daha zayıf olduğunu göstermiştir. Hunter yöntemiyle b değerinin 57.95-87.75 arasında değiştiğini belirtmişlerdir. Liang ve ark. (2003), Çin'in farklı bölgelerinden topladıkları 17 farklı siyah çay ile yaptıkları çalışmada (3:150 çay:su oranı, kaynama sıcaklığındaki su, 10 dakika demleme) kontrol olarak saf su kullanmışlar ve örneklerin "Δb" değerini 40.63-58.88 ortalama 48.22 olarak belirtmişlerdir. Kalite kriteri olarak b değerinin TF içeriği ile orantılı olduğunu, kaliteli çayların daha koyu kırmızı-sarı renkte olması gerektiğini belirtmişlerdir. Chandini ve ark. (2011a), 90°C de 0.25:200 çay:su oranı kullanarak elde ettikleri ekstraktların b değerini 10 dakikalık demleme için 12.99 olarak belirtirken 20, 30, 40, 60, 80, 100 ve 120 dakika için sırasıyla 17.54, 17.57, 18.46, 16.50, 16.39, 15.93 ve 15.32 olarak bildirmişler, ekstraksiyon süresi uzadıkça daha fazla madde geçişine bağlı olarak b değerinde 40 dakikalık



süreye kadar artış, süre uzadıkça ise azalma meydana geldiğini belirtmişlerdir. Chandini ve ark. (2011b), siyah çay ekstraktlarında kaliteyi artırmak amacıyla farklı enzim uygulamaları denedikleri çalışmada; CTC tipi siyah çay kullanarak 2:100 çay:su oranında 90 °C de 40 dakika uyguladıkları ekstraksiyon işleminden sonra elde edilen ekstraktta kontrol örneğinde b değeri 18.5 olarak belirlenirken farklı dozajlarda (10 ve 20 U/g-siyah çay) tannaz ilave edilmiş örneklerin her ikisinde de 18.6 olarak belirlemişlerdir. Laddi ve ark. (2011), 0.5:25 çay:su oranında kaynama sıcaklığındaki su ile 6 dakikalık demleme süresi boyunca Hindistan-CTC-BP çay ekstraktlarından her 30 saniyede bir ölçüm almışlar ve b* değerinde zamanla çok hızlı bir azalma meydana geldiğini, bunun sebebinin de çay soğudukça meydana gelen kremalaşma işlemi sırasında TF değerinde meydana gelen azalmadan kaynaklanabileceğini, b* değerinin 60-90 arasında değiştiğini bildirmişlerdir.

3.4. Siyah Çay Ekstraktlarının Duyusal Özellikleri

Duyusal değerlendirme için seçilen çayın başlıca kalite özellikleri lezzet, aroma, renk ve kuvvettir. Bunların arasında lezzet ve aroma en önemli özellikleridir (Someswararao ve Srivastav, 2012). Çay; rengi, kuvveti, burukluğu ve aromasından dolayı değerlidir ve bu özelliklerden ilk üçü theaflavin (TF) ve thearubijin (TR) ile yakından ilişkilidir. TF içeriğinin siyah çayın kalite kriterlerini belirlemede önemli bir faktör olduğu belirtilmektedir (Chandini ve ark., 2011b).

Çalışmada farklı çay:su oranları, demleme süreleri kullanılması ve tannaz enzimi ilave edilmesiyle elde edilen siyah çay ekstraktlarının duyusal (aroma, burukluk, dem rengi, dolgunluk, genel değerlendirme) özellikleri Tablo 1’de verilmiştir.

Aroma; burun ve dil ile algılanan bir duygudur. Yeşil çay filizinin karakteristik aroması reçine karakterindedir. Çayın aroma maddeleri, çayın işlenmesi sırasında oksidatif değişimler sonucu oluşan ve genellikle uçucu karakterli bileşiklerdir. Çay aromasının oluşumuna ilişkin birçok varsayım bulunmaktadır. Bunların başlıcaları olarak amino asitlerin değişmesi, sabunlaşma ve asitlerin dönüşümü sayılabilir. Günümüzde, çay aromasının, çayın bileşiminde yer alan reçinemsî maddelerle esasensiyel yağlardan kaynaklandığı, bunun yanısıra karotenlerin ve amino asitlerin parçalanma ürünlerinin aromayı tamamlayıcı maddeler olduğu belirtilmektedir. İşlenmiş yapraklarda meyve (elma) kokusu karakterinde bir koku oluşur. Kuruma sonrasında karamel kokusu da algılamak olasıdır. Çayın aroması; limon sarısı renkte, kolay katılaştan, buruk tatta ve tipik çay kokulu bir bileşikler topluluğudur. Çayın aroması ve burukluğu ancak tadılarak değerlendirilebilir (Altan, 2010). Ultrasonik ekstraksiyon yöntemiyle farklı çay:su oranları ve demleme süreleri uygulanarak elde edilen kontrol örneklerinin aroma puanı 1.40-



3.70 aralığında değişirken, enzim uygulanan örneklerde 1.65-3.45 arasında değişmiştir. Aroma açısından en yüksek puanı 5:100 çay:su oranında, 70°C’de 5 dakikalık demleme koşullarında 3.70 puan ile tannaz enzimi uygulanmamış örnek almıştır.

Dolgunluk ve burukluk; dolgun çayların suda çözünür kuru madde içerikleri fazladır. Bu durum, öncelikle yeşil çay yapraklarının durumuna ve hasat zamanına göre değişir. İşleme sırasında kıvrmanın yetersiz olması ya da oksidasyonun aşırılığı, ayrıca ambarlama sırasında çayın nem içeriğinin artması, çay dolgunluğunu azaltır ve boş bir çay meydana gelmesine neden olur. Basınç altında kıvrma, dolgunluğu artırır. Dolgun çaylar soğuyunca bulanık bir görünüm alırlar. Bunun nedeni sıcakta çözünen maddelerin soğukta çözülmez duruma gelmeleridir. Demleme sonrası soğuyan dolgun çay üzerinde parlak pulcuklar meydana gelir. Açık esmer renk, kırmızı parlak görünüm çay için bir kalite göstergesidir. Koyu renkli, donuk görümlü pulcuklar ise olumsuz bir kalite göstergesi oluştururlar. Çayın renginin yeşilimsi olması hamlık ve acılığa işaret eder. Bu çayların burukluğu da az olur. Demleme sonrası çay yapraklarının; kırmızı renkte olması bunların iyi işlendiğini, bakır renginde olması soldurmanın yetersiz olduğunu, yeşilimsi renkte olması bunların daha ziyade tomurcuk ve ilk yapraklardan, koyu yeşil renkte kart yapraklardan oluştuğunu gösterir. Burukluk ağızda algılanan bir olgudur. Dil ve ağızda bir çekilme duyulmasıyla anlaşılır. Burukluk çayda aranan bir niteliktir (Altan, 2010). Ultrasonik ekstraksiyon yöntemiyle farklı çay:su oranları ve demleme süreleri uygulanarak elde edilen kontrol örneklerinin burukluk puanı 1.40-3.40 aralığında değişirken, enzim uygulanan örneklerde 1.60-3.10 arasında değişmiştir. Burukluk bakımından en yüksek puanı 5:100 çay:su oranında, 70°C’de 40 dakikalık demleme koşullarında 3.40 puan ile tannaz enzimi uygulanmamış (kontrol) örnek alırken, en düşük burukluk puanını ise ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C’de 40 dakikalık demleme koşullarında 1.40 puan ile tannaz enzimi uygulanmamış (kontrol) örnek almıştır.

Renk; Çay likörünün göze görünümü ile alakalı bir özelliktir (Nas ve Öksüz, 1987). Demlenmiş çay, kırmızı ile kahverengi arasında değişen tonlarda bir renk açılımı gösterir. Buna göre dem; “açık”, “koyu” ve “donuk” olarak adlandırılır (Altan, 2010). Derinlik hissi veren parlak turuncu renk iyi kalite, bakırımsı kırmızılar orta kalite, kahverengi ve mat gri renk oluşumu kalitenin düşüklüğünü ifade ederler (Nas ve Öksüz, 1987). Siyah çayın klasik rengi üretim sürecinde meydana gelmektedir. Bu süreçte taze çay yaprağının kuru ağırlığında % 35 civarında bulunan renksiz kateşinler enzimatik ve kimyasal oksidasyonla iki temel pigment grubu olan theaflavin ve thearubijine dönüşmektedir (Davis ve ark., 1997). TF ve TR siyah çaya rengini veren temel iki pigment grubudur. TF kırmızı-turuncu rengi, TR ise kahverengi-kırmızı rengi vermektedir



(Chandini ve ark.,2011a). Çay deminin rengi ve karakteri üzerinde theaflavin ve thearubijin nicelikleri ile bu iki maddenin birbirlerine oranları etkili olur. Eğer çayın theaflavin içeriği fazla, thearubujin içeriği az ise, çay çok açık renkli ve parlak; aksine theaflavin az, thearubijin fazla ise, bu kez de çay çok koyu renkli ve mat görünümlü olur (Altan, 2010). Ultrasonik ekstraksiyon yöntemiyle farklı çay:su oranları ve demleme süreleri uygulanarak elde edilen kontrol örneklerinin dem rengi puanı 1.20-4.10 aralığında değişirken, enzim uygulanan örneklerde 1.40-4.20 arasında değişmiştir. Dem rengi açısından en yüksek puanı ultrasonik ekstraksiyon yönteminde 5:100 çay:su oranında, 70°C'de 10 dakikalık demleme koşullarında 4.20 puan ile tannaz enzimi uygulanmış örnekler alırken, en düşük dem rengi puanı ise ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C'de 5 dakikalık demleme koşullarında 1.20 puan ile tannaz enzimi uygulanmamış (kontrol) örnek almıştır.

Ultrasonik ekstraksiyon yöntemiyle farklı çay:su oranları ve demleme süreleri uygulanarak elde edilen kontrol örneklerinin dolgunluk puanı 1.60-3.50 aralığında değişirken, enzim uygulanan örneklerde 1.60-3.25 arasında değişmiştir. Dolgunluk bakımından en yüksek puanı (3.50) ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C'de 5 dakikalık demleme koşullarında tannaz enzimi uygulanmamış örnek almıştır.

Ultrasonik ekstraksiyon yöntemiyle farklı çay:su oranları ve demleme süreleri uygulanarak elde edilen kontrol örneklerinin genel değerlendirme puanı 1.50-3.50 aralığında değişirken, enzim uygulanan örneklerde ise 1.80-3.20 arasında değişmiştir. Genel değerlendirme bakımından en yüksek puanı ultrasonik ekstraksiyon yönteminde 5:100 çay:su oranında, 70°C'de 40 dakikalık demleme koşullarında 3.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek alırken, en düşük genel değerlendirme puanı ise ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C'de 5 dakikalık demleme koşullarında 1.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek almıştır.



Tablo 1. Siyah çay ekstraktlarının duyuşal deęerleri

	ULTRASONİK EKSTRAKSİYON									
	Çay:Su Oranı									
	DEMLEME		1:100		2.5:100		5:100		10:100	
	Sıcaklık (°C)	Süre (dk)	KNTRL	ENZİM	KNTRL	ENZİM	KNTRL	ENZİM	KNTRL	ENZİM
AROMA	70	5	1.40 ^d	2.20 ^{cd}	2.40 ^{bcd}	2.90 ^{abc}	3.70 ^a	2.60 ^{abc}	3.45 ^{ab}	3.45 ^{ab}
		10	1.90 ^b	2.40 ^{ab}	3.10 ^a	2.70 ^{ab}	3.25 ^a	3.15 ^a	3.05 ^a	2.80 ^{ab}
		20	2.30 ^{ab}	1.65 ^b	2.60 ^{ab}	2.50 ^{ab}	3.10 ^a	2.80 ^{ab}	2.40 ^{ab}	2.70 ^{ab}
		40	1.60 ^c	2.10 ^{bc}	2.60 ^{abc}	2.75 ^{ab}	3.30 ^a	3.20 ^{ab}	3.10 ^{ab}	2.55 ^{abc}
BURUKLUK	70	5	2.20 ^a	2.30 ^a	3.00 ^a	2.60 ^a	2.90 ^a	2.60 ^a	3.20 ^a	2.30 ^a
		10	1.65 ^a	2.10 ^a	2.90 ^a	2.70 ^a	2.35 ^a	2.85 ^a	2.95 ^a	2.50 ^a
		20	2.00 ^{ab}	1.65 ^b	2.80 ^{ab}	2.10 ^{ab}	2.80 ^{ab}	3.10 ^a	2.30 ^{ab}	2.70 ^{ab}
		40	1.40 ^c	1.60 ^{bc}	2.45 ^{abc}	2.70 ^{ab}	3.40 ^a	3.00 ^a	2.50 ^{abc}	2.40 ^{abc}
DEM RENGİ	70	5	1.20 ^c	1.50 ^c	2.70 ^b	2.70 ^b	3.70 ^{ab}	3.80 ^a	3.55 ^{ab}	3.70 ^{ab}
		10	1.70 ^c	1.60 ^c	3.40 ^{ab}	2.90 ^b	4.10 ^a	4.20 ^a	3.90 ^{ab}	3.70 ^{ab}
		20	1.60 ^{de}	1.40 ^e	2.40 ^{cde}	2.50 ^{bcd}	3.50 ^{ab}	3.50 ^{ab}	3.65 ^a	3.10 ^{abc}
		40	1.80 ^{bc}	1.40 ^c	2.90 ^a	2.70 ^{ab}	3.70 ^a	3.70 ^a	3.50 ^a	3.00 ^a
DOLGUNLUK	70	5	1.60 ^b	2.30 ^{ab}	3.10 ^a	2.60 ^{ab}	3.10 ^a	2.90 ^a	3.50 ^a	2.70 ^{ab}
		10	1.75 ^b	2.10 ^{ab}	3.00 ^a	2.80 ^{ab}	2.45 ^{ab}	3.25 ^a	2.85 ^{ab}	2.90 ^{ab}
		20	2.10 ^{ab}	1.60 ^b	3.10 ^a	2.70 ^{ab}	2.80 ^{ab}	3.10 ^a	2.60 ^{ab}	2.80 ^{ab}
		40	1.60 ^b	1.60 ^b	2.70 ^{ab}	2.85 ^a	3.50 ^a	3.00 ^a	2.80 ^a	2.30 ^{ab}
GENEL DEęERLENDİRME	70	5	1.50 ^b	2.10 ^{ab}	2.65 ^a	2.90 ^a	3.15 ^a	2.65 ^a	3.20 ^a	2.80 ^a
		10	1.80 ^b	2.30 ^{ab}	3.30 ^a	3.20 ^a	2.80 ^{ab}	3.20 ^a	2.90 ^{ab}	2.50 ^{ab}
		20	2.10 ^a	1.80 ^a	2.80 ^a	2.70 ^a	2.90 ^a	2.90 ^a	2.40 ^a	2.40 ^a
		40	1.50 ^d	1.80 ^{cd}	3.10 ^{ab}	3.00 ^{ab}	3.50 ^a	3.20 ^{ab}	2.70 ^{abc}	2.30 ^{bcd}

* Aynı satırda veya sütunda aynı harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir (p>0.05). Aynı satırda üst simge olarak gösterilen farklı küçük harfler farklı çay:su oranları kullanılarak elde edilen kontrol ve enzim uygulanmış örneklerin duyuşal deęerleri arasındaki istatistiksel farkı göstermektedir

4. SONUÇ

Bu çalışmada Ülkemizin önemli çay üreticilerinden Çay-kur işletmesine ait Güneysu-Ulucami çay fabrikası müdürlüğünden temin edilen siyah çay örneklerine ultrasonik ekstraksiyon yöntemi ile farklı süreler (5, 10, 20 ve 40 dakika) ve çay:su oranları (1:100; 2,5:100; 5:100; 10:100) uygulanarak elde edilen ekstraktlara tannaz enzimi uygulanmıştır. Çalışmada elde edilen ekstraktlarda SÇKM, pH, renk ve duyuşal özelliklere ait önemli veriler elde edilmiştir. Tannaz enzimi uygulaması örneklerin SÇKM deęerlerinde artış meydana getirirken, pH deęerlerinde azalmaya yol açmıştır. Çay ekstraktlarına tannaz enzim ilavesinin örneklerin L



değerlerinde genellikle artış sağladığı gözlemlenmiş ve enzim uygulanmış ve uygulanmamış örneklerin L değerleri arasındaki farklılıkların istatistiksel olarak da genellikle önemli ($p<0.05$) olduğu belirlenmiştir. Duyusal değerlendirme sonuçlarına göre ise genel değerlendirme bakımından en yüksek puanı ultrasonik ekstraksiyon yönteminde 5:100 çay:su oranında, 70°C’de 40 dakikalık demleme koşullarında 3.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek alırken, en düşük genel değerlendirme puanı ise ultrasonik ekstraksiyon yönteminde 1:100 çay:su oranında, 70°C’de 5 dakikalık demleme koşullarında 1.50 puan ile tannaz enzimi uygulanmamış (kontrol) örnek almıştır. Çalışmada elde edilen bulguların, bundan sonra konuya ilişkin olarak yapılacak daha kapsamlı çalışmalara başlangıç noktası oluşturacak ve ilgili endüstri kuruluşlarına yol gösterici nitelikte olduğu düşünülmektedir.

5. TEŞEKKÜR

Bu çalışma Esra ESİN YÜCEL’ in ‘Farklı Ekstraksiyon Uygulamalarıyla Elde Edilen Siyah Çay Ekstraktlarının Bazı Özelliklerinin Belirlenmesi ve Krema Oluşumunun Azaltılması’ başlıklı doktora tezinin bir bölümünden üretilmiştir. Araştırma, Tokat Gaziosmanpaşa Üniversitesi Bilimsel Araştırma Projeleri (BAP 2014/77) tarafından desteklenmiştir. Desteklerinden ötürü Tokat Gaziosmanpaşa Üniversitesi Bilimsel Araştırma Projeleri birimine teşekkür ederiz.



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GREEN HRM: A WAY FOR CORPORATE SUSTAINABILITY

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ABSTRACT

Human resource branch of an employer is meant to have a method to play an vital position within the layout of their organisation's sustainability. Now businesses that specialize in Green HR and that they need to get higher efficiency through implementing those practices in HR functions. Green human aid (HR) is one which involves important additives ecofriendly HR practices and the preservation of know-how belongings. Green HR practices contain minimizing paper paintings and specializing in inexperienced sustainable practices. Green HRM method the use of every employee interface in the sort of way in an effort to sell and hold sustainable commercial enterprise practices in addition to creating awareness, which in turn, facilitates organizations to perform in an environmentally sustainable fashion. Therefore this paper objectives to provides the concept of Green HRM and Corporate sustainability and imposing HR functions in Green Culture.

Keywords: Green HRM, Green HRM practices, green environment.



INTRODUCTION

Because of developing worldwide environmental concern and Development of universal environmental guidelines. There is a requirement for organizations to embrace formal environmental practices. By taking the base of green idea different literary works on Green Marketing, Green bookkeeping, Green Retailing and Green administration all in all have treat the zone of the board. There is a need of mix of environmental administration into Human Resource (HR) called Green HR. Various specialists have their commitment to help and raise the familiarity with Green HRM. These significances to selection of environmental practices as an essential reason for authoritative working to make it critical with the quality of HRM practices indicate „green management“ as the activity whereby organizations build up an environmental administration system to deal with the environment. So there is a need of proactive environmental administration. In any case, this can be conceivable with worker inclusion, Participation and contribution of representative is basically significant for accomplishment of the Green HRM idea, There is a need of executing Green HRM Practices in our everyday life filling in just as private have filed that employees“ support in environmental administration frameworks positively affects the character or environmentally capable dispositions and conduct in employees“ private life. Dynamic corruption of the indigenous habitat because of human misuse achieved the need to present the idea of maintainable advancement. In this manner, the indigenous habitat and asset security to support people in the future have become worldwide goals.

What is GREEN HRM?

Green HRM is directly responsible in creating green workforce that understands, appreciates, and practices green initiative and maintains its green objectives all throughout the HRM process of recruiting, hiring, training, compensating, developing and advancing the firms human capital. Typical green activities contain video recruiting, or the use of online and video interviews, to minimize travel requirements. Green rewards can embrace the use of workplace and lifestyle benefits, ranging from carbon credit compensates to free bicycles, to keep people in the green program, as continuing to identify their involvement. The major elements of Green HRM include:

GO GREEN

Going green methods Conservation of earth regular resources just as supporting the "Protection of your own resources" for example your family, Friends, way of life, networks. So we called Green HRM is the Conservation of Human asset their work life and Family life. It implies executing decided way of life changes that will assist individual with living in an eco-accommodating way. For this each individual ought to be a progressively mindful about the environment and changing their conduct, disposition and way of life to limit the practices or exercises that reason the debasement of the



environment. Any move that you make by keeping the manageability of the resources it contributes a positive effect on the environment. Each little change by each person in their way of life makes a Green work-life and green environment for us and for people in the future.

METHODS OF IMPLEMENTING GREEN HRM PRACTICES

Green HRM is a strategy used primarily for reducing the carbon foot print of each employee and talent retention. This term is combined by traditional concepts with longer term renewable approach to business practices. It involves undertaking environment friendly HR initiatives resulting in greater efficiencies, lower cost and better employee engagement and which in turn help the organization to reduce employee carbon.

Encouraging the Adoption of Digitalization

Digitalization helps us to reduce the office filing work, stationaries etc. and this green concept ensures the transparency in the administration. The digitalization leads to store huge volume of data in small equipment and avoids use of stationeries in offices Providing common Transportation facilities Common transportation facilities involve cabin services to the employees.

❖ Instead of using

separate vehicles common transportation facilities help to minimize the environmental hazardous like carbon emissions.

❖ Planting Trees

Organization makes awareness programs among the employees in the society about important of tree planting. It is to be noted that large industrial houses sponsor the highway beautification project as part of their brand building.

❖ Declare Plastic Free Zones

Declaration of industrial areas as plastic free leads to reduce the usage of plastic in offices. The organizations can digitalize the office and keep the office stationeries as minimum. The usage of pen, plastic files covers and other stationeries are also generating undisputable waste.

❖ Declare Smoke free Areas

Smoking injurious to health is the slogan everywhere but still it is unavoidable by the man. Organizations avoid such personals in the recruitment process itself and make ensure that the organization is smoke free.

❖ Encourage Green ideas

Educating the employees and stakeholders about the safe disposal of the electronic and bio medical waste.

❖ Environmental performance



It consists of a managerial procedure that assists a firm to organize its green initiatives by hiring green aware people. Empowering and training them as they become vital for their organizations performance and rewarding them for performing green initiatives (Lefebvre, A. Lefebvre & Talbot, 2003). In order to achieve a green goal, the organization must involve all of its employees in various work fields and motivate them to independently adopt eco-initiatives. This will significantly empower the employees and their satisfaction level would be enhanced. According to Jabbour et al., (2012), satisfied employees help in boosting the performance of the environment.

❖ **Green recruitment**

The green recruitment process includes the hiring of green-aware candidates without the use of paper i.e., employee applications can be accepted on the web. Interviews can be made either on the telephone or online the induction of green recruitment encourages the involvement of employees for monitoring of long-term competency and informing employees about the green company-wide initiatives like reducing wastage and greenhouse gasses. This ultimately facilitates in improving environmental performance.

❖ **Employee involvement**

Employee involvement involves an organizational environment, which encourages the decisions and actions of its employees to promote green initiatives. The more the participation of employees the more the efficacious outcomes a business will achieve. Eco oriented employees can be further involved in the organizational activities by participating in knowledge sharing relating to environmental constraints and the measures which must be taken to improve this dilemma A firm hiring green employees would find its employees to be better involved in green goals of the organization. This enhances employees' satisfaction as employers tend to appreciate the cost saving employees. Due to this behavior, environmental performance can be highly enhanced.

BENEFITS OF GREEN HR INITIATIVE

Today some of the activities of HRM have become vital for the business to perform who have become a standard for Green HRM:

1. Use of telephone – or video calling – for the pre interviewing so that companies can do pre screening of the candidates, in order to minimize the environmental impact, od travel.
2. Mailing and using the other internet facilities like fax for the office works so that the unnecessary usage of printing of papers can be avoided. Thus, there are also some HR policies that dedicate and/or reward the employees environmentally friendly

Following are the benefits:



1. Employees can be recommended to start making changes at home and then observe how they practice environmentally responsible behaviors at work. Once you witness significant energy savings from solar panels or the Energy Star-rated refrigerator, you are more likely to buy the value of saving energy and resources at home and at work.
2. Employees may be asked to suggest ways in which the organization can turn green. Example: companies can start a team of green employees "that can attract some volunteers from the workforce of employees and part of them. The group can meet monthly to bring changes such as the addition of transportation incentives and the use of paperwork recycled.
3. Publicly congratulate the employees who take advantage of the ecological benefits of the company and then publish a quarterly online newsletter dedicated exclusively to their stories and remind workers about the ecological benefits and how to participate. By doing so the employee will be motivated to do the same in future and others gets to learn from their behaviour and there may be chances for them to change their behaviour.
4. The HRM can create a green Infrastructure so that they can maintain the environment and also help to enhance the surroundings their in.
5. Everyone can be informed about green benefits like job candidates, shareholders, the media and community. In advertising campaigns environmental issues can be focused. Press releases can be sent to local media, which will publicize the unique employee benefits. Every employee communication must be green.
6. It is important to review what employees have already done and should advertise them while you can focus to rewrite the descriptions of the jobs in order to highlight the ecological aspects of a position.

CHALLENGES IN GHRM

There are various advantages that a worker and association can achieve by actualizing green HRM which includes: Change rate of maintenance in worker, enhancing open picture, change in pulling in better workers, change in profitability, change in maintainable utilisation of assets, decrease of practices that cause the corruption of the earth, decreased utility costs, discounts and tax benefits and expanded business opportunities. Apart from these mentioned advantages there are some challenges been face by HRM for following the GHRM policies:

1. It's difficult to alter the behaviour of employees in a short span of time and even its difficult to convince the employees for changing their behaviour towards environmental behaviour.
2. HR professionals faces problems of being expected to provide the essential green structures, green processes, green tools and green thinking to make the best selection and develop the future green leaders of the organization.



3. Sourcing and recruitment of green employees with quality talent is challenging.
4. HR professionals have a crucial role to play in recruitment of new employees who are more responsible towards green business practices.
5. The whole transformation process is a burdensome and lingering process.
6. Not every employee is equally motivated to participate in the promotion of green HRM practices in the organisation.
7. It requires high investment at initial stage and comparatively slow rate of return.
8. It is difficult to measure the effectiveness of green HR practices in employee's behaviour.

GREEN HRM AND SUSTAINABILITY

Going green is currently high on the list of priorities of everyone- be it politicians, left and right-wing environmental activists or business leaders. Companies are hitching themselves on to the green practices in their zeal to shore up their image, ratchet up employee morale and drastically cut their costs. In this green world the green HR or people management function has sustainability at its core as part of its people management and talent management focus and organizations engage with the society by aligning their agendas with it. Communities, customers and contractors all become equal stakeholders along with employees and shareholders.

SUGGESTIONS

- ❖ Employees need to be educated and trained on company objectives and green initiatives.
- ❖ Customers should be educated on how to create a more earth- friendly environment.
- ❖ Going green may also enable companies to keep customers and investors happy, maintain market share, become more efficient and avoid legal liability for environmental damage and stay in business.

CONCLUSION

Green HRM can help or affects the employee and their organization practices and behavior against environment. Employees learn so many things either from work life and private life and due to these learning individual behaviors varies toward environment. This is only possible by the effective implementation of green HRM within the organization. It makes intuitive sense that offering Green HRM practices would attract individuals to an organization and by implementing these practices would result in improving employee attitudes and behaviors within the organization. Future research needs to provide empirical evidence while the Green HRM delivers the positive outcomes. Human resource play very important role in managing employee from entry to exit. Now the corporate are focusing on greening the business, so the Human resource departments have the additional responsibility of go green along with HR policies.



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DETERMINATION OF DRY MATTER YIELD AND PROPERTIES OF SOME FABA BEAN (*Vicia faba* L.) CULTIVARS GROWN IN BORNOVA CONDITIONS

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ABSTRACT

This research was carried out in the trial areas of Ege University, Faculty of Agriculture, Field Crops Department in Bornova/İzmir, in the 2019-2020 growing season in order to determine the dry matter yield and some other characteristics of some faba bean (*Vicia faba* L.) cultivars grown in Bornova conditions. Faba bean (*Vicia faba* L.), which is a unique legume with its extremely rich nutritional content, has the ability to grow in various climatic regions, has seeds rich in protein and energy, and finds a wide variety of and valuable uses (feed industry, food industry, etc.). It is a plant with a long history. In the experiment, which was carried out in three replications according to the Random Block Experiment Design, 6 different broad bean varieties (Eresen 87, Kıtık 2003, Salkım, Reina Mora, Black Lazer, Ata 34) were used as plant material in order to determine the varieties that are well adapted to the region. In the research, properties such as dry matter yield, plant height, stem diameter, hay yield, crude protein yield, crude ash yield were investigated. According to the data obtained; The highest dry matter yield was obtained from Salkım (668 kg/da) and Ata 34 (632 kg/da) cultivars.

Keywords: Faba bean (*Vicia faba* L.), cultivars, dry matter yield, hay



INTRODUCTION

Due to the rapid population growth in the world, it is very important to consume adequate amounts of protein-containing foods as well as meeting their carbohydrate needs among the requirements of adequate and balanced nutrition. Especially in developing economies, the difficulty of accessing foods of animal origin and the expensiveness of these foods lead people to plant proteins.

Legumes are in second place after cereals in terms of economic importance. Leguminous species grow in temperate, humid regions, plateaus, and savannas, and there are even aquatic leguminous plants (Wrigley et al., 2016).

In general, legumes are known as nitrogen self-contained crops. However, the efficiency and extent of biological nitrogen fixation vary widely among legumes. Leguminous species that meet 50% to 90% of the total nitrogen requirements from symbiotic nitrogen fixation are considered effective nitrogen fixers (N'Dayegamiye et al. al., 2015).

Faba bean (*Vicia faba* L.) is a cool climate legume that originated in the Middle East in prehistoric times and has traditionally been used as the main protein source for human and animal nutrition (Multari et al., 2015). Beans are rich in protein and lysine in animal nutrition. It is also known to be very important in terms of physiology. In addition, it does not contain glycosides that form cyan acid. For this reason, faba beans are easily used in human and animal nutrition (Ergül, 2002).

The faba bean lives in a symbiotic state with the rhizobium bacteria and thus binds the free nitrogen in the atmosphere to the soil. In fact, it is reported that the legume has the highest nitrogen fixation rate among legumes (Erincik, 2010; Yıldırım and Özasan Parlak, 2016). Researchers have found the benefits of faba beans; Greenhouse gas emissions due to its higher grain yield than peas, its high protein content through symbiotic nitrogen fixation, the breaking of diseases and harmful cycles by entering crop rotations with grains and oilseeds, the diversification of soil microbial ecosystems and reduced product inputs. They list it as the ability to reduce emissions (Strydhorst et al., 2008; Köpke and Nemecek, 2010). According to TUIK (2020) statistics, the total bean sowing area is 34,884 decares. In this area, 21,040 decares of edible bean and 13,844 decares of fodder bean were planted. While faba bean production amount is 9,135 tons in total, 5.002 tons of it is edible faba bean and 4.133 tons is fodder faba bean. Fresh faba bean production in 2020 is 54,317 tons in total.

The aim of this research is to examine the dry matter yield and some other characteristics of 6 different faba bean varieties grown in Bornova-İzmir conditions, to determine the varieties that are well adapted to the region, to provide continuous and safe forage sources to our livestock producers, and thus to contribute to the development of our country's livestock.



MATERIAL AND METHOD

The research was carried out in the experimental fields of Ege University Faculty of Agriculture, Department of Field Crops in the 2019-2020 growing period.

In İzmir, where the Mediterranean climate is observed, summers are hot and dry, and winters are warm and rainy. The annual average temperature is 14-18 °C in the coastal areas. There are changes in precipitation distribution in İzmir according to months and seasons. Average rainfall is 700 mm per year. Annual precipitation is more than 50% in winter, 40-45% in spring and autumn, and 2-4% in summer. The long-term average temperature in İzmir is 18.4 °C. According to the observation data for many years, the total annual precipitation is 730.5 mm, while the distributions throughout the year are not regular.

The soil has a loamy-loamy structure at a depth of 0-20 cm and a clay-loam structure at a depth of 20-40 cm. The alluvial soil structure of the Bornova plain shows the characteristics of relatively heavy soil. While the pH value in the 0-20 cm part of the soil is 8.2, the pH value in the 20-40 cm part is 7.8. The lime ratios determined in the soil structure show that the soil is rich in lime. The determined organic and inorganic material values show that these soils are deficient in organic matter, moderate in total nitrogen, deficient in useful phosphorus and rich in beneficial potassium (Kacar, 1986; Kovancı, 1990).

In the research, the varieties of the Ministry of Agriculture and Forestry, Ege Agricultural Research Institute Directorate, "Kıtık 2003, Salkım, Eresen 87", "Ata 34" belonging to Istanbul Seed company, "Black Lazer" belonging to Neobi Seed company and "ReinaMora" belonging to Fito Seed company. 6 different faba bean varieties were used. In the study, faba bean varieties were examined as a factor. Trial Random Blocks were arranged according to the trial design with 3 replications. Soil tillage preparations of the research area were started 15 days before planting. The field was first plowed at a depth of 20-25 cm with a plow and milled. Thus, the field was made ready for planting. Before planting, a smooth planting bed is prepared. After these processes, the parceling process was started and the parceling was carried out in accordance with the trial plan. According to the results of the seed tests, the amount of seeds to be used was determined and the planting process was completed on 19 November 2019, with each plot consisting of 10 rows. In the study, the seeds were sown at a depth of 4-5 cm by hand, leaving 50 cm between rows and 10 cm above the row, and watered with the sprinkler irrigation method. 15-15-15 base fertilizer was applied to all plots in the experiment, at 8 kg N/da, 8 kg P₂O₅/da and 8 kg K₂O/da. In order to support the development and relieve the plants, the first hoe was made when the plants were approximately 15-20 cm, and the second hoe was made when needed



according to the weed. Plants in full bloom 20 April 2020 It was cut from the ground level with hand sickles. In the research, properties such as dry matter yield, plant height, stem diameter, hay yield, crude protein yield, raw ash yield were investigated.

The results of the analyzed data were evaluated according to the Single Factor Random Blocks experimental design by using the personal computers and the package program "TOTEMSTAT" in the Department of Field Crops, Faculty of Agriculture, Ege University (Açıkgöz et al., 1994).

RESULTS AND DISCUSSION

Plant Height (cm) and Stem Diameter (mm)

The average values of the plant height characteristics of 6 different faba bean cultivars discussed in the study are summarized in Table 1. In the evaluation, it was seen that the difference in plant heights between bean varieties was statistically significant. The plant height values of the cultivars are between 121.8-158.5 cm. Among the cultivars, the highest plant height value was followed by Salkım (158.5 cm) and Ata 34 (145.7 cm). Black Lazer, Reina Mora, Eresen 87 and Kıtık 2003 varieties were in the lowest and same statistical group. The lowest plant height value is 121.8 cm in Kıtık 2003 cultivar. Plant height is one of the most important factors affecting yield. Plant height is an important criterion in terms of determining feed values and yield elements. Findings obtained as a result of the research Özkayahan and Avcıoğlu (1997), Cevheri and Avcıoğlu (2004), Geren and Alan (2005), İdikut et al. (2018), Kadioğlu (2019), Başdemir et al. (2020), it is similar to the findings of (Gençkan, 1983; Manga et al., 1995). It is thought that the difference between the values determined for plant height and other researchers may be due to cultural practices such as irrigation and fertilization, climatic and soil conditions of the years the faba bean was grown, and the genotype of the cultivars used.

In the evaluation, the differences between the varieties in stem diameter were found to be statistically significant. Stem diameter values between cultivars vary between 7.54-12.60 mm on average. (Table 1). However, the highest stem diameter value was reached in the Salkım variety with 12.60 mm, and Ata 34 took the second place with a value of 12.02 mm. The lowest stem diameter value was obtained in the Reina Mora variety with 7.54 mm. Our findings regarding the stem diameter are similar to those of Karayel et al.(2016).

Dry Matter Yield and Hay Yield

Average values of dry matter yield of faba bean varieties are shown in Table 1. In the evaluation, the differences between the varieties in dry matter yield were found to be statistically significant. The highest dry matter yield value was obtained from Salkım variety (668 kg/da) and Ata 34 (632 kg/da) variety. The lowest dry matter yield value is Eresen 87 (382 kg/da). Regardless of the environmental effects of the research conditions, our findings regarding the dry matter yield value, which is a reliable



criterion in determining the biomass production of plants, valid in every country of the world; Sparrow et al. (1993), Panciera and Sparrow (1995), and the values found by Geren and Alan (2005).

Table 1: Average values of plant height, stem diameter and some yield characteristics ratio of faba bean cultivars

Cultivars	Plant Height (cm)	Stem Diameter (mm)	Hay Yield (kg da ⁻¹)	Dry Matter Yield (kg da ⁻¹)	Crude Protein Yield (kg da ⁻¹)	Crude Ash Yield (kg da ⁻¹)
ATA 34	145,7b	12,02b	820a	632a	112,6b	53,7b
SALKIM	158,5a	12,60a	717b	668a	123,1a	58,8a
ERESEN 87	124,3c	10,06c	539d	382c	70,7d	32,7d
BLACK LAZER	126,3c	8,92d	662c	446b	78,7c	42,3c
KITIK 2003	121,8c	8,76d	634c	440b	79,2c	31,9d
REINA MORA	126,0c	7,54e	559d	435b	74,3cd	38,3c
Mean	133,8	9,98	655	501	89,8	42,9
LSD (%5)	11,2	0,49	36	40	7,7	4,3

In the statistical evaluation, the differences between the varieties were found to be significant in hay yield. Among the varieties, the highest hay yield value of 820 kg/da was obtained from Ata 34 variety, followed by Salkım variety with 717 kg/da. The lowest hay yield value determined belongs to Eresen 87 variety with 539 kg/da. The average value was measured as 655 kg/da. Herbage is difficult to store because of its high moisture content. (Table 1). Therefore, it is dried and the humidity is reduced and preserved in this way. Hay yield and quality; It varies according to the type of plant, the time of the weed, drying and storage methods. The water content of herbage varies depending on factors such as region, climate, variety and storage conditions. Our research findings on hay yield; Genckan (1983); Manga et al. (1995), Yıldırım and Özasan Parlak (2016) found it higher than the results found.

Crude Protein Yield and Crude Ash Yield

As a result of the statistical analysis in terms of crude protein yield; Among the faba bean varieties, Salkım (123.1kg/da) with the highest crude protein yield was followed by Ata 34 (112.6 kg/da). The lowest crude protein yield was found in Eresen 87 variety (70.7 kg/da). The average crude protein yield of the cultivars was 89.8 kg/da.(Table 1) The findings we obtained; Geren and Alan (2005) show parallelism with the results of Ghanbari-Bonjar and Lee (2003). It is thought that the crude protein



yield is generally compatible with the literature data, but higher yields will be obtained if the amount of organic matter in the soil is high.

Crude ash yield among different faba bean cultivars varies between 31.9% and 58.8% on average (Table 1) While the highest crude ash yield was reached in the Salkım variety (58.8%), the lowest yields were reached in Eresen 87 variety (32.7%) and Kıtık 2003 variety (31.9%), which are in the same statistical group. The average value was found to be 42.9%. It was determined that the findings about the crude ash yield of faba bean cultivars were lower than the findings of Geren and Alan (2005).

CONCLUSIONS

Dry matter yield and some other characteristics of some faba bean (*Vicia faba* L.) cultivars grown in Bornova conditions were investigated in the study carried out in the experimental fields of Ege University Faculty of Agriculture, Department of Crop Plants in the 2019-2020 growing period. According to the findings obtained from the research; It seems possible to obtain a dry matter yield of approximately 1 ton/da as a result of winter faba bean cultivation in İzmir/Bornova, which represents the Mediterranean climate zone.

Among the bean varieties examined in the study, it was concluded that Salkım ve Ata 34 varieties, which have high dry matter yield, can be selected according to seed prices and recommended under regional conditions, and if it is considered that the results obtained from one-year data will not be very satisfactory, repeating the studies for at least 2 years will give clearer results.

P.S: “This article is part of the first author's MSc thesis”



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A STUDY ON CONSUMERS PERCEPTION TOWARDS ORGANIC PRODUCTS WITH SPECIAL REFERENCE TO CHENNAI CITY

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ABSTRACT

The study conducted in Chennai City of Tamil Nadu state has investigated the Consumers Perception towards Organic Products based on the data collected from 100 respondents. Besides looking into the awareness level, the study has found the association between demographic characters and awareness level about organic products. The study has revealed that factors like gender, family income, education and occupational status differentiate consumers of organic and non-organic food products. Besides, psychological factors such as attitude, perception, belief and intention have shown positive results for the organic Products consumers of Chennai City.

Keywords: Consumers attitude, organic foods, Consumer Preference, consumer satisfaction, attitude, Health



1. INTRODUCTION

The meaning of organic food is, obtaining agricultural produce without using manmade fertilizers and without harming the environment. Food products obtained by organic farming are called organic food products. AS these food products are environmental friendly, the food products are fresh, hygienic and healthy.

2. REVIEW OF RELATED LITERATURE

Rupesh Mervin and R.Velmurugan (2013) in their study ascertained that consumer's preference towards organic foods depends on gender, age, occupation, monthly income, family status and level of awareness towards organic foods.

Brijesh Sivathanu (2015) in his study entitled has showed that the Consumers prefer organic food due to safety, human health, and environmental concern and also due to attributes like nutrition value, taste, freshness and appearance of organic food matters a lot for consumers. It has been observed that females have more preference for organic food products as compared to male respondents. More number of educated respondents prefers to buy organic food products. Age group of 29-39 prefers to buy organic food as compared to other age groups. Also people of higher income group prefer to buy organic food. T. Mohanasoundari, A. Kalaivani (2016) in their study captioned that, they have brought out the fact that the people were well aware of images and availability, but not loyal entirely to organic food products. The respondents without doubt attracted towards Organic food products. So the marketers must create promotions which are both realistic and moral and the product availability in terms of volume and variety are required to become successful in marketing organic food products.

3. OBJECTIVES

- To study the consumer perceptions towards purchase of organic products in Chennai city
- To analyze the demographic profile of the consumers.
- To examine the consumer level of preference towards organic products.

4. HYPOTHESIS OF THE STUDY

Ho—There is no association between gender and satisfaction of consumers

H0: There is no significant relationship between monthly income and type of Organic products.

5. RESEARCH METHODOLOGY

Sampling Design: For the purpose of this study the data were collected from 100 respondents using random sampling technique.

Sampling Size: The sample size of the research is 100 respondents.



Method of Data Collection:

Primary Data : Questionnaire

Secondary Data: Books, journals and magazines

Tools Used for study:

Parentage analysis and SPSS will be adopted to analysis the consumer's response towards Organic products in Chennai city.

Limitations of the Study

- Due to time constraint, the sample size is limited to 100 & the study area is restricted to Chennai
- The sample size is limited to 100 respondents only.
- The analysis is made based on the opinion given by the sample respondents in the study area.

I.ANALYSIS AND INTERPRETATION OF DATA

S.NO	SOURCE	FACTORS	FREQUENCY	PERCENTAGE
1	Gender	Male	70	70
		Female	30	30
		Total	100	100
2	Classification on Age Group		38	38
		21-30	33	33
		31-40	22	22
		41-50	07	07
		Above 51	07	07
3	Marital Status	Total	100	100
		Married	69	69
		Unmarried	31	31
4	Members of the Family	Total	100	100
		Up to 2	09	09
		3 and 4	59	59
		5 and 6	27	27
		7 and above	05	05
5	Educational	Degree	03	03



	Qualification			
		Post graduation and above	97	97
		Total	100	100
6	Occupation	Private Service :	70	70
		Government service	12	12
		Business	05	05
		Student	07	07
		Others	06	06
		Total	100	100
7	Monthly Income	Below 15000	22	22
		15001-25000	23	23
		25001-35000	17	17
		Above 35000	38	38
		Total	100	100
8	Purchase of organic products	Yes	66	66
		No	34	34
		Total	100	100
9	Reasons for not purchasing organic products		41	41
		Less availability		
		Don't know where to get them	16	16
		No variety	14	14
		No different cost	12	12
		Other	03	3
		Other	14	14
		Total	100	100
10	Which organic product do you buy	Vegetables & fruits	41	41
		Pulses Cereals	13	13
		Dairy products	10	10
		Vegetables and fruits, Dairy products	08	8
		Vegetables & fruits, Dairy products, Pulses & Cereals	07	7
		Non -food Products	04	4
		Other	17	17
		Total	100	100
11	Place of Purchase	Farmer market	30	30
		Super market	24	24
		Local shop	20	20
		Organic shop	23	23
		Don't buy	01	1
		Other	02	2
		Total	100	100
12	Reasons for buying	Healthy	54	54
		Healthy Environment friendly	15	15



		Healthy Save to consume Environment friendly High quality	07	7
		Environment friendly	05	5
		Save to consume	04	4
		Healthy, High quality	03	3
		Other	12	12
		Total	100	100
13	How often do you buy organic products	Hardly never	17	17
		Once in a month	47	47
		Once in a week	36	36
		Total	100	100
14	Grades of organic products	Excellent	28	28
		Good	68	68
		Poor	04	4
		Total	100	100
15	Recommendations to Organic products	Yes	81	81
		No	19	19
		Total	100	100
16	Organic products are beneficial	Agree	41	41
		Disagree	06	6
		Neutral	18	18
		Strongly agree	20	20
		Strongly disagree	15	15
		Total	100	100
17	Level of satisfaction in Organic products	Dissatisfied	03	3
		Highly Dissatisfied	02	2
		Neutral	15	15
		satisfied	51	51
		Highly satisfied	29	29
		Total	100	100

- ❖ Majority 70% of the respondents are male.
- ❖ Majority 38% of the respondents are their age group up to “21 to 30years”
- ❖ Majority 70% of the respondents comes under Private employed category.
- ❖ Majority 41% of them are using vegetables and fruits
- ❖ Majority 54% of the respondents prefer for protection health
- ❖ Majority 68% of the respondents have good opinion regarding the organic products
- ❖ Majority 51% of the respondents were satisfied with the organic products
- ❖ Majority 30% of the respondents purchase organic food from Farmer market
- ❖ Among respondents 47% of the respondents purchase organic product once in a month.



Table – 2

Ho–There is no association between gender and satisfaction of consumers

		Level of satisfaction in Organic products					Total
		Dissatisfied	Highly Dissatisfied	Highly Satisfied	Neutral	Satisfied	
Gender	Female	0	1	8	5	16	30
	Male	3	1	21	10	35	70
Total		3	2	29	15	51	100

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.872 ^a	4	.759
Likelihood Ratio	2.694	4	.610
N of Valid Cases	100		

From the above table shows that the result of the chi-square test and the Asymp.Sig. (2.sided) P-value is .759 which is greater than .05. The hypothesis is rejected which shows that there is an association between gender and level of satisfaction.

Table – 3

Ho: There is no significant relationship between monthly income and type of Organic products.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.508	6	.276
Likelihood Ratio	7.922	6	.244
N of Valid Cases	100		

From the above table shows that the result of the chi-square test and the Asymp.Sig.(2.sided) P-value is .276 which is greater than .05. The hypothesis is rejected which shows that there is an association between Income and the type of organic product.



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SOME NOTES ON MAIZE-ALTERNATIVE SILAGES, BIOACTIVE COMPOUNDS AND LACTIC ACID BACTERIA ADDITIVES

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Abstract

The primary fodder used by the dairy sector in many developed nations is whole-plant maize silage. The increasing awareness on biodiversity and ensuring the supply of biomass led to heightened interest from governments and farmers in alternative crops. Legume silages have higher rates of rumen fermentation, physical breakdown, and passage from the rumen. Sorghum is a crop that stands out for its inherent rusticity, strong biomass yield, and exceptional tolerance of water deficiency. As water availability issues continue and pressure is applied to the dairy industry to become more water efficient, sorghum could play an important role as a potential solution. To minimise decreased starch digestibility and related detrimental effects on lactation performance, hybrids containing tannin must be handled. Plant bioactive compounds are common in the plant kingdom, including in forage species, but little is known about how they affect silage fermentation.

Keywords: Ensiling, silage, sorghum, plant bioactive compounds, Lactic Acid Bacteria



1. Introduction

Ensiling is a typical technique for preserving moist crops. It increases the feed's palatability and increases the associated storage time (Zhang et al., 2019). Fresh forage preserved by using the microbially-driven ensiling process can be used in both animal production and biorefinery. Ensiling can act naturally when epiphytic bacteria on the plant material are present, or it can be improved by adding inoculants, which produces better-quality silage (Avila et al., 2014). The research for new silage additives has benefited from the biochemical changes that occur during ensiling, highlighting the possibility of particular microbial strains that are more effective at biopreservation. Many different lactic acid bacteria (LAB) species additions in the fermentation of crop or forage biomasses during ensiling are well known (Okoye et al., 2022).

As compared to grass silages of comparable digestibility, legume silages have higher rates of rumen fermentation, physical breakdown, and passage from the rumen. Milk yields are typically higher for maize and legume silages despite the fact that total tract digestibilities are frequently lower than for grass silages. Legumes and maize also have the advantage of a slower rate of digestion reduction. Legume silages frequently result in higher quantities of polyunsaturated fatty acids and lower concentrations of milk fat (Dewhurst, 2013). In the intensive farming systems of several European nations, whole-plant maize silage is the principal own farm fodder contributing to the formulation of total mixed ration for high-genetic-merit lactating dairy cows. It is a high-yielding and flexible harvesting vegetable crop with a high nutritional value also for ruminant meat producers (Köhler et al., 2019; Segato et al., 2022).

The primary fodder used by the dairy sector in many developed nations is whole-plant maize silage. Whole-plant maize silage has traditionally been made by cultivating hybrids with high grain yield traits. Depending on the needs of their feed stocks, farmers can choose to collect maize grain or whole-plant maize silage using conventional or dual-purpose hybrids. However, more recently, farmers have begun to plant and harvest more hybrids designed specifically for silage in an effort to increase the nutritional qualities of whole-plant maize silage in order to meet the demands of dairy cows with high milk production. Modifications to the stalk or kernel properties of whole-plant maize silage might enhance its nutritional value. Typically, stalk properties are changed to improve the fiber's digestion in whole-plant maize silage (Ferraretto & Shaver, 2015).

2. Whole-plant sorghum silage as an alternative to maize silage

Sorghum (*Sorghum bicolor* L.) is a crop that stands out for its inherent rusticity, strong biomass yield, and exceptional tolerance of water deficiency. Due to these qualities and its high energy efficiency, it may be grown in dry and semi-arid environments and cultivated throughout the year. Sorghum is an



ideal plant for ensiling because of its phenotypic traits, which influence how simple it is to cultivate, handle, harvest, and store. Chemically, it contains a large amount of soluble carbohydrates, which are necessary for a sufficient lactic acid fermentation of organic waste, which is what gives silage its high nutritional value (Tolentino et al., 2016).

In regions where whole-plant corn silage production may be constrained, sorghum is an appealing crop due to its resilience to drought, water efficiency, and low cost of production. At the present, farmers are under more social and financial pressure to increase food production efficiency due to urban land expansion and decreased water availability. Due to its capacity to generate large dry matter yields while maintaining nutritional value, even in less than optimal growing conditions, sorghum can be predicted to be used more frequently as these difficulties become more common. Furthermore, the fibre and grain fractions in whole-plant sorghum silage offer calories as well as fibre that is physically effective. Common problems with whole-plant sorghum silage supplementation, such as increased neutral detergent fibre and decreased neutral detergent fibre digestibility, starch concentration, and starch digestibility, may be resolved with advances in sorghum genetics and mechanical processing. Whole-plant sorghum silage must overcome these nutritional obstacles in order to be a competitive alternative to whole-plant corn silage. Sorghum comes in a variety of forms, including grain, forage, biomass, and sweet sorghum. Physical and chemical differences between sorghum types and hybrids can be observed. Depending on the type and hybrid chosen, some variance in nutritive value may be observed. To avoid choosing a variety or hybrid that might yield unexpected results at harvest, careful variety and hybrid selection must be made. Supplementing whole-plant sorghum silage to lactation dairy cows presents a number of difficulties, including higher NDF and lignin concentrations and lower starch concentration and digestibility. But according to recent studies, some of these problems might be solved by mechanical processing or advancements in plant genetics. As water availability issues continue and pressure is applied to the dairy industry to become more water efficient, sorghum could play an important role as a potential solution. The distinctive feature of whole-plant sorghum silage is the presence of both a grain and a fibre percentage. The pericarp, endosperm, and germ are the three distinct parts of the sorghum grain. The pericarp covers the outside of the seed and functions as a physical barrier to prevent the endosperm and germ layers' nutrients from being digested. The endosperm can be further broken down into two sections: vitreous endosperm and floury endosperm. The changes in protein concentration between the floury and vitreous endosperm are connected. Under field conditions, mechanical processing of the sorghum grain contained in WPSS is frequently challenging. The link between grain processing, starch digestibility, and lactation efficiency must therefore be quantified through more research. The germ is of lesser importance in terms of grain



protection. However, it contains fatty acids and minerals important for dairy cattle. To minimise decreased starch digestibility and related detrimental effects on lactation performance, hybrids containing tannin must be handled. Before the harvest season even starts, several crucial decisions that affect the yield and nutritional value of a crop are decided. Sorghum can withstand many different planting populations. Sorghum genetics are continually improving and, therefore, consistent reassessment of optimal planting rates to maximise yield and nutrient value is justified. The prospective milk yield from dairy cows can be significantly influenced by forage quality, hence it is crucial to maintain forage quality throughout the harvest season. The production of silage can be used to provide effective harvesting methods, the storage of vast quantities of feed, and constancy in nutrient content as the average farm size increases. Four phases make up the silage-making process: the aerobic phase, the fermentation phase, the storage phase, and the feed-out phase. Some sorghum hybrids that are thought to have higher levels of tannins or prussic acid should be stored for a longer period of time. Whole-plant sorghum silage has consistently had lower starch content and digestibility than whole-plant maize silage. Harvesting at a maturity that permits increased starch deposition and vigorous mechanical processing of the grain fraction may be the most practical way to increase whole-plant sorghum silage starch content and digestibility. It has not been advised to completely replace whole-plant sorghum silage with whole-plant maize silage due to the higher NDF concentrations, as well as the decreased NDFD, starch concentration, and starch digestibility. Starch concentration can be increased by taking advantage of the crop's maturity during harvest, and problems with starch digestibility may be resolved by mechanically processing the grain portion of whole-plant sorghum silage in a forage harvester. To calculate the impacts of forage harvester settings on grain breakage, starch digestibility, and lactation efficiency, more research is required. Additionally, the use of a berry processing score could help to assess how well processing was done. Modern sorghum genotypes provide many alternatives for nutrient-rich, possibly high-yielding feed sources. The value of whole-plant sorghum silage as a feed source for dairy cattle will continue to increase with careful hybrid selection, effective silo management, and further progress in agronomic and harvesting procedures (McCary et al., 2020).

3. Plant bioactive compounds improving silage quality

Plant bioactive compounds (PBC) are common in the plant kingdom, including in forage species, but little is known about how they affect silage fermentation and ruminant consumption of PBC-containing silage. Reduced emissions of pollutants like enteric methane (CH₄), improved animal health due to antimicrobial, anthelmintic, or antioxidant activities, and favourable effects on the quality of animal products—especially greater increased polyunsaturated fatty acid (PUFA) content—are some of the



positive effects of plant bioactive compounds. Plant-protein protection against excessive degradation by tannins or polyphenol oxidase, which leads to reduced soluble nitrogen (N) and better N use efficiency by animals, is another. The increased competition between food and feed for scarce arable land resources, particularly for monogastric livestock, increases the demand for high-quality silage to provide forage for ruminants. Even more important is the issue of protein and energy losses, which start with enzymatic and microbiological processes in the silos long before the silage is actually consumed. In order to increase nutrient use efficiency and reduce pollutant losses in the form of greenhouse gases and ammonia (NH₃), silage lactic fermentation and plant protein protection, animal health (such as digestive diseases), and product quality, such as through FA profiles in meat and milk or increased oxidative stability, are some of the improvements made possible by plant bioactive compounds. A wide variety of bioactive substances are present in the plant kingdom, many of which can be found in forage entire plants, feeds, or plant extracts that can be added to silage. Plant bioactive compounds has been classified to varied degrees in grassland species, crops, agroindustry byproducts, and plant extracts or essential oils. Plant bioactive compounds are still only occasionally used in silages, despite increased interest in their usage in animal nutrition. There are several studies reporting on the bioactivity of these chemicals, but there is little research on how they affect silage. The low value of silage, the necessity for farmers to produce silage as quickly and easily as possible, and other elements known to enhance silage quality could be contributing factors to this serious lack of research (ensiling techniques, inoculants). Some bioactive substances that are naturally found in a variety of forage species or byproducts could be inexpensive while still adding value to current treatments. The limited data on plant bioactive compounds bioactivity in silage frequently emphasises polyphenols, particularly tannins. Beyond enhancing silage quality, plant bioactive compounds—and specifically tannins—may have the potential to improve ruminants' ability to absorb nutrients (N and energy), which would therefore improve animal performance. However, it remains to be seen whether the plant bioactive compounds provide further biological effects once ingested by ruminants. The issue is important because the tannins' hydroxyl groups, which are present in their structure and are employed to bind protein in silage, may not be enough to exert additional effects in the rumen. Plant bioactive compounds in silage, however, can only continue to promote N usage efficiency when particular bioactives also protect against excessive microbial protein breakdown in the rumen, simultaneously reducing rumen-degradable protein and increasing rumen-undegradable protein. A rise in metabolizable protein, or protein that can be digested and absorbed in the small intestine, is caused by an increase in rumen-undegradable protein, also known as rumen bypass protein. NH₃ is a crucial marker of protein deterioration in the rumen. Although rumen microbes require a certain amount of to



synthesise microbial protein, NH₃ overage in the rumen is a form of inefficiency of N use and can subsequently stimulate higher N excretion to the environment. All aspects of ruminant nutrition, including nutritional content, palatability, and voluntary intake, as well as animal health and product quality, can be impacted by silage quality. This has a significant impact on both the inputs (such as energy and protein concentrates, medications, etc.) required for animal performance and the pollutant emissions that must be reduced as much as possible to promote a more sustainable model of agriculture and agroecology. The usage of plant bioactive compounds is gaining popularity as a natural remedy that is also affordable, well-liked by customers, and supplied by ensiled forages. The ability of plant bioactive compounds to reduce the degradation of dietary protein into soluble N and NH₃ in the silo and in the rumen can increase nutrient use efficiency and animal performance while reducing pollution in the form of urinary N excretion and CH₄ emissions. In particular, tannins' anthelmintic properties and their antioxidant capacity to combat oxidative and inflammatory stress can have a positive impact on ruminant health. In addition, certain plant bioactive compounds have been demonstrated to improve PUFA content and oxidative stability in ruminant products by reducing FA biohydrogenation (Niderkorn & Jayanegara, 2021).

4. Animal and human health risks from silage

As the rumen bacteria may detoxify mycotoxins, ruminants are thought to be less vulnerable to them than monogastric animals. Therefore, compared to monogastric animals, the impact of mycotoxins on ruminants has been examined less. Silages composed of forage crops make up a significant element of the ruminant diet globally (i.e. all parts of the crop above the stubble are harvested). In reality, silages are frequently contaminated with a variety of mycotoxins. A combination of mycotoxins can have detrimental effects on human health and animal productivity (Wambacq et al., 2016).

Several substances may be dangerous to animal health, the safety of milk or other animal feeding items, or both, which may be present in silage. *Clostridium botulinum*, *Bacillus cereus*, *Listeria monocytogenes*, *Escherichia coli* that produces Shiga toxin, *Mycobacterium bovis*, and numerous mould species are examples of microbial risks. Cattle botulism has been linked to silage with high *C. botulinum* concentrations. The growth of *C. botulinum* in silage can be aided by a high initial concentration of *C. botulinum* spores in fodder and unfavourable silage fermentation conditions. The concentrations of *L. monocytogenes*, Shiga toxin-producing *E. coli*, and moulds in silage are significantly influenced by the elevated pH level that is typically associated with aerobic deterioration of silage. It may also favour the survival and growth of *M. bovis*, the bacterium that causes bovine tuberculosis. *B. cereus* spores in silage are mostly derived from soil, and its growth in silage seems to be constrained. Plant poisons that may contaminate forages during harvesting include pyrrolizidine,



tropane and tropolone alkaloids, phytoestrogens, prussic acid, and mimosine. These substances occur naturally in some plant species. Ergot alkaloids, which are produced by endophytic fungal species in forages such tall fescue grass, sorghum, and ryegrass, are another group of toxins falling under this category. Ensiling has been shown to have a variety of consequences on how these plant poisons degrade. Nitrate, nitrite, poisonous nitrogen oxide gases formed from nitrate, as well as high concentrations of butyric acid, biogenic amines, and ammonia, are examples of chemical hazards. Poorly fermented silages pose chemical and microbiological risks, which can be avoided by adhering to suitable silage-making procedures, fostering an immediate and sufficient pH lowering of the silage, and avoiding aerobic deterioration. Silage may become contaminated with various harmful microorganisms when the pH is not appropriately lowered or when oxygen is present. These undesirable microorganisms can be harmful to animal health or the safety of milk or other animal food products, such as *Clostridium botulinum*, *Bacillus cereus*, *Listeria monocytogenes*, *Escherichia coli*, other Enterobacteriaceae species, and moulds. They can also be detrimental to the nutritional quality of silage, such as yeasts and butyric acid bacteria. The bacteria itself may provide a health risk, or it may generate a metabolite like the mycotoxins that some moulds produce. Silages may contain toxic chemicals as a result of the forage crop being ensiled or from other pollutants, in addition to microbial health risks. The amount of plant moisture determines the threshold pH that prevents clostridial development. As a result, conditions that make the plant more susceptible to high moisture levels during harvest or ensiling or that slow the pH decline during ensiling may encourage clostridial growth. The amount of lactic acid that must be produced to reach the necessary pH to prevent clostridial growth depends on the buffering capacity of the ensiled crop, which is a key determinant in the development of clostridia. The likelihood of the chemical and microbiological health risks occurring in silage can be reduced by using good silage-making techniques. By quick lowering the pH of the silage to 4.5 or by quick field wilting before ensiling, it is possible to avoid the presence of *C. botulinum* toxins and large quantities of butyric acid or biogenic amines. Low silage pH levels also inhibit enterobacterial growth, lowering the possibility of nitrate oxidising into harmful nitrogen oxide emissions. By preventing aerobic deterioration, which can be accomplished by preserving anoxic conditions during silage storage and by limiting exposure to and ingress of air after opening a silage silo for feeding, *L. monocytogenes* and mould growth can be prevented. Chemical and biological silage additives can help to rapidly lower the pH of silage and stop aerobic decomposition. Both the existence of hazardous compounds in certain forage crops naturally and the contamination of forages by poisonous plants are linked to the presence of plant toxins in silage. In order to better understand how plant toxins affect



animal health and to design technologies that can degrade or detoxify these poisons in silage or the animal's diet, more study is required (Driehuis et al., 2018).

5. Lactic acid bacteria as additives for silage production

Ensiling is a substitute and crucial method for long-term silage preservation. In anaerobic conditions, naturally existing bacteria fermented grass and other green feeds to generate silage. A wide range of diverse aspects, including plant development, harvest, storage, and feed practises, must be taken into account during the process. The necessary procedures in silage production can be decided by taking into account the desired end results. In general, the main goals are to maintain the forages' digestible fibre, protein content, and energy so that ruminants can use them effectively. The perfect phase of plant development at which to harvest the forage plants can have a direct impact on the quality of the forage that will be kept as silage. Instead, harvesting the plants at the mature stage (for higher yield purposes) reduces the quality of silage. The three main steps in a rapid forage harvest are field preparation, forage transportation, and silo filling. On-time and uninterrupted transit from the field to the silo is the basis of high-quality silages. The forage will be left to wilt in windrows on the field after being chopped using sickle bar or drum mowers. Cutting or shearing operations are parts of the silage-making process. The length of the forage cut, which must be between 6 and 60 mm and appear sheared, is crucial for better packing with Lactic Acid Bacteria (LAB) and air extraction during the ensiling process. Fresh forages have more moisture (> 80%), soluble proteins, and sugars in the liquid, which make them more hospitable to moulds, yeasts, and bacteria. The enzyme activity is also higher in the liquid. The proper ensiling procedure produces an atmosphere devoid of oxygen that encourages lactic acid bacteria while restraining yeast, mould, and other unwanted germs. The naturally present bacteria can alter water-soluble carbohydrates during this period. Homofermentative and heterofermentative species of microorganisms are the main players in the fermentation of silage. Species of *Lactobacillus*, *Pediococcus*, and *Lactococcus* are homofermentative inoculant groups. These inoculants have the potential to increase lactic acid production, decrease pH, and slow down the degradation of proteins and sugar molecules in plants. The inoculants *L. buchneri* and *L. brevis* are heterofermentative. Both species are capable of producing a lactic acid and acetic acid mixture that can inhibit the development of contaminants like yeast and mould. Recent developments in homofermentative lactic acid bacteria have shown that they play a significant role in silage fermentation. Bacterial groups that are homofermentative are more effective than heterofermentative. As they can convert each glucose molecule into lactic acid, homofermentative bacteria are important because silages can be produced with higher dry matter and less energy decrease. More powerful than other acids, lactic acid can lower the pH of silage. Heterofermenters used in a scale-up procedure raise the ultimate pH. Distinct plant



environment habitats have significantly different native bacterial communities. While preventing other dangerous bacterial contamination and preserving plant proteins, the addition of homofermentative bacterial inoculum can rapidly lower the pH. Due to their effective production of biological metabolites, particularly increased lactic acid content with negligible levels of acetic acid and other organic acids, lactic acid bacteria (LAB) are regarded as powerful natural additives for the preparation of animal feed. Additionally, water-soluble carbohydrates can be used by LAB to produce important organic acids, causing the environment to become more acidic. Rapid acidification (lower pH) may aid in suppressing hazardous secondary metabolite release and undesirable microbial development. In addition, LABs have the GRAS (Generally recognised as safe) status. There is optimism for adopting LAB as a substitute tool for preserving both animal and human meals in farm sectors and food manufacturing businesses due to its historical use and recent research into its probiotic potential and favourable effects on animal and human health. A key requirement for manufacturing and long-term nutrient-free storage of silages is the suppression of microbial pathogens. Numerous scientists have investigated the prevention of harmful bacterial, yeast, and mould development that produces toxic compounds using a variety of experimental paradigms. According to the study, LABs produce several organic acids and peptide-like bacteriocin, which together provide them strong antibacterial activity. However, the strains of bacteria from either the homofermentative or heterofermentative categories of bacteria have different fermentation capacities and inhibitory effects on pathogenic germs. Some studies have suggested that the use of mixed inoculants for silage production has a greater effect on silage fermentation than the use of a single culture. In order to produce and preserve green silages, it may be best to choose starter cultures of LABs that have the capacity to inhibit the growth of unwanted microorganisms as *Clostridium*, *E. coli*, *Salmonella* spp., or *L. monocytogenes*. In addition to blocking harmful microorganisms, LAB is used in the production of animal feed to promote beneficial microbes in the gastrointestinal tract, preserving the health of the animals. This tactic would provide a wonderful opportunity to produce potential future silages with higher nutrient levels than the harvested crops (Soundharrajan et al., 2021).



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HISTORY OF SPECIES IN THE HISTORY OF HUMAN CIVILIZATION: SOCIO-CULTURAL ASPECT

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Cuisine is an extremely interesting complex of human culture and history. Spices are not only a common culinary seasoning, but also an important attribute of the world history of mankind. Spices open up a world full of knowledge of cultural history, traditions, a healthy lifestyle, and are an integral part of a person's lifestyle.

What can the topic of food interest such a theoretical discipline as social philosophy? What can be of scientific interest? I think that the object of research is society. Society is a rather complex entity. Of course, economy, politics, jurisprudence, and culture play a significant role in its development and functioning. But the everyday life of people also allows us to show the peculiarities of the development of society. Human life and the social world cannot be reduced to certain algorithms and shown through the prism of economy, politics and other social institutions only. Society is influenced by human preferences and aspirations. The human world is always present in society, even at the everyday level. It is like how in the thermodynamics of I. Prigozhin, insignificant particles and fluctuations are able to change the configuration and direction of development of a large system. So, a part can determine the whole. This approach allows us to reflect on society as a changing, very unstable social system. It shows social life as a complex organism that does not have pre-defined highway development paths. This is a world where everything is possible and everything is meaningful.



Let's think about how spices affected the social life of a person. We will try to show that the invisible attributes of cooking were an important ingredient in social processes. Spices are not only a common culinary seasoning, but also an important attribute of the world history of mankind. Spices open a world full of knowledge about the history of culture, traditions, healthy lifestyle, are an integral part of a person's lifestyle. For many centuries in world history, incredible events took place around spices. The people of the past really made them the heroes of their lives. Spices influenced many social things, namely the creation of world trade, the development of market relations, and the creation of social hierarchies. The discovery of the New World by Europeans would not have happened without a craving for spices. Spices played not only a culinary, but also a ceremonial, social role. The excessive use of spices is explained by the lack of food storage technology at the time.

For many centuries, incredible events in world history revolved around spices. People in the past times really made them the heroes of their lives. Spices influenced many social things, namely the creation of world trade, the development of market relations, and the creation of social hierarchies. The discovery of the New World by Europeans would not have happened without the craving for spices. Spices played not only a culinary, but also a ceremonial, social role. The immoderate use of spices is explained by the lack of food storage techniques at that time.

Wealthy strata of the population showed a surprising desire for particularly spicy dishes. The wealthier a person was, the more spices he added to his dishes. In a symbolic sense, the physiological taste of spices was closely intertwined with social ties, power relations, wealth and prestige. Spices were given like treasures, they were accumulated like jewels. They were a status symbol for the ruling class, a symbol of power that was first displayed and then consumed. Perceiving social and cultural relationships and circumstances through taste became a self-evident, almost unconscious ability in the Middle Ages through taste. They were a status symbol of the ruling class, a symbol of power that was first displayed and then consumed. The perception of social and cultural relations and circumstances through taste became a self-evident, almost unconscious ability in the Middle Ages through taste. At this time, new signs of a new culture of life, interest in beautiful things and elegant manners appeared in Europe. More and more new ways of life appeared, deepening the distance between the ruling and plebeian social strata. Spices were the center around which other luxury items were grouped. The luxurious architecture of Venice is a monument to the spice trade and the accumulation of money. At this time, new markings of a new culture of life, interest in beautiful objects and elegant manners appeared in Europe. More and more new lifestyles were produced, which deepened the distance between the ruling and plebeian social strata. Spices were the center around which the rest of the luxury



items were grouped. The luxurious architecture of Venice is a monument to the spice trade and the accumulation of money.

Thus, the perception of social and cultural relations through the process of tasting is understood as a self-evident, almost unconscious ability. A new format of cultural life is being created in Europe. Its basis is an interest in beautiful objects and elegant manners. They, like other attributes of life, symbolize the turn from the church-regulated Middle Ages to new times, with new customs, views, and actions. In general, this illustration of the influence of spices on the life of society and man shows the need to abandon clear metanarratives in the analysis of historical processes. Showing the local history of everyday life allows for a more complete analysis of complex processes. This is a demonstration of how an insignificant part in a complex social organism is not leveled, but on the contrary, allows to show its complexity and multifacetedness.



ASSESSMENT OF THE PHYTOSANITARY CONDITION OF STREET TREES ON THE EXAMPLE OF THE CITY OF KHMELNYTSKY

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Intensive development of urban infrastructure changes the anthropolandscapes of human life. Therefore, one of the problems in the development of modern urban planning is the preservation of the sphere of human life in modern conditions and the creation of a sustainable social and ecological structure of the city. The level of greening plays an essential role in solving a complex spectrum of problems of the development of a modern city. Tree plantations play an optimizing role in the urban environment, as they contribute to the functional organization of the urban territory, increase the artistic expressiveness of architectural ensembles, and contribute to the formation of favorable microclimatic and sanitary-hygienic conditions. The conditions for the growth of tree plantations on city streets are difficult. They are caused by a number of ecological, technological, technical, chemical, physical, anthropological and other factors. Among the factors that have a negative impact on the condition of the vegetation cover of urban agglomerations, the following are distinguished: increased air temperature, its pollution by dust and gases, drying, compaction and salinity of the soil, deterioration of its physical and chemical properties, deterioration of the conditions for the activity of soil microorganisms, limited amount of plant nutrition, etc. This problem should be considered through the prism of resistance of plants to unfavorable conditions of the urban environment and optimization of the factors of their vital activity. First of all, the peculiarities of care for street trees should be based on a rational, scientifically based selection of plant species. An important role in this process is played by the accounting of plantations as a result of the inventory and assessment of their phytosanitary status. Secondly, there is a choice of a complex of agrotechnical measures for the care, preservation of vitality, durability and decorativeness of street tree plantings. The set of agrotechnical care measures includes measures aimed at preserving the vitality and longevity of street trees. First of all, it is the introduction of nutrients into the soil. Ammonium nitrate (NH_3NO_3) or urea ($\text{CO}(\text{NH}_2)_2$) are the most appropriate, due to their inherent bioeffect compared to other types of nitrogen fertilizers. Their duration is calculated depending on the age of the trees within the annual requirement. It is advisable to mulch and loosen the soil of planting sites. For woody plants, the depth of soil loosening should not exceed



5-10 cm. In summer it is important to sprinkle and wash the plants. Watering the soil and washing the crown of plants (water content in the soil can be controlled by absolute humidity, maintaining it within 15-26% with periodic watering). Agrotechnical care of street plantings involves taking into account the specifics of planting woody plants, since they are planted on streets with asphalt or other surfaces. Scientists claim that reducing the size of holes in row plantings on sidewalks leads to the deterioration of tree development and causes early shedding of leaves. The root systems of street tree plants in their development are not limited to the dimensions of the planting hole, but cover a much larger volume. According to the researchers, the root system makes up not less, but even more space along the clearly defined projection of the tree crown. The soil under the asphalt plays a significant role in providing trees with elements of mineral nutrition and moisture in areas of asphalted sidewalks. The thickness of asphalt pavement in the area of sidewalks can be 0.5 m or more. Therefore, plants must be planted so that their root neck is level with the soil (after it has subsided). It is necessary to fill the holes with garden soil. The next issue to consider when planting street tree plants is to ensure the correct ratio of tree canopy size to street width and building height. For the normal growth of trees and the convenience of traffic and pedestrians, the height of broad-crowned trees in street plantings should be 13-60%, for pyramidal trees - 30-90% of the total width of the road; the height of the trunk is 1.8-3.0 m, and the distance between the crowns is not less than 1.5 m. Difficulties during the selection of tree plants for street plantings arise in cases when their height is limited to certain dimensions. Scientists recommend using four types of trees for street planting in holes and strips: a) with the correct oval-egg shape; b) with an irregular spreading crown; c) with a pyramidal crown; d) with the correct spherical shape. Analysis of the phytosanitary condition of street tree plants in the city of Khmelnytskyi showed that 4,324 trees (37.7%) were in good condition. More than half have a satisfactory condition. Thus, 6,119 trees (53.39%) received a satisfactory rating. 1017 pieces (8.87%) are in unsatisfactory condition. Specimens with signs of slow growth and development fell into the category of woody plants that received a satisfactory assessment. The leaves of these plants are much smaller, their color is light green, occasionally there are yellowed leaves. Individual dry skeletal branches are visible in various parts of the crown, there is mechanical damage to the trunk, signs of activity of wood-destroying fungi. Plants that received a negative assessment are characterized by significant damage to the trunk, partial drying of the crown, inhibition and cessation of growth, which causes browning, drying and falling of leaves and ultimately leads to the death of the plant. Among the street plants, there is a single dead plant. Thus, from the number of woody plants growing in the central streets of the city, 227 specimens have mechanical damage, damaged branches of tree crowns, untreated sections after cleaning, etc. Hollows were found in 138 trees, 19 trees have from 2 to 4 hollows. In two woody plants, through



hollows were recorded, and in four the core was missing. The causes of the formation of hollows are natural factors (influence of wind, rain, high air temperatures, etc.), the influence of bacteria and fungi. In addition, areas of trees that were attached to branches that fell off during the aging process can become hollow. About 413 trees are affected by insects. 119 copies are in good condition. The density of their crown is in the range of more than 65%, there is no peripheral dieback of the crown, the transparency of the leaves is 6-10%. Satisfactory condition is observed in 1330 trees. The density of their crown is in the range of 50-60%, the peripheral dieback of the crown is 5-10%, the transparency of the leaves is 15-20%. Unsatisfactory condition of the crown is observed in 81 tree plants. Its density is up to 45%, the peripheral dieback of the crown is more than 15%, the transparency of the leaves is more than 25%. Most of the trees that have an unsatisfactory condition of the crown have signs of dryness and need to be felled. Spots on leaf plates were found in 422 trees. Their occurrence and spread are caused by diseases of fungal and bacterial origin. They primarily affect weak trees with damaged bark. The plantations of *Aesculus hippocastanum*, *Tilia platyphyllos*, and *Tilia cordata* were the most vulnerable. In these trees, the leaf surface is affected. The phytosanitary condition of street trees is the worst on Kamianetska, Proskurivska, and Volodymyrska streets. This is due to the intensive movement of motor vehicles on them, which leads to an increase in gas and dustiness of the air, an increase in noise pollution, etc. More favorable conditions for the development of tree plantations are observed on streets where there is no intensive traffic and there are no industrial facilities. Thus, on the streets of Podilska, Heroy Maidan, Pushkin there is mostly a good and satisfactory phytosanitary condition of plants, which allows them to a certain extent to perform sanitary-hygienic, landscape, aesthetic functions, etc. Monitoring of tree plantations on streets has an important ecological, sanitary-technical, aesthetic climate-regulating value. Determination of species diversity and assessment of the phytosanitary status of trees contributes to the implementation of a comprehensive approach to improving the state of greening in settlements. The analysis of the phytosanitary state of woody plants in the conditions of an urbanized environment proved the need to study a complex of urbogenic factors in order to select species of woody plants resistant to urbogenic conditions and carry out the necessary selection works aimed at the development of ecological compensation measures to increase the vitality, longevity and decorative appearance of plants. In order to improve the phytosanitary condition of street trees in the city of Khmelnytskyi, it is possible to recommend rejuvenating and sanitary pruning, diversification of the species composition of plants that have passed many years of testing and acclimatization in local conditions, and replacement of individual plants that have lost their functional and decorative value.



BESİN DEĞERİ BAKIMINDAN SEBZELER

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ÖZET

İnsanoğlu tarım ve hayvancılık dönemine geçmesiyle bazı dönemde alınması gereken besinlerin fazla alması ya da az tüketilmesi sonucu hastalıklarla çoğu zaman yüz yüze gelmiştir. Bununla birlikte bilim insanları doğada bulunan besinlerin içeriğine yönelik araştırmalar yaparak sebzelerin kimyasal özelliklerini inceleyerek vitamin, mineral ve daha birçok özelliğini sınıflandırmışlardır. Böylece hastalıklara karşı koruyucu yöntem olarak sebzelerin hangi şekilde daha doğru kullanılacağına yönelik araştırmalar yapılmıştır. Bu derleme makalede B grubu vitaminleri ve C vitaminin kaynakları, etkileri hakkında araştırma yapılmıştır. Dışarıdan alınamayan B12 vitaminin bile sebzelerden karşılanabileceği saptanmıştır.

Anahtar Kelimeler: Sebze, Beslenme, Vitamin



VEGETABLES IN TERMS OF NUTRITIONAL VALUE

ABSTRACT

With the transition to the period of agriculture and animal husbandry, human beings have often come face to face with diseases as a result of over- or under-consumption of the nutrients that should be taken in some periods. In addition, scientists have studied the chemical properties of vegetables by conducting research on the content of nutrients found in nature, and they have classified vitamins, minerals and many other properties. Thus, research has been conducted on how to use vegetables more accurately as a preventive method against diseases. Research has been done on B group vitamins and the sources and effects of vitamin C. It has been determined that even vitamin B12, which cannot be taken externally, can be met from vegetables.

Keywords: Vegetable, Nutrition, Vitamin



1. Giriş

Miyosen-Erken Pleistosen dönem, Paleolitik dönem, Neolitik dönem ve Endüstri devrimi olmak üzere insanoğlu için beslenme tarihi 4 dönemden meydana gelmektedir (Jew ve ark., 2009). İnsan ve hayvanlar başta olmak üzere her canlı yaşamını sürdürmek için vücut metabolizmasının işleyişi için gerekli olan enerjiyi dışarıdan almak zorundadır. Bu enerji yine canlı olan bitki veya hayvanlardan alınmaktadır. İnsanların kabuklu yemişler, yapraklı sebzeler, tohum ve otlar (elbette yabani) olmak üzere bitkisel besinlerle, hayvan leşleri ile de hayvansal besin ihtiyaçlarını karşılamaya çalıştıkları dönem Miyosen-Erken Pleistosen dönemdir (Jew ve ark., 2009). İnsanlar, henüz yerleşik hayata geçip bitkisel ve hayvansal yetiştiricilik yapmadan önce, avcı-toplayıcı toplum konumunda olup, avlanmak için keşfettikleri kesici malzemelerle (taş ve alet) ve önemlisi de ateşi bulmaları ile yeni avlanma yöntemleri oluşturmuşlardır. Protein ihtiyaçlarını hem bitkisel ürünlerden hem de avladıkları hayvan veya denizden sağladıkları ürünlerle de hayvansal ürünlerden karşıladıkları dönem ise Paleolitik dönem olarak tanımlanmaktadır (Güleç ve Açıkkol, 2006). İnsanların, tarım (bitkisel ve hayvansal üretim) faaliyetlerine başladıkları dönem ise Neolitik dönemdir (Haviland, 2008). Önceki dönemlerden edinilen becerilerin yanında konserve etler, bitkisel yağlar, sebzeler ve rafine tahıllar veya önceden pişirilmiş veya dondurulmuş gıdaların insanların beslenmesinde daha fazla yer kaplamaya başladığı dönem ise Endüstri dönemidir. Endüstri dönemi, 18. Yüzyılda başlamış ve bu dönem insanoğlunun beslenme tarihinin neredeyse son dönemi olarak tanımlanmaktadır. Endüstri dönemi ile birlikte insanların beslenme kültüründe daha fazla karbonhidratın, hayvansal gıdaların, doymuş yağların yer aldığı dönem olmaktadır. Bu dönem beslenme kültürüyle birlikte pek çok hastalığın yayılması gerçekleşmiştir (Jew ve ark., 2009).

2. Sebzelerin insan sağlığındaki önemi

Sebzecilik Dünya’da ve Türkiye’de önemli bir yere sahiptir. Türkiye, yaklaşık 31 milyon tonluk sebze üretimiyle dünya ülkeleri arasında dördüncü sırada yer almaktadır. Türkiye iklim, toprak ve diğer çevresel faktörlerce ayrıca bulunduğu coğrafi konum açısından sebzecilik yönünden avantajlı konumdadır. Ülkemiz hem sıcak hem de serin iklim sebzelerinin yetiştiriciliğinin yapılabildiği bir ülkedir. Jeotermal potansiyelinden ve mikro klima alanlarının varlığı ile Akdeniz iklimine sahip yerlerin mevcudiyetinden dolayı örtüaltı sebze yetiştiriciliği açısından da tatmin edici özelliklere sahiptir. Komşu ülkelerin sebze ithalatçısı konumunda bulunmaları da Türkiye’nin sebzeciliği açısından pozitif katkı sunmaktadır.

Sağlık ile beslenme arasındaki paralelliğin her geçen gün daha iyi anlaşılması ve beslenmede sebzelerin yeri doldurulamayacağına bilinmesi ve son yıllarda görülen pandemi boyunca beslenmenin, iyileşme sürecinin ve bulaşma riskini azalttığına ortaya çıkmasıyla sebzeciliğin ezbere



bilinen gerçeklerinin bu kez yüksek sesle tekrarlanmasına neden olmuştur. Sebze ve meyveler fitokimyasallarla birlikte devrimde bulunabilen kimi bileşenlerce zengin besin kaynaklarıdır (Yahia ve ark., 2017). Tehlikeli hastalıklardan olan bulaşıcı ishalin ve bağırsak işleyişinin iyileştirilmesinde, antiinflamatuvar etki, bağışıklık sisteminin gelişmesi ve patojenlerin baskı altında tutulmasında önemli rol oynayan probiyotiklerden olan *Lactobacillus* ve *Bifidobacterium* cinslerinin laktik asit bakterileri sebzelerin fermentasyonu sonucunda elde edilmektedir (James & Wang, 2019). Depresif bozukluklarda gerekli olan sebzeler yüksek besin içeriğine sahiptirler. Akıl ve beden sağlığı ile sebze ve meyve tüketimi arasındaki ilişkinin çok kuvvetli olduğu tespit edilmiştir (Głabska ve ark., 2020; Smith ve ark., 2021).

3. Sebzelerin besin değerleri

Sebzeler vitaminler, karbonhidratlar, yağlar, proteinler ve mineraller açısından insan beslenmesinde önemli bir etkiye sahiptir. Ayrıca sebze ve meyvelerin lif içeriklerinden dolayı hipertansiyon ve kan basıncı hastalıklarına karşı diyetlerde yer alması gerekmektedir zira sebze tüketimi ile kan basıncı ve hipertansiyon arasında zıt ilişki olduğu belirlenmiştir (Arıkan ve Perçinci, 2021).

İnsan sağlığı açısından oldukça önemli olan aynı zamanda makro ve mikro besinler olarak adlandırılan bununla beraber vücuda doğru ve dengeli beslenmeyle verilmesi gereken besinler; karbonhidratlar, yağlar, proteinler, vitaminler ve minerallerdir (Baysal, 2005).

Yüksek oranda lif ve su içeriklerinin yanında vitamin ve mineral içerikleriyle de sebzeler sağlıklı beslenme için kaçınılmaz besinlerdendir. Sebzeler, B1, B2, B3 ve B6 vitaminlerini kapsadığı gibi beta-karoten ve A ve C vitamini gibi antioksidan özellikli vitaminlerin de kaynağıdır (Demir, 2021).

İnsanoğlunun günlük ihtiyaç duyduğu C vitamini miktarı, 75 mg'dır. Sadece 100 gram maydanoz yemek bile günlük C vitamini ihtiyacımızın iki katı kadar C vitamini karşılamaktadır. Zira özellikle koyu yeşil renge sahip yapraklı sebzelerin C vitamini açısından zengin olduğu belirlenmiştir. 100 g maydanoz sebzesinde toplam 180 mg C vitamini içermektedir. Ispanak sebzesinin 100 gramında 50 mg, lahana sebzesinin 100 gramında 43 mg ve marul sebzesinin 100 gramında ise 11 mg C vitamini bulunmaktadır (Sezgin, 2014).

Doğru ve düzenli beslenmede bir diğer gözden kaçırılmaması gereken faktör de besin çeşitliliğidir. Toplumumuzda sağlıklı beslenmek için tüm besin gruplarını her öğünde gerekli miktarda ve çeşitte tüketmek gerekmektedir. Bu besin gruplarının dağılımı ülkeden ülkeye değişmekle beraber başlıcaları süt ve süt ürünleri, et, yumurta ve kuru baklagiller, sebze/ meyveler ve nihayet ekmek ve tahıllardır. Çağımızın önemli hastalıklarından diyabet ve kanser hastalıklarına karşın dünya ülkeleri, en temel çözümün sağlıklı beslenmeden geçtiğini kabul etmektedirler (Hulshof ve ark., 1993). Sebzeler, diyetimizde önemli koruyucu besinlerdir; yapılan araştırmada sebze tüketimi ve günlük beslenme



menüsünde sebze ve meyve oranının artmasıyla kansere yakalanma riskinin düştüğü saptanmıştır (McIntosh ve ark., 2001; Terry ve ark., 2001)).

Gıda, içerdiği kimyasal bileşenlere göre değerlendirilir. Böylece, insan vücudunun ihtiyaçlarını belirlemek için biyokimyasal kavramlar kullanılabilir. Sebzeler karbonhidratlar, proteinler, yağlar, mineraller, vitaminler ve su gibi besinleri içerir. Bu besinlerin % 90-95'i su, %1-3'ü azotlu maddeler, % 1'den düşük oranda yağ, % 3-7 oranında karbonhidrat ve % 1-2 minerallerden oluşmaktadır (Demir, 2021).

İnsan sağlığı üzerine sebze tüketiminin olumlu yönleri büyük oranda kabul görse de, sebze tüketimi belirlenen miktarların altında kalmaktadır. Hatta kardiyoasküler açısından faydalı olduğu belirlenen sebzelerin günlük diyetteki miktarı oldukça azdır (Connolly ve ark., 2020). Connolly ve ark. (2020) dünya genelinin ortalamasını kastetmektedirler. Ülkemizde bu durum farklıdır. Zira dünya sebze tüketim ortalaması yıllık kişi başına 65 kg iken, bu rakam ülkemizde 200 kg, hatta üstüdür.

Sebzeler, antioksidan özelliklere sahip olan A, C vitaminleri ve beta-karoten açısından zengindir. Sebzelerde, bu vitaminlerin dışında B1, B2, B3 ve B6 vitaminleri de çokça bulunmaktadır (Demir, 2021). Vücut metabolizmasında hayati fonksiyonların devam etmesinde ve daha sağlıklı yaşamın sürekliliğinde vitamin ve mineraller temel bileşiklerdendir. Enzimlerin mevcudiyeti, üreme ve bağışıklık sisteminin işlevleşmesinde ve hatta hormon sentezinde görev almaktadırlar. Vücut onları sentezleyemez, bu yüzden yiyeceklerle birlikte alınmaları gerekir. Günlük yemekle bağlantılı olarak, çözünürlüğe göre ikiye ayrılan 13 farklı vitamin alınmaktadır. Bunlar; yağda eriyen vitaminler A, D, E ve K vitaminleri ile suda eriyen C ve B vitaminleridir (Ball, 2005; Yeşil ve Sarıözkan, 2017).

4. Sebzelerin vitamin içerikleri

Yeşil yapraklı sebzelerin B1 ve B2 vitaminin kaynakları olduğu saptanmıştır (Demir, 2021). B3 vitamini, niasin olarak da bilinmektedir. Niasin etken maddesiyle zengin sebzeler günlük diyetlerimizde yer almaktadır. Kabak (0.920 mg/100 g), marul (0.375 mg/g) ve Karpuz (0.199 mg/g) sebzelerinin niasin etken maddesi içerdiği tespit edilmiştir (Çatak ve Yaman, 2019).

B6 vitamini, sinir hücreleri ve bağışıklık için çok önemlidir. Serotonin yapımına yardımcı olan B6 vitamini hemoglobin proteinlerinin yapımında da rol almaktadır (Mackey ve ark., 2006). Ispanak ve fasulye sebzesi B6 kaynakları arasındaki sebzelerdir (Otani ve ark., 2005). B12 vitamini, kobalt iyonu içerir, bu şekilde metalle protein özelliği taşıyan tek vitamindir. İnsanlarda B12 ile ilgili genler bulunmadığından sentezleme yapılamamaktadır. B12 esansiyel bir vitamindir. Bu sebeple vücuda dışardan alınması zorunludur (Sezgin, 2019). Beyaz baş lahana kürü zengin B12 kaynağıdır (URL 1).



B9 vitamini, yapısı folik asitten türetilen folat grubu ile temsil edilir. Folat eksikliği, kardiyovasküler hastalık, embriyonik kusurlar ve muhtemelen depresyon ile ilişkilidir (Guilland ve AimoneGastin, 2013). Yeşil yapraklı sebzeler B9 vitamin kaynağıdır.

Sebze ve meyvelerin önemli bir kaynak olduğu vitamin, C vitamindir. C vitamini, askorbik asit olarak adlandırılmaktadır. Biyolojik görevler için temel besin maddelerindedir (Rebouche, 1991). C vitamini, insan metabolizmasındaki önemli reaksiyonlarda (kolesterol, amino asit ve bazı peptid hormonları) yardımcı etmen olarak hizmet etmektedir (Chatterjee ve ark., 1975). Bir başka görüşe göre ise C vitamini takviyesinin bilişsel performansın iyileştirilmesi, kötü yaşam kalitesi, göz rahatsızlıkları ve hatta kardiyovasküler ve kanser gibi önemli hastalıkların riskini etkilediğine dair kanıt olmadığı yönündedir (Granger ve Eck, 2018).

5. Sonuç

Gıda olmadan hayat olmaz. Doğduğumuz andan itibaren hayatta kalmamız için gerekli enerji, gıdalardan temin edilmektedir. Vücuda alınan gıdaların özellikleri her tarafımıza yansır. Vücut organlarının dışında ruhsal yapımızda dahi yer almakta olan gıdaların ilkel dönemdeki gibi ne bulursak değil ne ve ne kadar gerekiyor dönemini yaşamamız yine gıdanın belirleyeceği bir süreç olacaktır. B grubu vitaminler ile C vitamini insan fizyolojisinde etki mekanizmaları sayesinde birçok hastalığa (Kardiyovasküler, Hipertansiyon, Osteoporoz, Kanser, Diyabet, KOAH, Nörodejeneratif ve Gastrointestinal gibi) karşı koruyucu ve tedaviye yönelik etkin bir role sahiptir. Doğru besinlerle doğru miktarda tüketimle birlikte sebzelerde bulunan vitaminlerin insan vücudu için önemi büyüktür. Bu derleme de kimyasal bileşiklerin ilaç sanayisinde etken madde olarak yaygın olarak kullanıldığı saptanmış olup bağışıklık sistemini güçlendirmesi ve hastalık öncesi koruma amacıyla kullanılmalrı önemli olduğu görülmüştür. Kar amacı gütmeyen ve kontrollü yetiştirilen tüm sebzelerin insan vücudu için faydalı olduğu yadsınmayan bir gerçektir. Bununla beraber Terry ve ark. (2001)'in de vurguladığı üzere; kanserin yegâne hastalık olmadığı gibi sebze ve meyvelerin de tek başına kanser gibi ölümcül hastalıkları önlediği tam olarak anlaşılmamıştır. Bununla beraber günlük beslenme programlarında sebze ve meyve porsiyon sayısı artışıyla kanser görülme riskinin azaldığı da bir gerçek.



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KAHRAMANMARAŞ MERKEZLİ 6 ŞUBAT 2023 TARİHLİ DEPREMLERİN TÜRK TARIMI ÜZERİNDE OLASI ETKİLERİ

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ÖZET

Türkiye de 2023 yılı Şubat ayında meydana gelen depremler 10 ilde ve 3.58 milyon hektarlık tarım alanını kapsayan geniş bir coğrafyada etkili olmuştur. Depremde kırsal kesimde de çok sayıda can kaybı meydana gelmiş, tarım işletmelerin konut başta olmak üzere tarımsal donatı, araç ve makinalarında zararlar oluşmuştur. Dolayısıyla deprem bölge ve ülke tarımı üzerinde de önemli sorunlara yol açmıştır. Tarım işletmelerinde oluşan zararların tespiti ve giderilmesi bölge çiftçisinin desteklenmesi yanında, kısa ve orta vadede gıda arz güvenliğinin sağlanması ve gıda fiyatlarının kontrolü açısından kritik önemdedir. Tarımın zamana bağlı bir sektör olması bölgede çok ivedilikle hareket edilmesini zorunlu kılmaktadır. Bölge çiftçisinin içinde bulunduğu ruh hali, üretim kaynaklarındaki zararları ve ekonomik durumları dikkate alındığında böylesine büyük bir yükün altından kendi imkanları ile çıkamayacakları ve tarımsal üretimin sektöre uğrayacağı açıktır. Dolayısıyla tarım alanında faaliyet gösteren kamu ve özel sektörün tüm kaynaklarının planlı bir şekilde seferber edilmesi gerekecektir. Bu anlamda sektörün tüm bileşenleri ile acilen bir araya gelerek depremin tarım üzerinde ki zararını ve geleceğe yönelik oluşturduğu riskleri tespit edip sosyal, ekonomik ve teknik konuları da içeren kapsamlı yol haritalarını oluşturması kritik önem taşımaktadır.

Anahtar Kelimeler: Deprem, Türk tarımı, tarım işletmeleri, kırsal hayat



POSSIBLE EFFECTS OF KAHRAMANMARAS CENTERED EARTHQUAKES ON 6 FEBRUARY 2023 ON TURKISH AGRICULTURE

ABSTRACT

The earthquakes that occurred in February 2023 in Turkey were effective in 10 provinces and a wide geography covering 3.58 million hectares of agricultural land. In the earthquakes, many deaths occurred in the rural areas, and damages occurred in the residences of agricultural enterprises, agricultural equipment, vehicles and machinery. Therefore, the earthquake caused significant damage to the agriculture of the region and the country. Detection and elimination of damages in agricultural enterprises is of critical importance in terms of ensuring food supply security and controlling food prices in the short and medium term, as well as supporting the local farmers. The fact that agriculture is a time-dependent sector makes it necessary to act very urgently in the region.. Considering the mood of the farmer in the region, the damage to the production resources and their economic situation, it is clear that they cannot cope with such a great burden on their own and agricultural production will be interrupted. Therefore, all the resources of the public and private sectors operating in the field of agriculture will need to be mobilized in a planned manner. In this sense, it is critical for the sector to come together with all its components urgently, to identify the damage of the earthquake on agriculture and the risks it poses for the future, and to create comprehensive road maps that include social, economic and technical issues.

Keywords: Earthquake, Turkish agriculture, agricultural enterprises, rural life



Giriş

Fertler ve toplumlar için hayatın rutini dışında gerçekleşen ve bazen de köklü değişimlere yol açan önemli olaylar gerçekleşebilmektedir. Türkiye’de 6 Şubat 2023 Pazartesi saat 04:17 ve 9 saat sonrasında gerçekleşen Kahramanmaraş merkezli 7.7. ve 7.6 şiddetindeki iki deprem bu türden bir olaydır. Bu depremler Türkiye tarihi hatta tüm dünya tarihi için büyük bir olaydır. Depremi takiben bir taraftan yardım ve kurtarma çalışmaları sürerken diğer taraftan sebebi ve ihmaller konusunda yoğun tartışmaların sürdüğünü görüyoruz. Söz konusu tartışmalar bu büyük acıya şahit olmuş ve onu yüreğinde hissetmiş milletimiz için elbette doğaldır. Ancak yaşadığımız depremin sıra dışı bir olay olduğu ve felaketin boyutlarının görünenin ötesinde bir derinliği olduğunun acilen farkına varmak zorundayız. Bir tarafta on binlerce kaybımız diğer tarafta hayatta kalan ve yaşamını devam ettirmek zorunda olan yöre insanımız bulunmaktadır. Bedenlerde ve ruhlarda açılan yaraların sarılması, ihtiyaçların giderilmesi, konutların ve tüm alt yapının yeniden inşası büyük ve uzun zamana yayılabilecek çabaları gerektirmektedir. Üstelik bu çabalar sadece bölgenin ihtiyaçlarını gidermekle sınırlı kalmayacaktır. Bölgenin ülkedeki var olan ancak büyük oranda gerilemesi beklenen potansiyelinden oluşan açığı da kapatacak düzeyde olmalıdır. Zira söz konusu deprem 10 ilimizi ve ülke nüfusunun 15.7’sine karşılık gelen 13 milyonu aşkın insanımızın yaşadığı geniş bir alanı kapsamaktadır. Bu illerimizin her biri farklı ölçeklerde de Türkiye için sanayi, eğitim, tarım, turizm gibi ekonomik, sosyal ve kültürel bakımdan büyük bir öneme sahiptir. Dolayısıyla karşı karşıya kaldığımız durumun çok yönlü ve tüm ülkeyi kökten etkileyen büyük bir felaket olduğunun farkına varmak ve geleceği yönetmek adına acilen kurumsal ve meslekler bazında durumun analiz edilip yeni yol haritalarının oluşturulması gerekmektedir. Bu yol haritaları, deprem sonrası sürecin yönetimi, hizmet ve kaynakların kanalize edilmesi ve bu süreçte devlete de yön vermek adına kritik önemdedir.

Depremın Tarıma Etkisi

Deprem bölgesinde en önemli ekonomik alanlarından biri de tarımdır. Deprem 110.000 km² gibi çok geniş ve tarımsal üretim potansiyeli yüksek bir alanda etkili olmuştur. 2021 yılı verilerine göre depremin etkilediği 10 ilin bitkisel üretim değeri, ülkenin toplam bitkisel üretim değerinin %20’sine karşılık gelmektedir. Türkiye toplam tahıllar ve diğer bitkisel üretim miktarının %12’si, işlenen tarım alanının ise %14.5’i deprem bölgesindedir. Bölgenin hayvan varlığı ülkedeki büyükbaş hayvan varlığının %12’sini, küçükbaş hayvan varlığının %16.3’ünü oluşturuyor (Anon 2021).

Türkiye’de tarıma elverişli 23.85 milyon hektar alanın % 16.2’si, yani 3.58 milyon hektarlık bölümü depreme maruz kalan 10 ilde bulunmaktadır (Tablo 1). Bu illerdeki kayıtlı çitçi sayısı da 270 civarındadır. Bu iller içinde en fazla tarım alanına 1.1 milyon hektarla Şanlıurfa sahiptir. Onu 0.58 milyon hektarla Diyarbakır, 0.5 milyon hektarla Adana, 0.36 milyon hektarla Kahramanmaraş, 0.35



milyon hektarla Gaziantep ve 0.24 milyon hektarla Hatay izlemekte. Tahıllar ve diğer bitkisel ürünlerin on ildeki toplam ekim alanı 2.56 milyon hektarla ülke genelinin % 15.5'ine karşılık gelmektedir. Türkiye'de ki sebze bahçelerinin de 0.11 milyon hektarı, yani % 15.2'si, meyveler, içecek ve baharat bitkileri ekim alanlarının da 0.93 milyon hektarla %25.2'si yine bu 10 ilde bulunmaktadır (Anon 2022). Buğday, arpa gibi tahılların üretildiği alanlarda açık farkla Şanlıurfa, Diyarbakır ve Adana, sebze bahçesi alanında Adana ve Hatay, meyve alanlarında ise Gaziantep öne çıkıyor. Tarımsal ticaret bakımından da depremin etkisinin çok yüksek olacağı öngörülebilir. Türkiye'nin toplam tarım ve ormancılık ürünleri ihracatının yaklaşık %20'si bu illerden gerçekleştirilmektedir. Bu alanda Gaziantep çok önemli bir paya sahiptir ve 34.2 milyar dolarlık Türkiye toplam tarım ve ormancılık ihracatının %11.8'i sadece bu ile aittir. Ülkesel tarım ihracatında Adana'nın payı % 2.5, Hatay'ın %2.4, Malatya'nın ise %1 düzeyindedir. Söz konusu 10 ilin toplam tarım sektörü gayri safi hasılasındaki payı ise % 14.3'tür (Anon 2023). Elbette depremin etkisi tüm illerde aynı düzeyde değildir. Depremin en yıkıcı olduğu iller Kahramanmaraş, Hatay ve Adıyaman olmuştur. Dolayısıyla bu üç ildeki tarımsal kayıp çok yüksek olabilir. Tarımsal alan bakımından ilk üç sırada yer alan Şanlıurfa, Diyarbakır, Adana ve diğer illerdeki yıkım görece daha düşük seviyededir.

Ayrıca bölge tarım alanında toplam üretimi yanında bazı ürünlerle farklı bir değer taşımaktadır. Mısır, pamuk, kayısı, buğday, arpa, narenciye, zeytin, yer fıstığı, Antep fıstığı, badem, kırmızıbiber gibi pek çok ürünün bölgedeki üretimi Türkiye için büyük önem taşımaktadır. Söz konusu 10 il çok sayıda yöresel hayvansal ve bitkisel ürünle, gıda ve baharat alanındaki üretimiyle yeri doldurulamaz bir özelliğe sahiptir. Bu ürünlerin üretiminin azalması ve beraberinde fiyat istikrarının bozulması kısa dönemde gıda güvenliği açısından sorunlara yol açabilir. Diğer taraftan bölge Türkiye'nin güneyinde yer aldığından ilkbahar erken gelmekte ve tarımsal faaliyetler diğer bölgelerimizden çok daha önce başlamaktadır. Bölge hem örtü altı hem de tarla koşullarında ciddi avantajlara sahiptir. Bu anlamda deprem bölgesi Türkiye'de tarımsal gıda arzının tüm yıla yayılmasında, gıda arz güvenliğinin ve fiyat istikrarının sağlanmasında önemli bir yere sahiptir.

Depremin gerçekleştiği Şubat ayı tarımsal zamanlama açısından çok kritiktir. Takip eden mart nisan ve mayıs ayları bölge tarımının en aktif olduğu ve birçok üründe ekimin tamamlanması gereken, bazılarında ise hasatın gerçekleştirileceği aylardır. Felaketin etkisinin bu kısa sürede ortadan kalkması ve bölgenin tarımsal potansiyeline ulaşması olası değildir. Tarım doğası gereği zamana ve iklime bağlı bir sektördür. Ekim, bakım veya hasat işlemlerinde yaşanılacak bir kaymanın büyük zararlara yol açacağı ve bu zararın telafisinin en erken 1 yıl gerektirdiği göz ardı edilmemelidir. Bu itibarla önümüzdeki aylar için bölgede en acil müdahale edilmesi gereken alanlardan biri tarımdır. Birçok durumda bir ürünün üretiminden daha çok hasat sonrası işleme ve depolama gibi işlemler daha kritik



olabilmektedir. Bölgede tarım ürünlerinin hasat sonrası işlemlerine dair bir çok yapının, işletmenin veya bunların işlem hacminin zarar görmüş olması da ihtimaller dahilindedir.

Tablo 1. Depremden etkilenen 10 ilin Türkiye bitkisel üretimindeki yeri*

	Toplam işlenen alan (da)	Bitkisel üretim (da)	Sebze ekim Alanı (da)	Meyve içecek ve baharat bitkileri (da)
Türkiye	238 450 494	164 866 554	7 176 802	36 754 808
Hatay	2 379 337	1 104 315	209 177	1 011 034
Kahramanmaraş	3 556 866	2 549 093	67 457	657 998
Osmaniye	1 261 406	965 479	67 879	219 906
Gaziantep	3 468 102	1 126 982	135 409	2 189 908
Adıyaman	2 261 749	1 597 762	49 948	594 184
Kilis	1 024 756	383 524	50 897	545 742
Şanlıurfa	11 039 897	7 815 503	103 664	1 801 630
Diyarbakır	5 754 392	5 345 042	106 374	212 916
Adana	5 045 193	3 686 297	258 222	1 038 031
Malatya	2 723 433	1 022 697	41 914	987 717
10 İl Toplam	38 515 131	25 596 694	1 090 941	9 259 066
10 il/Türkiye (%)	16.2	15.5	15.2	25.2

Anon, 2022, * Çayır mera, nadas ve süs bitkileri ekim alanları hariç.

Bütün bunlar depremin tarımsal alanda ki sonuçlarının da oldukça yıkıcı olabileceğine, özellikle bu yıl bölgeye özgü ürünler başata olmak üzere birçok tarımsal ürünün üretiminde ve fiyatlarında olumsuzluğa yol açacağına işaret etmektedir.

Depremın Kırsal Ekonomi ve Hayata Etkisi

Deprem kırsal kesimde de çok etkili olmuş ve köylerimizde ciddi can ve mal kayıplarına yol açmıştır. Yaşanılan can kayıpları yanında birçok çiftimizin konutlarında, ahırlarında, diğer tarımsal donatı, araç ve gereçlerinde zararlar meydana gelmiş ve henüz tam rakamlar belirli olmasa da hayvanları telef olmuştur (Resim1). Bu kayıpların tarım işletmeleri için ekonomik yükü çok ağır olabilir. Zaten büyük ekonomik güçlük çektiğini bildiğimiz çiftimizin bu kayıplarını kendi imkanları ile karşılaması en azından kısa sürede mümkün olmayacaktır. Bunun dışında bölgede sulama kanalları veya donatılarında da zararların olması yüksek bir ihtimaldir. Yer kabuğunda meydana gelen büyük hareketlilik birçok doğal su kaynağında da değişimlere yol açmış olabilir. Dolayısıyla bölgenin tarımsal potansiyelin eski gücüne ulaşması, sosyolojik, ekonomik hatta demografik güçle karşı karşıyadır.

Şüphesiz bu felaketin oluşturduğu en önemli zarar yitirdiğimiz canlardır. Yitirdiğimiz canların yerini doldurulması ve gönüllerde açtığı yaraların kapanması asla mümkün olmayacaktır. Bununla birlikte her insanın bilgi, tecrübe ve yetenekleri ile toplumsal hayat ve ekonomi içinde de özgün bir değeri bulunmaktadır. Yitirdiğimiz her can beraberinde bu değerleri de götürmektedir. Depremde hayatını kaybedenler arasında tarım alanında farklı konumlarda çalışan yetişmiş teknik elemanlar, üretimin ana unsurunu oluşturan ve her biri derin tecrübe sahibi çiftçilerimiz bulunmaktadır. Bu konuda



şu an net bir rakama sahip değiliz. Ancak depremin boyutu ve yayıldığı alan dikkate alındığında bu sayının yüksek alacağını öngörebiliriz.

Tarımsal açıdan özellikle köylerde işletme sahiplerinin veya tarımsal üretimde kilit rolde bulunan insanların yitirilmesi belki de bu süreçte en kritik konudur. Zira bu eksiklik ekonomik tedbirlerle veya fiziki önlemlerle telafisi mümkün olacak bir şey değildir. Diğer taraftan hayatta olanların da yaşadıkları travma, kayıplarının acıları ve üretime ilişkin altyapı zararları nedeniyle etkinlikleri önemli düzeyde azalacaktır. Bir diğer husus ise deprem sonrasında kırsaldan da çok sayıda insanın bölgeyi terk etmek zorunda kalmasıdır. Bu göçün kısa dönemde bir zorunluk olduğu düşünülebilir. Ancak bu insanların bölgeye tekrar gelmesi çok kolay olmayacak veya uzun zaman alabilecektir. Bu anlamda bölgeye geçici süreyle de olsa destek mahiyetinde nitelikli tarımsal insan desteği de alınması gereken acil önlemler arasında düşünülebilir. Tüm bunlar bölgenin tarımsal alanda da ciddi sorunlarla karşı karşıya olduğunu ve çözüm için yüksek koordinasyonlu çabalara ihtiyaç duyulduğunu açıkça ortaya koymaktadır.



Resim 1. Depremin kırsal alanda ki etkilerinde ait görünüm



- a: <https://www.vitrinhaber.com/deprem-koyleri-de-yerle-bir-etti-sadece-bu-koyde-33-kisi-oldu>
b: <https://rayhaber.com/2023/02/tarim-ve-orman-bakanligi-deprem-magduru-ciftcilere-destek-icin-kirsalda/>
c: <https://www.ekmeginsesi.com/gundem/bakanliktan-deprem-magduru-ciftcilere-destek-1322-personel-kirsalda-h12487.html>
d: <https://www.gazetevatan.com/ekonomi/deprem-bolgesi-icin-iki-onemli-karar-resmen-devreye-girdi-2084107>
e: <https://www.hurriyet.com.tr/haberleri/tmo>

Sonuç

Olayı takiben acil önlemler kapsamında Tarım ve Orman Bakanlığının bölgede ki faaliyetleri başlamış durumdadır. Ne var ki, olayın boyutları çok uzun soluklu ve kapsamlı bir süreci gerektirmektedir. Bu süreçte bakanlık kadar, akademi ve özel sektöre de önemli görevler düşmektedir. Bakanlık bu alanda hukuki ve mali destek süreçlerini yönetirken akademi durumun sosyal ve ekonomik boyutlarını ortaya koyacak ve sürece yön verecek bilimsel çalışmalara odaklanmalıdır. Şüphesiz bu felaket bölgede can kayıpları yanında tarımsal üretimi derinden sarsacak fiziksel ve ekonomik kayıplara neden olmuştur. Bölgede tarım alanında çiftçilerimiz başta olmak üzere, ilgili kamu kurum ve kuruluşları, oda, kooperatif ve birlikler veya temsilcilikleri ve özel sektöre ait kurum veya temsilcilikleri de derinden etkilemiştir. Bu durum kısa ve orta vadede tarımsal girdilerin tedarikinde, üretimin her aşamasında ve ürünlerin ticaretinde önemli sorunlara yol açabilir. Dolayısıyla, ilgili bütün birimlerin saha dışındaki unsurlarının bölge ile güçlü bir koordinasyon kurarak bu kayıpları acilen tespit edip oluşan boşluğun nasıl doldurulabileceğine dair yol haritalarını oluşturması oldukça önemlidir.

Bu kapsamda bölgenin tarımsal potansiyelinin tüm yönleriyle ve Türkiye ölçeğinde ne anlama geldiği ortaya konmalıdır. Akabinde depremin sektörde meydana getirdiği zararın boyutu genel ve özel alanlarda belirlenmeli ve eldeki veriler ışığında eylem planları oluşturulmalıdır.



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ÖZET

İklim değişikliği, toprak kirliliği, kentleşme ve nüfus artışı gibi sorunlar, tarımsal üretkenliği olumsuz etkilemektedir. Bu durum sürdürülebilir ve çevre dostu yöntemler bulma ihtiyacını doğurmuştur. Faydalı mikroorganizmalar, toprak sağlığını koruyarak bitkilere besin sağlamanın doğal bir yolu olarak kullanılmaktadır. Faydalı mikroorganizmalardan olan bitki gelişimini teşvik eden bakteriler (PGPB), bitki beslenmesi ve büyümesini sağlama, toprak besin mevcudiyetini koruma ve artırmanın yanı sıra birçok mahsülün verimini artırır. Ayrıca toprakta tuzluluk, alkalilik, toksik metaller ve kuraklık gibi abiyotik stres faktörlerine karşı direnç sağlar. Buğday ve çavdar melezlenmesiyle elde edilen tritikale, buğdayın üstün kalite özelliklerini ve çavdarın streslere uyum sağlama, canlılık ve direnç/tolerans özelliklerini birleştirecek yeni bir tahıl mahsulü olarak kültüre alınan ilk melez türdür. Tritikale ağırlıklı olarak tahıl, yem ve son zamanlarda biyoenerji üretimi için yetiştirilmektedir. Tritikale yetiştiriciliğinde mevcut tarımsal girdilerden maksimum faydayı sağlamak için sürdürülebilir yöntemlerin kullanımı uzun vadede kazanç sağlayacaktır. Bu amaçla hem bitkisel verimi artırdığı hemde doğa dostu tarım yapmayı sağladığı yapılan çalışmalar ile kanıtlanan PGPB kullanımını önem kazanmıştır. PGPB'lerin tritikale tarımı üzerine etkileri genel olarak; tohum verimi, yaprak alanı indeksi ve büyüme hızında artış; tuzlu topraklarda çimlenme ve kök uzunluğunun artışı; stress etkilerini azaltmak için antioksidan enzim üretimi; kurak koşullarda verim artışı ve kimyasal gübre maliyetinde azalma şeklindedir. Tritikale yetiştiriciliğinde PGPB uygulamasının çeşitli çalışmalarda sonuçlarının derlendiği bu çalışma sonunda, PGPB kullanımının tritikale yetiştiriciliğinde sürdürülebilirliği sağlamak için bir alternatif olabileceği sonucuna varılmıştır.

Anahtar Kelimeler: Faydalı Bakteriler, Tritikale, Verim, Stres



USE OF PLANT GROWTH PROMOTING BACTERIA IN TRITICALE CULTIVATION

ABSTRACT

Problems such as climate change, soil pollution, urbanization and population growth negatively affect agricultural productivity. This situation has led to the need to find sustainable and environmentally friendly methods. Beneficial microorganisms are used as a natural way to provide nutrients to plants while maintaining soil health. Plant growth promoting bacteria (PGPB), which is one of the beneficial microorganisms, increases the yield of many crops as well as providing plant nutrition and growth, protecting and increasing soil nutrient availability. It also provides resistance to abiotic stress factors such as salinity, alkalinity, toxic metals and drought in the soil. Triticale, obtained by crossing wheat and rye, is the first hybrid strain cultivated as a new cereal crop that will combine the superior quality characteristics of wheat and the stress adaptability, vitality and resistance/tolerance characteristics of rye. Triticale is grown mainly for grain, feed and more recently for bioenergy production. In Triticale cultivation, the use of sustainable methods in order to obtain maximum benefit from the available agricultural inputs will provide benefits in the long run. For this purpose, the use of PGPB has gained importance, which has been proven by studies that both increase plant yield and enable nature-friendly agriculture. The effects of PGPBs on triticale agriculture are generally; increase in seed yield, leaf area index and growth rate; increased germination and root length in saline soils; production of antioxidant enzymes to reduce the effects of stress; yield increase in dry conditions and decrease in chemical fertilizer cost. At the end of this study, in which the results of PGPB application in triticale cultivation in various studies were compiled, it was concluded that the use of PGPB could be an alternative to ensure sustainability in triticale cultivation.

Keywords: Beneficial Bacteria, Triticale, Yield, Stress



1. Giriş

Hızlı kentleşme ve sanayileşme, iklim değişikliği, bilinçsiz kimyasal ilaç kullanımı, yanlış tarım teknikleri toprağı verimsizleştirmektedir (Albayrak, 2019). Bu durum toprak yapısını bozmanın yanı sıra gıda güvenliğini de tehdit etmektedir. Özellikle aşırı ilaç ve gübre kullanımı insan sağlığını tehdit eden kalitesiz ürünlerin ortaya çıkmasına neden olmuştur (Çığ ve ark., 2021a). Ayrıca, sentetik gübrelerin yüksek fiyatları, ek bir mali yük getirmektedir (Salama, 2019). Bu nedenle, çevreye zarar vermeden, bitkisel verimi ve kaliteyi artırmayı amaçlayan daha uygun fiyatlı alternatiflere ihtiyaç duyulmaktadır. Bu ihtiyacın karşılanması ise biyo-gübrelerin kullanılması ile mümkündür (Çığ ve ark., 2021b). Bitki gelişimini teşvik edici bakterilerin (PGPB), biyo-gübre olarak tarımsal üretimde kullanımı son yıllarda artmıştır. PGPB, çevre dostu, sürdürülebilir ve düşük maliyetlidir (Johnson & Puthur, 2021). Aynı zamanda, toprak yapısını koruma, stres toleransını artırma ve çeşitli patojenlere karşı antagonist görevi görme özellikleri ile organik biyopestisitler ve biyogübreleyiciler olarak formüle edilebilir (Dhir, 2017).

Bitki büyümesini teşvik eden bakteriler (PGPB), çeşitli biyokimyasal ve moleküler yollarla bitki büyümesi ve korunması gibi doğrudan ve dolaylı etkilere sahiptir (Erman ve ark., 2022). Doğrudan etkileri, fitohormonların sentezi, ACC deaminaz aktivitesi, organik asit üretimi ve besin alımının kolaylaştırılması şeklindedir. Dolaylı etkiler ise enzimlerin, allelo-kimyasalların sentezi ve indüklenmiş sistemik direncin aktivasyonu yoluyla fitopatojenlere karşı koruma şeklindedir (Rocha ve ark., 2019; Ceritoğlu ve ark., 2022). Biyolojik gübre olarak kullanılan bakteri suşları genellikle *Acetobacter*, *Achromobacter*, *Acinetobacter*, *Aereobacter*, *Alcaligenes*, *Agrobacterium*, *Artrobacter*, *Azotobacter*, *Azospirillum*, *Bacillus*, *Clostridium*, *Burkholderia*, *Enterobacter*, *Flavobacterium*, *Erwinia*, *Klebsiella*, *Pseudomonas*, *Micrococcus* gibi cinslere aittir (Burr ve ark., 1984; Çakmakçı, 2005; Etasemi ve Adl, 2020; Ceritoğlu ve ark., 2022).

Buğday ve çavdar melezlenmesiyle elde edilen tritikale, buğdayın üstün agro-morfolojik ve kalite özelliklerini çavdarın ise streslere uyum sağlama, canlılık ve direnç/tolerans özelliklerini birleştirecek yeni bir tahıl mahsulü olarak kültüre alınan ilk melez türdür. Tritikale, buğdaya göre daha geniş alanlarda yetişme özelliğine sahiptir. Ayrıca stres koşullarında da daha iyi performans göstermiştir. Tritikale ağırlıklı olarak tahıl, yem ve son zamanlarda biyoenerji üretimi için yetiştirilmektedir (Mergoum ve ark., 2019). Mahsul verimliliğini artırırken toprak sağlığını korumaya yönelik sürdürülebilir ve çevre dostu yaklaşımlar sunduğundan, PGPB'nin tarımda kullanılması önerilmektedir (Ajijah ve ark., 2023). Bu çalışmada, tritikale yetiştiriciliğinde PGPB uygulamasının çeşitli çalışmalardaki sonuçları derlenmiştir.



2. Tritikale Yetiştiriciliğinde Bitki Gelişimini Teşvik Edici Bakterilerin Kullanımı ile İlgili Çalışmalar

Kimyasal gübrelere alternatif olarak kullanılan bitki gelişimini teşvik eden bakteriler (PGPB), bitki beslenmesi ve büyümesini sağlama, toprak besin mevcudiyetini koruma ve artırma yeteneğine sahiptir. Sebze ve baharatlar (Kang ve diğerleri, 2021), baklagiller (Ferchichi ve diğerleri, 2019), tahıllar (Youseif, 2018) dâhil olmak üzere çok çeşitli mahsullerin verimini artırmıştır. PGPB'lerin tritikale yetiştiriciliğinde kullanıldığı bazı çalışmalar ve sonuçları aşağıda verilmiştir.

Kamari ve Sharifi (2015), bitki büyümesini teşvik eden rizobakteriler ile tohum aşılmasının ve nano-çinko oksit uygulamasının tritikale verimi, tanecik dolum oranı ve hızı üzerindeki etkilerini incelemiştir. Çalışma sonucunda, maksimum verimin, verim bileşenlerinin, tane dolum oranının ve süresinin *Azotobacter* ile tohum aşılması ve 1 g/L NZO uygulamasında olduğu görülmüştür. Tritikale verimini artırmak için biyolojik gübrelerin ve çinko mikro besin maddelerinin kullanılmasının uygun ve ucuz bir yöntem olduğu sonucuna varılmıştır.

Arough ve ark. (2016a) çalışmalarında, tuzlu koşullar altında tritikalede biyo-gübrelerin ve çinko gübrenin klorofil içeriği, antioksidan enzim aktivitesi, prolin ve çözünebilir şekerler üzerindeki etkilerini incelemiştir. Çalışmadaki uygulamalar mikoriza, PGPR (*Pseudomonas putida* strain, *Azotobacter chroococum*), PGPR+ mikoriza, nano çinko oksit (0, 0.4, 0.8) şeklindedir. Çalışma sonunda, tuzlu koşullarda biyo-gübre ve nano çinko oksit uygulamalarının antioksidan enzim aktivitesini, tane verimini, klorofil içeriğini, çözünür şekerleri ve prolin içeriğini artırdığı bulunmuştur. Ayrıca tuzlu koşullarda karlı bir tritikale üretimi için biyogübre ve nano çinko oksit uygulamalarının kullanımı önerilmiştir.

Arough ve ark. (2016b), kısıtlı sulama koşullarında nano çinko oksit, bakteri (*Azospirillum lipoferum*, *Pseudomonas putida*), mikoriza ve bakteri+mikoriza uygulamalarının tritikale yetiştiriciliğine etkilerini araştırmıştır. Tritikalenin biyogübre (mikoroza ve bakteri) ile aşılması ve çinko uygulamasının, katalaz (CAT), peroksidaz (POD) ve polifenol oksidaz (PPO) özelliklerini iyileştirdiği bulunmuştur. Biyogübreler ve nano çinko oksit uygulanan tritikale bitkilerinde, antioksidan enzimlerin sentezi ve savunma mekanizmaları uyarılarak su stresi etkilerini azalttığı görülmüştür.

Küçük ve Cevheri (2016), tuzlu koşullarda bakterilerin, tohum çimlenmesi ve bitki hormonlarının üretimine etkisini incelemiştir. Çalışmada bakteri suşu olarak *Pseudomonas fluorescens*, *Bacillus simplex*, *Serratia plymuthica*, *Spingomonas paucimobilis* kullanılmıştır. Tritikale tohumlarının *Pseudomonas fluorescens* ile aşılmasının, kontrole kıyasla tohum çimlenmesini önemli ölçüde arttırdığı bulunmuş ve bakterilerin, toprak tuzluluğu koşullarında bitki büyümesini iyileştirmek için kullanılabiliceği önerilmiştir.



Zare ve ark. (2020) çalışmalarında farklı bakteri, nano gübre ve sıradan gübre kullanımının tritikaleye olan etkilerini araştırmıştır. Dört farklı bitki gelişimini teşvik eden bakteri (aşısız, *Azotobacter crococcoccus*, *Azospirillum metilpofrome* ve *Pseudomonas putida*), beş farklı seviyede nano demir gübresi (0, %0,5, %1, %1,5 ve %2) ve iki seviyede (%2 ve %0) sıradan gübre kullanılmıştır. Çalışma sonunda *Azotobacter crococcoccus*, *Azospirillum methylpofrome* ve *Pseudomonas putida* uygulamalarının kontrole kıyasla tohum veriminde sırasıyla %15, 17 ve 13'lük artış sağladığı bulunmuştur. Bakteri uygulamaları karşılaştırıldığında ise en yüksek yaprak alanı indeksinin *Azotobacter* muamelesinde olduğu görülmüştür.

Ghasemi ve ark. (2020), tritikale tohumlarının kısıtlı su koşullarında PGPR ile aşılınması ve demir uygulamasının, elektriksel iletkenlik, katalaz (CAT), peroksidaz (POD) ve polifenol oksidaz (PPO) özelliklerinde iyileşme sağladığını bildirmiştir. PGPR ve demir uygulamasının, kısıtlı sulama koşullarında tritikale verimini artırmak için kullanabileceği sonucuna varılmıştır.

Salama ve Badry (2021) çalışmalarında, bitki büyümesini teşvik eden rizobakterilerden biri olan *Azotobacter chroococcum* ile aşı tohum ve farklı dozlarda (sıfır,% 25, 50,% 75) mineral gübreler kullanmıştır. Çalışma sonucunda *Azotobacter chroococcum* tohum aşılmasının, tritikale protein içeriği, tane ve yem veriminden ödün vermeden kullanılan mineral gübre miktarında %50, gübre maliyetinde ise %43'lük bir azalma sağladığı bildirilmiştir.

Sepehrzadegan ve Alizadeh (2021), yürüttüğü çalışmada, dört farklı (aşılmasız, *Azotobacter crococcoccus*, *Azospirillum metilpofrome* ve *Pseudomonas putida* ile aşılama) bitki büyümesini teşvik eden bakteri, beş seviyede nano demir gübresi (%0,0, %0,5, %1,0, %1,5, ve %2,0) ve iki seviyede (%2,0 ve %0,0) demir gübresi kullanmıştır. Çalışma sonunda bakterilerin tritikalede agronomi ve fizyolojik özelliklerini iyileştirdiği ve kimyasal gübre kullanımını azaltma potansiyeline sahip olduğu bulunmuştur. Ayrıca bakteri uygulamalarının tritikale yetiştiriciliğinde sürdürülebilirliği sağlamada iyi bir alternatif olduğu bildirilmiştir.

Fitouri ve ark. (2022), rizobakterilerin ve mikorizanın kombinasyon halinde uygulandığında, kuru madde (YDM) verimini %41,2 oranında artırdığını belirtmiştir. Sadece bakteri uygulamasında ise tritikale boylarının arttığını bildirmiştir. Ayrıca biyogübrelerin tek başına veya kombinasyon halinde kullanımını önermiştir.

Sarlou ve ark. (2023) tarafından, bakterilerin tritikalede oksin, sitokinin ve gibberellin gibi fitohormonlar sentezlenmesine yardımcı olduğu belirtilmiştir. Ayrıca fosfor gibi minerallerin çözündürülmesi, sideroforların üretimi ve besin alımında artış, N₂ fiksasyonu gibi çeşitli mekanizmalarla bitkilerin stres toleransını artırdığı bildirilmiştir. Biyo gübrelerin ve hümik asit



uygulanmasının bazı fizyolojik özellikleri iyileştirmesi nedeniyle toprak tuzluluk koşulları altında tritikalenin tane verimini artırabileceği bulunmuştur.

3. Sonuç

Dünya nüfusunun hızla artması, iklim değişikliği, kentleşme ve sanayileşme toprak sağlığını ve dolayısıyla bitkisel üretimin önemini artırmaktadır. Bilinçsiz gübreleme ve yanlış tarım teknikleri toprak sağlığını olumsuz etkilemektedir. Toprak yapısını korumaya yönelik sürdürülebilir ve çevre dostu yaklaşımlar sunduğundan, PGPB'nin tarımda kullanılması son yıllarda yaygın olarak kullanılmaktadır. Bitki büyümesini artıran bakterilerin tritikale yetiştiriciliğindeki faydalı rolü yapılan çalışmalar sonucunda kanıtlanmıştır. Elde edilen sonuçlara göre PGPB'lerin tritikale üzerine etkileri, tohum verimi, yaprak alanı indeksi ve büyüme hızında artış; tuzlu topraklarda çimlenme ve kök uzunluğunun artışı; stress etkilerini azaltmak için antioksidan enzim üretimi; kurak koşullarda verim artışı ve kimyasal gübre maliyetinde azalma şeklindedir. Bu sonuçlar ışığında PGPB kullanımının tritikale yetiştiriciliğinde sürdürülebilirliği sağlamak için bir alternatif olabileceği düşünülmektedir.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemiştir.

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SÜS BİTKİLERİNDE ÇİÇEK KURUTMA ÜZERİNDE GELİŞTİRİLEN GÜNCEL YÖNTEMLER

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ÖZET

Çiçekler, uygarlığın başlamasından beri insanlıkla ilişkilendirilmiştir. Çiçekler geçmişten bugüne kadar işlevsel olarak törenler, ritüeller ve kutlamalarda kullanılmakla beraber sevginin, güzelliğin sembolü olarak kabul edilen doğanın harika yaratımıdır. Estetik değerlerinin yanında, çiçekler ekonomik ve tıbbi özelliklerinin yanı sıra çevrenin renklendirilmesinde de önemli rol oynamaktadır. Çiçekler, insanları mutlu ve neşeli kılan güçleri nedeniyle haz ve saadetin eşanlamlıdır. Son yıllarda, çevre dostu olarak dekorasyon için tüm dünyada çiçek ve yapraklara olan talep artmaktadır. Ayrıca, taze çiçekler ve yapraklarla yapılan dekorasyon da pahalı, zaman alıcı ve kısa ömürlüdür. Kurutulmuş çiçekler veya bitki parçaları daha doğaldır, nispeten ucuzdur ve yıl boyunca mevcudiyetine bağlı olarak sonsuz bir değere sahiptir. Çiçek ve yaprakları kurutmak için farklı yöntemler geliştirilmiştir ve her yöntem her materyalin kurutulması için uygunluk göstermemektedir. Bu çalışmada süs bitkisi olarak kullanılan bitkilerin çiçek ve yapraklarının güzelliğini ve özelliklerini kaybetmeden kurutulabilmesi için uygulanan yöntemlerin tarihçesi ve güncel gelişmelerinden bahsedilmiştir.

Anahtar Kelimeler: Çiçek, Kurutma yöntemi, Süs bitkisi, Yaprak



CURRENT METHODS DEVELOPED ON FLOWER DRYING IN ORNAMENTAL PLANTS

ABSTRACT

Flowers have been associated with humanity since the beginning of civilization. Flowers are a wonderful creation of nature, which has been used functionally in ceremonies, rituals and celebrations from the past to the present, and is considered a symbol of love and beauty. In addition to their aesthetic values, flowers play an important role in the coloring of the environment as well as their economic and medicinal properties. Flowers are synonyms of pleasure and bliss because of their power to make people happy and joyful. In recent years, the demand for flowers and leaves has been increasing all over the world for environmentally friendly decoration. Also, decorating with fresh flowers and leaves is expensive, time-consuming, and short-lived. Dried flowers or plant parts are more natural, relatively inexpensive, and have endless value based on year-round availability. Different methods have been developed to dry flowers and leaves, and not every method is suitable for drying every material. In this study, the history and current developments of the methods applied to dry the flowers and leaves of the plants used as ornamental plants without losing their beauty and properties are mentioned.

Keywords: Flower, Dried method, Ornamental plant, Leaf



1. Giriş

Bitki materyallerini kurutulmuş halde muhafaza etmek yeni bir fikir değildir; yüzlerce yıldır bir sanat olarak kabul edilmiştir. Mısır piramitlerinde bedenler mis kokulu kuru otlar ile mumyalanarak kaplanmıştır. Orta Çağ boyunca keşişler, çiçekleri, yaprakları ve bitkileri dekoratif motiflerde kullanmak, el baskı kitaplarını renklendirmek ve boya yapmak için kurutmuşlardır. Kurutulmuş çiçek aranjmanları Avrupa'da yüzyıllardır popüler olmuştur ve 1700'li yıllarda Amerikalılar, özellikle karanlık kış aylarında evlerini aydınlatmak için kuru çiçekler kullanmışlardır (Brown, 2022).

Çiçek kurutmak estetiğin yanı sıra girişimciler için kazançlı ve gelir getiren bir hobidir. Hindistan, çiçekçilik ticaretinde kuru çiçek endüstrisi olarak gelişmişlik olarak ilk sırada yer almaktadır. Toplam çiçekçilik ticareti ve talebinin yaklaşık yüzde 70'ine katkıda bulunduğu için kuru çiçekler yılda yüzde 8-10 gibi ciddi oranda artış göstermektedir (Jain ve ark., 2016). Kuru çiçekler ABD, Avrupa, Japonya, Avustralya, Uzak Doğu ve Rusya'ya ihraç edilmektedir.

Kurutulmuş ve korunmuş süs ürünleri, yenilik, uzun ömür, estetik özellikler ve esneklik gibi çok çeşitli nitelikler sunmaktadır. Süs çiçeklerinin cazibesi, renk ve formları bozulmadan birkaç yıl boyunca kurutma tekniği kullanılarak kullanılabilir. Çiçekleri kurutmada haftada birkaç gün kuru tutmak için farklı yaklaşımlar vardır, ancak kurutma teknikleri uygulandığında çiçekler kurutulduktan sonra aylarca hatta yıllarca bile uzun süre saklanabilir. Çiçeğin uzun ömürlü olması için kurutulmuş çiçeklerdeki nem içeriği de uzun ömürlülüğü etkiler ve ters orantılıdır. Yüzde 8-11,5 nem içeriği aralığı, iyi bir nem içeriği sağlar. Kurutulmuş çiçekler, taze çiçeklere göre daha narin oldukları için özenle kullanılmalıdır.

2. Kuru çiçeklerin avantajları

- ⦿ Kurutulmuş çiçekler ve ürünleri, zarar görmeden uzun yıllar saklanabilir ve korunabilir.
- ⦿ Uzun ömürlüdürler ve daha az bakım gerektirirler.
- ⦿ Hammaddeleri yıl boyunca temin edilebilir.
- ⦿ Kurutulmuş bitki malzemeleri, ayırt edici iç mekân dekorasyonu sağlar.
- ⦿ Hava durumuna veya mevsime bağlı değildir
- ⦿ Taze çiçeklerden nispeten daha ucuzdurlar.
- ⦿ Çevre dostudur ve biyolojik olarak parçalanabilir.
- ⦿ Buket, kuru çiçek aranjmanı, çiçekli balolar, tebrik kartları, bayram dekorasyonları vb. birçok ürünün hazırlanmasında kullanılabilir.
- ⦿ Kurutulmuş aranjmanlar zamandan tasarruf sağlar.



● Kuru çiçekler, taze kesme çiçek aranjmanları gibi kuru vazolarda da düzenlenebilir. Dekoratif bantlara bağlanarak buket veya duvar süsü haline getirilebilir. Preslenmiş yaprak ve çiçekler birçok ürünün yapımında kullanılabilir.

● Kurutulmuş malzemeler vazolarda, sepetlerde, plakelerde, kutularda ve taze çiçek aranjmanlarında kullanılabilir. Ayrıca duvar dekorasyonu olarak da kullanılabilirler; çelenklerde, tebrik kartlarında ve hediye kutularında; dekorasyon olarak da şeker kavanozları, teraryumlar ve diğer cam eşyalar, kurutulmuş malzemeler için etkileyici görüntüler sağlar. Camın altına çerçevelenmiş pres çiçekler ve yapraklar canlı bir görünüm kazandırır (Jain ve ark., 2016; Kamal, 2018; Koley, 2020).

3. Materyal toplama ve çiçeklerin kurutulmasında dikkat edilmesi gerekenler

En kaliteli ürünü alabilmek için bitki materyali toplanırken ve kurutulurken aşağıdaki önlemler alınmalıdır.

- Taze malzeme toplanmalıdır.
- Çiğ/nem buharlaştıktan sonra (gündüz) malzeme toplanmalıdır.
- 2-3 gün sulamadan sonra tarladan malzeme toplanmalıdır.
- Çiçek gelişiminin tüm aşamaları izlenip uygun zamanda toplanmalıdır.
- Olgunlaşmamış çiçekler çok hızlı büzüştüğü için yeterince sertleşmiş çiçek salkımları toplanmalıdır (Trinklein, 2006).

4. Çiçek ve yaprak kurutma yöntemleri

Kuru çiçeklerin kalitesi esas olarak çiçeklerin hasat aşamasından etkilenmektedir ve herhangi bir kurutma tekniği uygulanmadan önce, öncelikle bu konu hatırlanmalıdır. Çiçeğin hasat edilmesi için en uygun dönem, çiçeğin cinsine ve şekline göre değişmekle birlikte, olgunlaşmaya yeni başladığı veya tamamen açıldığı, yaprakların en olgun halini aldığı dönemdir. Hasat zamanındaki 2-3 günlük gecikme yaprakların birbiri üzerine katlanarak kırılmasına neden olabilmektedir. Çiçekler, tomurcuk aşamasında, tamamen açılmadan veya daha sonraki aşamalarda, renkleri solmadan önce hasat edilmelidir.

4.1. Hava ile kurutma

Hava ile kurutma en kolay ve en ucuz yöntemdir. Tek dezavantajı, çiçekler orijinal renklerini koruyamazlar ve yaprakları da küçülür. Çok az zaman ve beceri gerektirir ve neredeyse her zaman doğru sonuçlar verir. Oda sıcaklığı, bağıl nem, hava akışı ve nem yüzdesi işlem süresini büyük ölçüde etkiler, ancak tüm işlemler 3-4 hafta içinde tamamlanarak sonuçlanabilir.

- Asılı kurutma:

Dikey kurutma, çiçekleri baş aşağı asarak veya yerleştirerek yapılabilir. Bunun için:

- Çiçekler veya yapraklar olgunlaşmamış bir aşamada toplanır ve alt kısımların 1/4'ü çıkarılır.



- ☉ Sapları küçük demetler halinde gruplanır ve bir lastik bantla bağlanır ve iyi havalandırılan, düşük nemli, temiz ve karanlık odada aşağıya sarkıtılır (De ve ark., 2016) (Şekil 1).
- ☉ Çiçekler ayrıca karanlıkta veya güneşte, kurutma kağıdına veya temiz gazeteye yayılarak bekletilebilir (Datta, 1997).



Şekil 1. Asılı kurutma (URL-1).



Şekil 2. Pres ile kurutma (URL-2).

Koley (2020), *Acroclinum*, *Gypsophilla*, *Helichrysum*, *Hydrangea*, *Larkspur*, *Limonium*, *Statice* vb. çiçeklerin kurutulmasında en uygun metodun bu olduğunu; ancak Sharavani ve Divya (2018) mavi ve sarı renkli taçyapraklara sahip çiçeklerin havada kurutulduğunda renklerini korurken, pembe renkli çiçeklerin solduğunu söylemiştir.

4.2. Pres ile kurutma

Pres kurutma, çiçekleri ve yaprakları korumak için hala en basitleştirilmiş, zahmetsiz, ucuz ve bilinen yöntem olarak kabul edilmektedir. Bu yöntemde çiçek kurutma kâğıdı, gazete, eski defter kâğıdı vb. kıvrımlarına koyulur (Şekil 2). Onun da üzerine ağır bir cisim koyulur. Çiçeklerin kuruması, çiçeklerdeki dokunun su içeriğine bağlıdır. Genelde 1-3 hafta süren bu teknik, çiçeklerin fırında uygun sıcaklıkta tutulmasıyla kısa sürede uygulanabilir. Kurutma işlemi, herbaryum presinin 24 saat boyunca 45-50 °C'de sıcak hava fırınına yerleştirilmesiyle hızlandırılabilir (Datta, 1997). *Adiantum*, *Silver Oak*, *Thuja* yaprakları ile *Aster*, *Bougainvillea*, *Candytuft*, *Chrysanthemum*, *Euphorbia*, *Hibiscus*, *Ixora*, *Lantana*, *Marigold*, *Melia*, *Rose*, *Verbena* gibi çiçekler bu yöntemle kurutulur. Düzleşen materyaller duvarı süsleme, için tebrik kartları ve diğer çiçek aranjmanları gibi farklı el sanatlarının hazırlanması için uygun hale gelmiş olur (Bhutani, 1990) (Şekil 3).



Şekil 3. Pres ile kurutma (URL-3, URL-4, URL-5).

4.3.Gliserinle kurutma

Bitkilerin çiçeklerinden çok, ağırlıklı olarak yapraklarını kurutmak için uygulanan tekniktir. Bu teknikte, kurutmak yerine yapraklar korunur ve sulu gliserin çözeltisi nemin yerini aldığından ürün kalitesi daha iyi kalır (Paul ve Shylla, 2002). Genel olarak, yapraklar olgun bir aşamada hasat edilir, sonrasında tüm istenmeyen kısımlar gövdeden çıkarılır. Gövde istenilen yükseklikte kesilir ve kesilen uç bir çekiçle ezilir. Daha sonra ezilmiş kısım %33 gliserin solüsyonuna 5-7 cm derinlikte daldırılır. Yaprak çözeltiyi emer ve hava koşullarına da bağlı olarak bir hafta içinde parlak kahverengi bir renk alır. Gliserin mikroorganizmalar için iyi bir ortam olduğundan, mikrobiyal büyümeyi önlemek için gliserin çözeltisine antibiyotikler eklenir. Okaliptüs, Gypsophilla, Ortanca, Manolya ve Akçaağaç yaprakları bu teknik için uygun materyallerdir (Koley, 2020) (Şekil 4).



Şekil 4. Gliserinle kurutma (URL-6).



Şekil 5. Güneşte kurutma (URL-7).



4.4. Güneşte kurutma

Güneşte kurutma, çok dikkat gerektiren bir yöntemdir. Bu yöntemde, bitki materyali bir kap içindeki kurutucuya gömülür ve hızlı dehidrasyonu kolaylaştırmak için her gün kap güneş altında tutulur. Bu işlem sayesinde, havayla kurutmanın aksine, çiçekler daha az büzülür ve taze çiçeklerle aynı görünümde olduğu kadar çaplarını da korurlar (Wilson ve ark., 2013). Çiçekler doğru aşamada toplanır ve havaya asılır veya silika jel, kum vb. kurutma ortamları ile bir kapta gömülür. Bu yöntem için en uygun çiçekler Karanfil, Krizantem, Kadife çiçeği, hercai menekşe ve ponpon krizantem gibi çiçekler baş aşağı olacak şekilde ters çevrilerek kuma gömülür ve güneş ışığında kurumaya bırakılır. Çiçekler 3-4 gün içinde kurur (Şekil 5).

4.5. Dondurarak kurutma

Teknik olarak liyofilizasyon olarak bilinen bu yöntemle ürünlerin içindeki sıcaklık düşürülür ve ardından nem bir vakum yoluyla buhar halinde uzaklaştırılır. Bu teknik, sıcaklığın donma noktasının altına düştüğü ve nemin sıvı hale geçmeden buzdan buhara kısmi vakum basıncıyla (4,58 torr'dan az) uzaklaştırıldığı süblimasyon ilkesine dayanmaktadır. Daha sonra buharlar yoğunlaştırılır ve haznenin dışında ayrı ayrı toplanır. Kurutulan ürünler oda sıcaklığında iklimlendirilir. İstenmeyen kimyasal reaksiyonların oluşmaması için bu işlem sıvı hale geçmeden tamamlanır. Dolayısıyla bu yöntemle elde edilen ürünler orijinal şekil, renk ve dokularını korurlar (Sankari ve Anand, 2014). Bu tekniğin en büyük dezavantajları, yaklaşık bir ay gerektiren süreç ve yüksek maliyet içermesidir. Dondurularak kurutulmuş ürünler ağırlıklı olarak pasta, düğün buketleri süslemek ya da masalara serpiştirilmek için kullanılırlar. Gardenya, Glayöl, Gypsophilia, Sümbül, Ortanca, İris, Zambak, Nergis, Orkide, Şakayık, Phaleonopsis, Gül, SnapDragon çiçekleri bu teknikle kurutulmak için uygun bitkilerdir.



Şekil 6. Dondurarak kurutma (URL-8, URL-9).



Şekil 7. Suda kurutma (URL-10).

4.6. Su ile kurutma

Kurutma sonrası taç yapraklarının parçalandığı çiçekler için en uygun yöntem suda kurutmadır. Bu yöntemde, çiçeklerin sapları başlangıçta birkaç inç derinlikte suya yerleştirilir ve burada taç yaprakları sağlam tutmak için kesme çiçekler tarafından su alınır. Çiçeklerin doğal olarak kurumaması için 7-10 gün kuru, ılık ve karanlık bir yerde muhafaza edilmelidir. Bu yöntem ile kurutma için en uygun çiçek ortancadır (Şekil 7). Akasya, İrlanda Çanları, Celosia, Delphinium, Gypsophila, Proteae, bitkileri de su ile kurutulmaya uygunluk gösterir (Koley, 2020).

4.7. Gömerek kurutma

Bu yöntem taç yapraklarının büzülmesini önlemek ve daha iyi çiçek taç yaprağı rengini ve şeklini korumak için benimsenmiştir (Datta, 1997; Jain ve ark., 2016). Bu yöntemde, bitki parçaları olgun bir dönemde uygun renk oluşumu ile hasat edilir ve bitki materyalinin kalınlığına bağlı olarak 4-14 gün boyunca silika jel, talaş, kum, boraks, perlit veya bunların kombinasyonları gibi kurutucu maddelere gömülür. Kurutucular metalik veya plastik veya toprak kaplara konur ve iyi havalandırılan bir odada oda sıcaklığında dehidrasyona bırakılır. Bitki örnekleri kurutucuya 5 cm derinlikte gömülür ve çiçek şeklini bozmadan hafifçe kapatılır. Gömülü kurutma, çiçeklerin güneşte, güneş enerjili kurutucuda, sıcak hava fırınında, mikrodalga fırında vb. kurutulmasıyla hızlandırılabilir (Jain ve ark., 2016). Kurutucu olarak kullanılan madde, kurutma sırasında açığa çıkan su buharı ile reaksiyona girmeden, gömülü halde bulunan çiçeklerinden veya bitki kısımlarından nemi hızla uzaklaştırır. İdeal kurutucu boyutu 0,02-0,2mm veya 20200 mesh olmalıdır (Raj, 2014).

Dehidrasyonda içine gömülürken kullanılan malzemeler genellikle kum, boraks ve silika jeldir.

Kum içinde kurutma



En eski, en ucuz ve en iyi kurutuculardan biri kuru, ince, neredeyse tuzsuz yıkanmış kumdur. Kumla ilgili en büyük sorun, ağır olması ve bazen narin yaprakları çürütmesidir. Kurumayı hızlandırmak için 1 litre kuma 1ölçü boraks, 1 yemek kaşığı tuz eklenebilir. Deniz kıyısında bulunan ince beyaz kum (nehir kumu), kolay işlenmesi ve bulunabilirliği nedeniyle gömme için kullanılabilir (Datta, 2001). En hızlı ve ucuz yöntem olmasına karşın kum, kurutucu olarak silis jel, boraks, mısır unu gibi tercih edilmez, ancak kum kullanılması gerekiyorsa mısır unu veya boraks ile birlikte gömme amaçlı kullanılmalıdır (Shailza ve ark., 2018).

Boraks içinde kurutma

Boraks narin çiçeklerin kurutulması için en ucuz ve en uygun yöntemdir (Verma ve ark., 2012). Karışım yapılmak istendiğinde kumun yaptığı ağırlıktan dolayı yaprakların düzleşme ihtimaline karşılık (Trinklein, 2006), mısır ununun hafif ve çiçekleri düzleştirmeye daha az eğilimli olması, yerleştirme için en iyi karışım olması ve ayrıca çiçek kutularının işlenmesini kolaylaştırması sebebiyle boraks ile karışım kurutma için uygun hale gelmektedir. Boraksta kurutmaya uygun bitki materyalleri gül, aster, karanfil, kadife çiçeği, dahlia, larkspur, geranium, zinnia, chrysanthemum ve delphinium olarak bildirilmiştir (Smith, 1993).

Silica jel içinde kurutma

Uzun süre gömülü kalsa bile çiçek taç yapraklarında ağartma veya kırılabilirliğe neden olmayacağı için silika jel ile rengini ve şeklini koruyan mükemmel kalitede kuru çiçekler elde edilir (Champoux, 1999; Verma ve ark., 2012). Gül tomurcuklarının kurutulmasında tomurcukların silika jel kaplamasının renk ve şekil açısından en iyi kaliteye neden olduğu bildirilmiştir (Dhatt ve ark., 2007). Anemon, Bebek nefesi, Bekar düğmesi, Cosmos, Gladiolus, Delphinium, Larkspur, Salvia, Ayçiçeği vb. silika jel kullanılarak kurutulmaya uygundur. Kurduğunda mavi olan ve nemi emdikten sonra pembeye dönüşen silika jel oldukça pahalıdır ve kristaller mavi renge dönene kadar fırında ısıtılarak tekrar kullanılabilir (Paul ve Shylla, 2002).

4.5.1. Güneşte kurutma

Bu yöntemde, gömülme işleminin içinde yapıldığı kap, dehidrasyon sürecini hızlandırmak için günlük olarak baş aşağı güneş ışığına maruz bırakılmalıdır. Dehidrasyonun tamamlanması 3-4 gün sürecektir. Bu yöntem için uygun bitkiler anason, krizantem, kadife çiçeği, ponpon, küçük zinya vb. olarak gösterilebilir (Jain et al., 2016).

4.5.2. Fırında kurutma

Gömülmenin yapıldığı kap, 40-500 °C sıcaklıktaki sıcak hava fırınlı kurutucuya yerleştirilir. Bu tekniğin önemli faktörleri, bitki türlerine bağlı olarak işlemin sıcaklığı ve süresidir. Jain ve ark. (2016) yüksek sıcaklıkların süreci hızlandırabileceğini ancak çiçek pigmentlerini bozabileceğini



bildirmektedir. 450 °C sıcaklığa maruz bırakılan Fransız Kadife Çiçeği ve Afrika Kadife Çiçeğinin tam kuruma için 72 Saat; Chrysanthemum, Gerbera, Helipterum gibi çiçeklerin ise 48 saat içinde kurutulduğu bildirilmektedir (Koley, 2020).

4.5.3. Mikrodalga ile kurutma

Çiçek kalitesinin bozulmadığı çok hızlı bir yöntemdir. Gömülmenin yapıldığı kap, bir bardak su eklenerek mikrodalgada tutulur. Fazla kurumasını önlemek için fazladan su eklenir. Bundan sonra mikrodalga ledi kapatılır ve ihtiyaca göre süre ve sıcaklık ayarlanır. 10 dakikadan birkaç saate kadar bekleme süresi en iyi sonucu verir. Dahlia, Golden Rod, Gypsophilla, Lily, Rose, Violet, Zinnia bu yöntemde kurutma yapabilmek için en uygun çiçeklerdir (Koley, 2020).

4.5.4. Solar kurutucu ile kurutma

Bu yöntem en hızlı yöntemdir ve sıcak hava fırını ve mikrodalgada kurutma yöntemlerinin gibi sonuç alınır. Sıcaklığı kontrol etmek için fırının altına hareketli bir tepsi sabitlenerek gömülü malzemelerin güneş kurutucusunun altında tutulmasıyla yapılan bir yöntemdir (Koley, 2020).

4.5.5. Vakum ile kurutma

Bu yöntemde ürün kalitesi iyidir. Vakum odası, sırasıyla vakum basıncını korumaya ve nemi yoğunlaştırmaya yardımcı olan bir vakum pompası ve kondansatörden oluşur. Gömülü malzemeler bu hazneye yerleştirilir ve kurutma gerçekleşir (Koley, 2020).

5. Sonuç

Canlı olarak kullanılan ve tüketilen süs bitkilerinin iç mekân düzenlemelerinde vazolarda, estetik kaplarda, buket, demet ve sepetlerde kurutulmuş hallerinin de kullanılması mümkündür. Tüketici alışkanlıkları günümüzde daha uzun süreli kullanımlara ve bozulmadan estetik-güzellik taleplerine meyil etmektedir. Bu bağlamda canlı, taze çiçek aranjmanları ile aynı düzenleme tarzında kullanılan kuru çiçekler ev, işyeri vb mekanlarda tercih edilebilmektedir. Kurutulmuş materyaller olarak çimler, tohum başları, baklalar, dallar, taç yapraklar, meyveler, yapraklar uygun kurutma yöntemleri ile kurutulduğu takdirde uzun yıllar güzelliklerini muhafaza ederek yaşadığımız mekanlarda yer edineceklerdir. İç mekân düzenlemelerinde bozulmadan kaldıkları için kullanımları uzun olacaktır. Özel günlerde ve gelin buketi olarak tercih edilen kurutulmuş çiçekler, aynı zamanda kolye, toka vb takılar, tablo, kitap ayıracı, mum, takvim, resim çerçevesi, kavanoz, masa ve duvar süslemeleri başta olmak üzere günlük hayatta pek çok yerde karşımıza çıkmaktadır. Uzman olmanın dışında hobi olarak da çiçek severlerin uğraştığı bir alan olan çiçek kurutmacılığı yaygınlaşmakta ve bazı kesimlere gelir kaynağı da olmaktadır.



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KAHRAMANMARAŞ DEPREMİNİN BÖLGENİN KIRSAL KALKINMASINA ETKİSİNİN İNCELENMESİ

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ÖZET

Türkiye geçmişten günümüze depremlerin çok sık meydana geldiği bir coğrafyadır. Ülke nüfusunun %90'ından fazlasının deprem bölgelerinde bulunması, yaşanan depremlerin yıkıcılığını arttırmakta, çok ciddi miktarda can ve mal kaybının ortaya çıkmasına neden olmaktadır. 6 Şubat 2023 tarihinde Kahramanmaraş ilinin Pazarcık ve Elbistan ilçelerinde meydana gelen 7.7 ve 7.6 şiddetindeki yıkıcı depremler, bölge genelinde 11 ilde çok sayıda insanın yaşamını kaybetmesine, büyük bir fiziksel ve sosyal yıkımın yaşanmasına neden olmuştur. Bu deprem 1939 yılında Erzincan'da ve 1999'da Marmara'da yaşanan depremlere kıyasla çok daha büyük bir alanı kapsamış, çok daha büyük bir yıkıma neden olmuştur. Bu araştırma yaşanan depremlerin ekonomik ve sosyal kırsal kalkınma üzerindeki etkilerini incelemiştir. Bugün hem gelişmiş hem de gelişmekte olan ülkelerde kalkınma politikaların en temel konularından birisini kırsal kalkınma başlığı oluşturmaktadır. Sürdürülebilir bir kırsal kalkınma, bir ülkenin ekonomik ve sosyal yönden geri kalmış bölgelerinin refah düzeyinin artırılmasına ve ülkenin geri kalanıyla arasındaki gelir çarpıklığının iyileştirilmesine katkı sağlamaktadır. Bu amaçla başta turizm, tarım, hayvancılık ve dış ticaret olmak üzere kırsal kalkınmayı sağlayacak sektörlerin önceliklendirilmesi ve desteklenmesi çok önemlidir. Ancak öngörülemeyen ve yıkıcı özellikteki depremlerin yaşanması, uzun dönemli sürdürülebilir kırsal kalkınma hedeflerini kesintiye uğratabilmektedir. Araştırmada depremin etkilediği 11 ilde turizm, ticaret, üretim, hayvancılık ve tarım sektörlerinin Türkiye ekonomisi içerisindeki yeri analiz yapılarak incelenmiş, bu bağlamda yaşanan büyük yıkımın muhtemel ekonomik etkileri ortaya konulmaya çalışılmıştır. Kırsal kalkınmanın bir diğer önemli bileşeni sosyal kalkınmadır. Bölgenin nüfus yapısı incelendiğinde, on üç milyonun üzerinde insanın depremden olumsuz etkilendiği görülmektedir. Bu bakımdan bölgenin göç ve nüfus göstergeleri üzerinden Kahramanmaraş depreminin neden olduğu olası sosyal kayıplar değerlendirilmeye çalışılmıştır.

Anahtar Kelimeler: Büyük yıkım, kahramanmaraş depremi, kırsal kalkınma, afet ekonomisi



INVESTIGATION OF THE IMPACT OF THE KAHRAMANMARAŞ EARTHQUAKE ON THE RURAL DEVELOPMENT OF THE REGION

ABSTRACT

Turkey is a geography where earthquakes have occurred frequently from the past to present. That over 90% of the country's population is in earthquake zones increases the destructiveness of the earthquakes experienced and causes a very serious loss of life and property. The destructive earthquakes of 7.7 and 7.6 magnitude that occurred in the Pazarcık and Elbistan districts of Kahramanmaraş province on February 6, 2023 caused a large number of people to lose their lives and a great physical and social destruction in 11 provinces throughout the region. This earthquake covered a much larger area and caused much greater destruction compared to the earthquakes in Erzincan in 1939 and Marmara in 1999. This research examined the effects of earthquakes on economic and social rural development. Today, one of the most fundamental issues of development policies in both developed and developing countries is the title of rural development. Sustainable rural development contributes to increasing the well-being of an economically and socially backward region of a country and improving the income distortion between it and the rest of the country. For this purpose, it is very important to prioritize and support the sectors that will provide rural development, especially tourism, agriculture, animal husbandry, and foreign trade. However, unpredictable and destructive earthquakes can disrupt long-term sustainable rural development goals. In the research, the place of tourism, trade, production, livestock and agriculture sectors in the Turkish economy in 11 provinces affected by the earthquake was analyzed and examined, and in this context, the economic effects of the great destruction experienced were tried to be revealed. Another important component of rural development is social development. When the population structure of the region is examined, it is seen that over thirteen million people were adversely affected by the earthquake. In this respect, the social losses caused by the Kahramanmaraş earthquake were tried to be evaluated through the migration and population indicators of the region.

Keywords: Great destruction, kahramanmaraş earthquake, rural development, disaster economics



1. GİRİŞ

Türkiye geçmişten günümüze depremlerin çok sık meydana geldiği bir coğrafyadır. Ülke nüfusunun %90'ından fazlasının deprem bölgelerinde bulunması, yaşanan depremlerin yıkıcılığını arttırmakta, çok ciddi miktarda can ve mal kaybının ortaya çıkmasına neden olmaktadır. 6 Şubat 2023 tarihinde Kahramanmaraş ilinin Pazarcık ve Elbistan ilçelerinde meydana gelen 7.7 ve 7.6 şiddetindeki yıkıcı depremler, bölge genelinde 11 ilde çok sayıda insanın yaşamını kaybetmesine, büyük bir fiziksel ve sosyal yıkımın yaşanmasına neden olmuştur. Bu deprem 1939 yılında Erzincan'da ve 1999'da Marmara'da yaşanan depremlere kıyasla çok daha büyük bir alanı kapsamış, çok daha büyük bir yıkıma neden olmuştur. Dünya Bankası'nın deprem sonrası yapmış olduğu tahmine göre, depreminin neden olduğu ekonomik kayıp, ülkenin 2021 yılı GSYH'sinin %4'üne karşılık gelen tahmini 34,2 milyar dolar civarındadır (NTV, 2023). Birleşmiş Milletler Kalkınma Programının (UNDP) yaptığı tahmine göre ise depremin maliyeti 100 milyar doları aşacaktır (Dünya, 2023). Her iki uluslararası kuruluşun da hesaplamaları göz önünde bulundurulduğunda, Kahramanmaraş depreminin ülke ve bölge ekonomisine maliyetinin on milyarlarca dolar düzeyinde olacağı öngörülebilir.

Doğal afetler genellikle hem bölgesel ekonomiyi hem de daha yıkıcı durumlarda ulusal ekonomiyi bozabilecek çok karmaşık olaylar zincirini tetikleyebilmektedir (Kliesen, 1994). Bu nedenle başta depremler olmak üzere doğal afetlerin ekonomi üzerindeki etkilerinin incelenmesi makroekonominin en temel konularından birisini oluşturmaktadır. Zira, afetler başta yapı stokunun, fabrikalar ve teçhizatların, alt yapının ve sermaye varlıklarının zarar görmesine neden olmakta, nitelikli işgücünün kaybı ve eğitimin aksaması yoluyla beşerî sermayeyi baltalamaktadır (Deraniyagala, 2016). Özellikle yaşanan afetlerin büyüklüğü ve süresi, yerel ekonominin mevcut yapısı, etkilenen coğrafi alan, nüfus tabanı ve meydana geldiği günün saati de afetlerin maliyetinin artmasını sağlayan temel faktörlerdir (Kliesen, 1994). Ayrıca doğal afetlerin farklı gelir grupları üzerindeki farklılaşabilmektedir. Yaşanan afetlerden etkilenen kesimlerin başında yoksul kesimler gelmektedir (Deraniyagala, 2016). Bu nedenle yoksulluğun yüksek olduğu kırsal bölgelerde ve kentlerde yaşanan yıkıcı afetler, ciddi can kaybına, ekonomik hasara ve toplumsal psikolojik travmalara yola açabilmektedir.

Bu araştırma Kahramanmaraş'ta meydana gelen ve 11 ilde yıkıcı etkilere yola açan büyük depremin bölgenin sosyo-ekonomik yapısına ve ülke ekonomisine olan muhtemel etkilerini durum analizleri üzerinden değerlendirmiştir.

2. LİTERATÜR TARAMASI

Doğal afetlerin kırsal ve ulusal ekonomi üzerindeki etkileri konusunda ampirik literatür son dönemde genişlemiştir. Bu araştırmaların bir kısmı doğrudan doğal afetlerin ekonomi üzerindeki etkilerini analiz



etmiştir. Bir kısım çalışmalar ise afetlerin kırsal kalkınma ve göç üzerindeki etkilerini ortaya koymuştur.

Cutter vd. (2016), afet direncinde kent-Kır farklılıklarını analiz ettikleri araştırmalarında kentsel alanlardaki direncin öncelikle ekonomik sermaye tarafından yönlendirildiğini, toplum sermayesinin kırsal alanlarda afet direncinin en önemli itici gücü olduğunu göstermiştir.

Songwathana (2017), 1990-2016 dönemini kapsayan araştırmasında daha yüksek gelirin, etkilenen insan sayısı ve toplam etkilenen insanlar açısından afet kaybını azaltabileceğini göstermiştir. Bunun yanında, çalışmada daha yüksek gelirin doğal afetlerden kaynaklanan hasar miktarının artmasına neden olduğu ortaya koyulmuştur.

Panwar ve Sen (2019), 1981-2015 döneminde 102 gelişmiş ve gelişmekte olan ülkeyi inceledikleri araştırmalarında doğal afetlerin afet türlerine ve yoğunluklarına bağlı olarak ekonomik sektörler arasında çeşitli ekonomik etkilere sahip olduğunu belgelemiş ve gelişmekte olan ülkelerde doğal afetlerin ekonomik etkilerinin istatistiksel olarak daha güçlü olduğuna dönük bulgulara ulaşmıştır.

Ahmed ve Eklund (2019), Bangladeş'i inceledikleri araştırmalarında kırsal erişilebilirliğin iyileştirilmesinin, sürdürülebilir sosyal ve ekonomik kalkınma fırsatlarını artırdığı ve Bangladeş gibi gelişmekte olan ülkelerdeki doğal afetlerin kırsal alanlar üzerindeki olumsuz etkilerini azalttığını göstermiştir.

Cang vd. (2022), 1995-2018 arasını içeren dönemde Çin'i analiz ettiği araştırmasında afet kayıpları ile ekonomik büyüme arasında önemli ölçüde bir ters U şeklinde ilişkisi olduğunu tespit etmiştir.

Trinh vd. (2021), 2006-2008 döneminde Vietnam'ı inceledikleri araştırmalarında daha şiddetli afetlerin daha büyük bir göç olasılığı ile doğrudan ilişkili olduğunu ortaya koymuştur.

Tasri vd. (2022), 1990-2019 döneminde Endonezya içeren araştırmalarında işsizlik ve yoksulluk değişkenlerinin afet kaybı değişkeni üzerinde anlamlı bir etkiye sahip olduğunu tespit etmiştir.

Tran ve Wilson (2023), ABD ekonomisini inceledikleri araştırmalarında afetlerin uzun dönemde toplam geliri ve kişi başına düşen geliri artırdığını göstermiş, etkinin başlangıçta istihdam artışı ve daha uzun dönemde ise daha yüksek ücretler tarafından yönlendirildiğini ortaya koymuştur.

3. METODOLOJİ

Bu araştırma 6 Şubat 2023 tarihinde Kahramanmaraş ili merkezli meydana gelen depremlerin ulusal ve bölgesel kalkınma üzerindeki etkilerini değerlendirmiştir. Bu kapsamda büyük yıkımdan etkilenen Adana, Adıyaman, Diyarbakır, Elâzığ, Gaziantep, Hatay, Kahramanmaraş, Kilis, Malatya, Osmaniye ve Şanlıurfa'nın ekonomik ve sosyal göstergeleri üzerinden durum analizleri yapılmıştır. Tablo 1 ve Tablo 2'de depremden etkilenen illerin 2004-2021 yılları arasında kaydetmiş olduğu Gayri Safi Yurt İçi Hasıla (GSYH, Bin TL) istatistikleri verilmiştir. GSYH, ekonomik büyümeyi temsil etmesinin



yanında ekonomik aktivitenin de standart göstergelerinden birisidir. Buna göre, önceki dönemlerde Adana bölgenin başat ekonomisiyken, 2021 yılı itibariyle en önemli ekonomik hasılaya sahip il Gaziantep olmuştur. Aynı yıl bu ili Adana ve Hatay takip etmiştir. 2021 yılı itibariyle bölge bazında en düşük GSYH'ye sahip il Kilis iken, onu Adıyaman ve Osmaniye izlemiştir.

Tablo 1: Depremden Etkilenen İllerin GSYH'si (Bin TL)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2004	582.852.799	11.839.365	2.022.559	6.120.510	2.679.634	8.245.934
2005	680.275.847	13.799.884	2.364.280	6.777.363	3.188.885	9.422.706
2006	795.757.109	15.910.092	2.739.540	7.949.249	3.807.194	11.175.587
2007	887.714.414	17.808.704	3.046.049	8.710.571	4.248.185	12.213.036
2008	1.002.756.496	19.914.664	3.501.880	9.473.037	4.863.226	13.458.118
2009	1.006.372.482	20.447.250	3.455.743	9.822.206	4.956.460	13.313.099
2010	1.167.664.479	24.033.702	4.248.598	11.722.029	5.742.908	15.957.447
2011	1.404.927.615	28.353.288	5.175.418	14.162.039	6.775.730	20.031.948
2012	1.581.479.251	32.163.447	5.561.973	16.240.554	7.618.492	24.520.146
2013	1.823.427.315	36.908.829	6.327.521	19.321.351	8.746.748	29.901.857
2014	2.054.897.828	40.676.801	7.092.468	20.474.248	9.500.462	34.505.859
2015	2.350.941.343	46.699.386	8.050.681	23.327.687	10.674.212	41.106.824
2016	2.626.559.710	52.807.198	8.906.831	25.703.315	11.966.080	45.502.350
2017	3.133.704.267	61.022.301	10.365.992	30.033.864	14.815.704	54.805.379
2018	3.758.773.727	70.271.231	12.684.671	34.736.081	16.827.113	67.402.191
2019	4.311.732.766	81.883.938	14.238.665	41.430.336	19.085.633	76.732.284
2020	5.048.220.067	99.580.814	16.875.232	47.635.666	24.668.367	99.285.765
2021	7.248.788.983	141.672.580	23.236.012	62.494.019	33.124.400	148.588.413

Kaynak: TÜİK'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Tablo 2'de görüldüğü üzere, 2019 yılında deprem bölgesinin kaydetmiş olduğu GSYH'nin Türkiye GSYH'si içerisindeki oranı %9.371 iken, 2020 yılında %9.762, 2021 yılında ise %9.766'ye yükselmiştir. Bu bakımdan, bölge ekonomisi büyüklük bakımından ülke ekonomisinin %10'una tekâmül etmektedir.



Tablo 2: Depremden Etkilenen İllerin GSYH'si -2 (Bin TL)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2004	7.361.345	3.382.487	5.246.385	5.201.357	467.846	1.742.789
2005	8.756.169	4.298.824	6.060.423	5.879.319	601.449	2.076.131
2006	9.972.863	4.511.837	6.327.758	6.721.661	652.922	2.370.334
2007	11.258.744	5.017.436	7.330.339	7.356.270	724.468	2.778.641
2008	12.886.544	5.611.698	8.477.906	8.148.813	738.529	3.273.561
2009	12.704.845	5.846.289	8.814.646	8.456.624	839.440	3.311.974
2010	14.611.730	6.801.988	10.487.429	10.880.213	1.055.767	4.454.705
2011	17.840.030	8.412.868	11.851.364	12.759.633	1.110.384	5.380.774
2012	19.113.831	9.340.538	12.885.230	14.017.210	1.257.972	5.991.987
2013	22.329.358	10.641.488	15.318.074	16.275.300	1.637.266	6.668.233
2014	25.418.756	11.718.307	16.807.292	17.955.211	1.732.313	7.362.639
2015	28.928.616	13.749.524	19.969.422	21.270.349	2.321.516	8.278.649
2016	33.146.965	14.954.005	22.358.898	23.387.165	2.479.212	10.005.120
2017	40.481.603	17.626.199	26.497.396	27.959.184	2.895.462	12.280.936
2018	49.095.647	20.799.124	32.630.466	31.693.747	3.501.542	14.968.831
2019	51.467.044	24.250.123	39.033.513	35.801.335	4.142.753	15.994.236
2020	62.324.859	29.102.843	45.782.042	42.866.637	5.056.845	19.645.645
2021	101.461.596	38.831.203	63.004.412	57.589.407	7.006.880	30.945.765
2019 Yılı Yüzdesi*		9,371				
2020 Yılı Yüzdesi *		9,762				
2021 Yılı Yüzdesi*		9,766				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“**”, Söz konusu yılda 11 ilin toplam GSYH'sinin Türkiye GSYH'sine olan oranı alınmıştır.

Kişi başına düşen GSYH (ABD Doları) cinsinden değerlendirildiğinde, bölge illerinde kaydedilen kişi başına düşen gelir Türkiye'nin altındadır. Bu durum depremin yol açtığı sosyo-ekonomik maliyetlerin daha ağır hissedilmesine neden olabilir. Örneğin, 2004 yılında Türkiye'de kişi başına düşen GSYH 6.021 ABD Doları iken, bu rakam bölgenin lokomotifleri olan Adana, Gaziantep ve Hatay'da 4.257, 4.049 ve 3.858 dolar olarak hesaplanmıştır. 2021 yılına gelindiğinde ise Türkiye için bu rakam 9.592 ABD Dolarına yükselmiş, bölge illerinde Adana için 9.592 dolar, Gaziantep ve Hatay için ise 7.819 ve 6.785 dolar olarak hesaplanmıştır. Bölgenin en düşük Kişi başına GSYH'sine sahip illeri 2021 yılı itibariyle 3.012 ABD Doları ile Şanlıurfa olurken, onu 3.893 ve 4.092 dolar ile Diyarbakır ve Adıyaman takip etmiştir.



Tablo 3: Depremden Etkilenen İllerde Kişi Başına Düşen GSYH (ABD Doları)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2004	6.021	4.257	2.453	3.083	3.535	4.049
2005	7.376	5.223	3.036	3.575	4.441	4.787
2006	7.971	5.581	3.279	3.866	4.929	5.172
2007	9.735	6.860	4.028	4.625	6.057	6.102
2008	11.018	7.710	4.682	5.008	6.974	6.624
2009	9.044	6.476	3.813	4.228	5.844	5.278
2010	10.629	7.717	4.797	5.128	6.931	6.335
2011	11.289	8.064	5.210	5.450	7.274	6.917
2012	11.675	8.431	5.191	5.699	7.542	7.660
2013	12.582	9.073	5.576	6.346	8.128	8.624
2014	12.178	8.624	5.429	5.776	7.644	8.454
2015	11.085	7.921	4.946	5.231	6.888	7.935
2016	10.964	7.971	4.859	5.113	6.869	7.710
2017	10.696	7.573	4.637	4.882	6.988	7.550
2018	9.793	6.719	4.341	4.293	6.053	7.087
2019	9.195	6.469	4.009	4.182	5.664	6.595
2020	8.600	6.291	3.808	3.823	5.944	6.763
2021	9.592	6.977	4.092	3.893	6.272	7.819

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Deprem bölgesindeki 11 ilin yıllar itibariyle kişi başına düşen GSYH (ABD Doları) ortalamaları Tablo 4'de verilmiştir. 2019 yılında bölgede kişi başına düşen GSYH 5.207 ABD Doları iken, bu oran 2020 yılında pandeminin etkisiyle şüphesiz 5.076 dolara gerilemiştir. Bir sonraki yıl ise tekrar artarak 5.624 dolar olmuştur.



Tablo 4: Depremden Etkilenen İllerde Kişi Başına Düşen GSYH-2 (ABD Doları)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2004	3.858	3.357	3.777	2.620	2.866	2.818
2005	4.822	4.500	4.591	3.063	3.872	3.517
2006	5.079	4.385	4.440	3.188	3.889	3.703
2007	6.284	5.366	5.644	3.765	4.731	4.749
2008	7.187	6.019	6.509	4.108	4.816	5.571
2009	5.749	5.147	5.522	3.435	4.471	4.579
2010	6.643	6.130	6.707	4.421	5.733	6.238
2011	7.202	6.696	6.735	4.504	5.350	6.654
2012	7.172	6.819	6.754	4.473	5.613	6.804
2013	7.857	7.334	7.526	4.799	6.803	7.071
2014	7.692	6.997	7.103	4.503	6.158	6.697
2015	6.989	6.575	6.740	4.197	6.601	5.989
2016	7.103	6.368	6.699	4.039	6.276	6.398
2017	7.090	6.163	6.485	3.904	5.942	6.413
2018	6.539	5.571	6.091	3.343	5.326	5.978
2019	5.597	5.347	5.980	3.068	5.119	5.249
2020	5.385	5.147	5.601	2.907	5.036	5.133
2021	6.785	5.355	5.997	3.012	5.406	6.256
2019 Yılı Ortalaması*		5.207				
2020 Yılı Ortalaması*		5.076				
2021 Yılı Ortalaması*		5.624				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.
“*”, Söz konusu yılda 11 ilin ortalama kişi başına düşen GSYH'si alınmıştır.

Tablo 5 ve Tablo 6'da depremden etkilenen illerin dış ticareti ihracat istatistikleri üzerinden 2013-2022 yılları için değerlendirilmiştir. 2013 yılında bölgede en fazla ihracata sahip ülke 6.707 milyon ABD dolarıyla Gaziantep iken, onu aynı yıl 2.889 milyon dolarla Hatay ve 1.901 milyon dolarla Adana izlemiştir. 2022 yılına gelindiğinde bu rakamın Gaziantep için 10.180 milyon dolar, Hatay ve Adana için ise 3.533 ve 2.999 milyon ABD doları olarak kaydedilmiştir.



Tablo 5: Depremden Etkilenen İllerin Dış Ticareti (İhracat, ABD Doları)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2013	161.480.915	1.901.578	100.376	281.376	262.529	6.707.624
2014	166.504.862	1.913.737	339.028	254.084	234.682	6.950.431
2015	150.982.114	1.666.503	548.636	192.754	169.676	6.719.406
2016	149.246.999	1.597.913	344.303	159.575	252.668	6.860.579
2017	164.494.619	1.836.671	137.788	198.064	321.291	6.990.184
2018	177.168.756	2.017.698	85.269	212.778	221.191	7.208.951
2019	171.464.945	1.912.169	59.311	216.604	207.891	7.418.005
2020	169.637.755	1.869.080	68.957	255.134	146.527	8.164.823
2021	213.598.369	2.481.299	62.865	392.111	302.903	9.798.729
2022	235.283.032	2.999.234	82.968	395.864	366.932	10.180.391

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilin toplam GSYH'sinin Türkiye GSYH'sine olan oranı alınmıştır.

Söz konusu dönemde kaydedilen oranlar Türkiye toplamına oranlandığında bölge ihracatının payının genel olarak artmış olduğu söylenebilir. 2019 yılında bölge ticaretinin Türkiye ihracatına oranı %8.365 iken, bu oran 2020 yılında %8.688, 2021'de ise %9.141'e yükselmiştir. Ancak bir sonraki yıl yaşanan ekonomik gelişmelerinde etkisiyle ihracat payı %8.588'e gerilemiştir. Bölge dış ticareti içerisinde en düşük paya sahip iller 2022 yılı itibariyle 82.968 milyon dolar ile Adıyaman olmuştur. Bu ili 95.147 ve 308.310 milyon dolarla Kilis ve Şanlıurfa izlemiştir.



Tablo 6: Depremden Etkilenen İllerin Dış Ticareti-2 (İhracat, ABD Doları)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2013	2.889.945	307.737	846.406	224.891	26.183	133.794
2014	2.302.460	311.199	907.913	267.067	46.023	93.680
2015	1.903.731	250.101	811.532	274.787	83.167	136.783
2016	1.827.033	248.397	866.656	191.625	107.300	142.724
2017	2.410.737	235.780	935.686	143.509	86.940	163.040
2018	2.965.359	224.177	978.598	150.115	94.543	273.180
2019	2.837.263	271.877	905.538	166.709	43.415	304.974
2020	2.657.309	288.864	861.318	153.412	68.211	204.800
2021	4.014.476	405.220	1.357.910	208.583	80.309	420.721
2022	3.533.505	449.694	1.420.813	308.310	95.147	375.077
2019 Yılı Yüzdesi		8,365				
2020 Yılı Yüzdesi		8,688				
2021 Yılı Yüzdesi		9,141				
2022 Yılı Yüzdesi		8,588				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilin toplam GSYH'sinin Türkiye GSYH'sine olan oranı alınmıştır.

Bölgedeki ekonomik aktivitenin bir diğer göstergesi yıllar içerisinde kurulan girişim sayısıdır. Tablo 7 ve Tablo 8'de 11 ilde 2009-2021 yılları arasında kurulan toplam girişim sayısı verilmiştir. Buna göre 2021 yılı itibariyle açılan 102.608 girişimle Adana birinci, 92.644 ile Gaziantep ikinci ve 76.409 girişimle Hatay üçüncü olmuştur. Gerek GSYH'si gerekse de dış ticaret (ihracat) ve kurulan girişim sayıları göz önünde bulundurulduğunda bölgenin iki ana lokomotifini olan Gaziantep ve Hatay'ın depremden ağır etkilenmesi ekonomik açıdan ortaya çıkacak maliyetleri arttıracaktır.



Tablo 7: Depremden Etkilenen İllerde Girişim Sayısı

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2009	3.266.911	80.500	17.704	35.192	20.214	66.795
2010	3.287.412	81.769	18.486	36.724	20.525	66.310
2011	3.309.859	82.753	18.740	37.405	20.731	66.720
2012	3.362.086	82.959	18.688	37.676	20.854	68.500
2013	3.397.724	83.880	18.592	37.946	20.808	70.884
2014	3.434.912	84.127	18.784	37.904	21.073	72.629
2015	3.498.586	84.659	19.321	38.152	21.454	74.127
2016	3.608.470	86.551	19.913	38.918	22.199	77.456
2017	3.696.004	86.718	20.499	39.253	22.674	78.549
2018	3.845.951	89.834	21.487	41.575	23.473	80.988
2019	3.954.698	91.911	22.480	42.488	23.969	84.379
2020	4.095.218	95.712	22.900	43.553	24.206	86.996
2021	4.384.672	102.608	24.761	47.451	25.376	92.644

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Bölgede açılan girişim sayısının Türkiye toplamına oranı Tablo 8'de verilmiştir. Buna göre, Türkiye'de her yıl kurulan on girişimden birisi bölgede kurulmaktadır. 2019 yılında bu oran %12.44 iken, 2021 yılına gelindiğinde %12.278 olmuştur. 2021'de bölge en az girişimin kurulduğu iller 6.571 ile Kilis olurken, onu 22.685 ve 24.761 girişimle Osmaniye ve Adıyaman izlemiştir.



Tablo 8: Depremden Etkilenen İllerde Girişim Sayısı-2

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2009	52.975	26.745	34.639	42.509	4.847	17.071
2010	53.118	27.355	34.660	44.513	4.941	17.191
2011	54.968	27.244	34.258	46.493	4.985	17.337
2012	57.123	27.296	34.732	48.122	5.213	17.948
2013	59.050	27.300	35.320	49.585	5.203	17.992
2014	60.918	27.582	35.641	50.506	5.459	17.961
2015	61.994	28.015	36.503	51.167	5.633	18.303
2016	63.432	28.902	38.029	52.613	5.630	18.971
2017	65.024	29.789	39.137	52.172	5.665	19.438
2018	68.315	30.858	41.000	54.231	5.791	20.099
2019	70.230	31.719	41.925	55.768	6.288	21.111
2020	70.890	32.016	42.250	55.931	6.322	21.562
2021	76.409	33.953	44.915	60.998	6.571	22.685
2019 Yılı Yüzdesi*		12,44				
2020 Yılı Yüzdesi*		12,26				
2021 Yılı Yüzdesi*		12,278				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilde verilen toplam girişim sayısının Türkiye'deki toplam girişim sayısına oranı alınmıştır.

Turizm bakımından bir değerlendirme yapmak gerekirse Tablo 9 ve 10'u incelemek yerinde olacaktır. 2002-2021 dönemi gecelik konaklama sayısı göz önünde bulundurulduğunda, Adana, Gaziantep ve Hatay illerinin ön plana çıktığı söylenebilir. 2021 yılında Adana 1.556.040 konaklamayla birinci olurken, bu ili 1.423.473 ve 1.306.526 ile Gaziantep ve Hatay izlemiştir. Buna karşın, Kilis, Osmaniye ve Adıyaman bölgenin en az turist çeken illeri olarak dikkat çekmektedir.



Tablo 9: Depremden Etkilenen İllerde Turizm (Toplam Geceleme Sayısı)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2002	81.444.786	385.268	80.083	363.660	49.212	296.442
2003	79.933.219	393.166	49.495	297.765	34.694	346.372
2004	93.301.902	434.725	53.537	226.205	42.287	415.039
2005	103.007.179	527.573	84.243	263.193	48.496	399.489
2006	91.052.777	514.376	63.257	437.483	77.849	388.858
2007	115.967.310	708.565	115.641	585.030	172.291	535.792
2008	113.917.756	674.638	84.217	621.716	155.439	515.666
2009	124.389.217	614.010	80.472	637.269	142.075	515.145
2010	149.186.942	657.539	109.303	573.174	148.697	531.518
2011	156.234.715	590.171	93.004	606.667	204.751	681.530
2012	172.318.712	833.294	103.073	589.221	199.515	831.665
2013	169.709.109	996.892	123.993	696.488	186.670	893.755
2014	181.593.241	1.232.050	141.124	707.419	230.132	836.530
2015	177.494.692	1.135.780	126.730	655.885	236.820	757.619
2016	154.311.928	1.106.406	109.589	437.403	261.356	702.984
2017	155.809.568	1.494.739	223.626	485.199	351.361	1.087.668
2018	190.686.722	1.592.013	282.838	662.295	378.034	1.152.420
2019	211.287.063	1.596.139	328.393	812.541	387.853	1.294.725
2020	95.323.093	1.166.260	243.639	594.382	351.361	826.661
2021	176.095.499	1.556.040	344.296	837.204	414.171	1.423.473

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Bölge illerinde gecelik konaklayan toplam turist sayısının Türkiye toplamına oranı incelendiğinde, 2019 yılında %3.809, 2020 yılında %5.944 ve 2021 yılında %4.578 olarak gerçekleştiği görülmektedir. Bu bakımdan deprem bölgesinin ülke turizmine yıllık katkısının %5 civarında olduğu söylenebilir.



Tablo 10: Depremden Etkilenen İllerde Turizm-2 (Toplam Geceleme Sayısı)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2002	281.881	160.679	113.006	211.033	8.060	49.969
2003	321.164	152.565	144.417	172.278	7.347	68.918
2004	284.866	156.602	136.974	195.653	9.258	73.335
2005	265.114	170.942	145.834	108.766	11.589	55.118
2006	286.608	153.862	138.642	171.208	11.681	50.289
2007	379.290	182.957	704.926	216.166	9.684	62.221
2008	403.007	157.336	507.500	220.757	12.778	66.653
2009	411.628	179.608	727.284	235.333	12.961	55.219
2010	643.525	247.544	550.794	297.613	11.247	64.424
2011	660.137	292.737	573.788	363.514	13.621	78.125
2012	636.702	310.361	514.703	425.611	20.042	80.515
2013	750.941	313.641	530.487	480.135	52.514	78.904
2014	762.764	345.249	574.751	494.189	63.784	90.008
2015	738.135	350.915	569.353	432.624	51.424	79.131
2016	741.278	368.896	559.697	449.326	49.415	82.893
2017	1.237.086	486.273	444.727	704.515	95.288	134.199
2018	1.336.140	499.126	524.467	1.008.319	91.816	111.570
2019	1.328.148	510.495	529.671	1.057.333	83.745	120.702
2020	924.909	458.056	392.176	546.996	55.746	106.034
2021	1.306.526	612.333	538.117	810.366	61.275	157.874
2019 Yılı Yüzdesi*		3,809				
2020 Yılı Yüzdesi*		5,944				
2021 Yılı Yüzdesi*		4,578				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilde konaklayan toplam turist sayısının Türkiye toplamına oranı alınmıştır.

Türkiye'deki ekonomik aktivitenin en önemli bileşenlerinden birisini kırsal ekonomik kalkınma oluşturmaktadır. Tablo 11 ve Tablo 12'de depremden etkilenen illerin 2003-2021 yıllarındaki bitkisel ürün üretim değerleri verilmiştir. Buna göre, üretim bakımından 2021 yılı itibariyle birinci sırada Şanlıurfa gelirken, onu Hatay ve Adana izlemiştir. En düşük tarımsal üretime sahip iller ise Kilis, Elâzığ ve Osmaniye olmuştur.



Tablo 11: Depremden Etkilenen İllerde Tarım (Bitkisel Ürün Üretim Değeri, Bin TL)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2003	40.569.390	1.598.029	298.750	960.199	222.650	795.585
2004	45.680.438	1.698.603	284.462	1.156.383	274.632	501.084
2005	50.939.687	1.935.083	348.408	1.048.146	311.628	710.837
2006	54.515.463	2.076.476	341.707	1.113.486	362.822	983.577
2007	56.787.424	2.349.666	396.525	1.189.339	387.878	961.292
2008	66.010.114	2.463.418	415.371	833.624	436.525	889.712
2009	68.267.486	2.587.225	421.896	1.264.772	396.184	919.368
2010	80.038.126	3.137.061	577.093	1.484.288	438.421	1.247.068
2011	88.979.273	3.248.646	759.640	1.910.202	493.883	1.198.431
2012	87.946.988	2.998.811	658.667	1.745.998	492.142	1.348.680
2013	92.452.530	3.434.464	760.529	2.039.304	504.059	1.185.534
2014	98.123.089	3.661.380	890.375	2.080.473	470.638	1.160.076
2015	120.152.079	4.152.159	1.034.722	2.203.342	634.090	2.440.349
2016	119.237.661	4.544.696	1.181.221	2.623.776	763.340	2.215.832
2017	135.885.136	5.290.437	1.321.056	2.905.858	841.866	1.698.984
2018	159.142.178	6.755.182	2.057.911	3.216.571	997.385	4.368.596
2019	197.455.884	8.008.703	1.437.140	3.877.481	1.136.048	2.247.322
2020	246.016.799	9.415.790	2.717.861	5.235.723	1.614.748	6.056.120
2021	306.373.402	11.759.741	3.011.783	6.490.672	1.855.542	5.530.439

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Bölgenin tarımsal üretiminin ülke içerisindeki payı incelendiğinde, bu oranın yaklaşık %20 civarında olduğu görülmektedir. Başka bir ifadeyle, ülkede her yıl üretilen bitkisel üretimin beşte biri 11 ilde üretilmektedir. Bu oran ülkenin tarımsal üretim düzeyi açısından önemli bir rakamdır. Buna göre 2019'da %17.500 olan üretim payı, 2021 yılına gelindiğinde %21.534'e yükselmiştir. Bununla birlikte, bölge tarımının ağırlıklı olarak Urfa ve Adana'da üretildiği (Hatay istisna kabul edilirse) göz önünde bulundurulduğunda, bu illerin deprem dolayısıyla bölgenin geri kalanına kıyasla daha az etkilendiği ve bu durumun da tarımda üretim kaybıyla ortaya çıkabilecek maliyetlerin daha az olmasına neden olacağı söylenebilir.



Tablo 12: Depremden Etkilenen İllerde Tarım-2 (Bitkisel Ürün Üretim Değeri, Bin TL)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2003	1.231.061	487.853	738.950	1.488.356	231.804	322.663
2004	1.471.821	382.773	828.996	1.621.344	141.645	339.723
2005	1.684.764	876.057	1.000.481	1.732.669	215.085	393.308
2006	1.886.447	521.132	712.485	1.947.909	196.814	395.215
2007	1.983.799	568.139	935.120	1.942.574	231.425	494.929
2008	2.180.537	710.425	1.199.526	2.136.883	172.693	632.936
2009	2.091.296	701.161	1.283.127	2.421.657	257.910	571.576
2010	2.263.009	681.068	1.209.399	3.189.759	338.162	922.938
2011	2.592.312	964.422	1.354.136	4.062.158	180.454	893.403
2012	2.271.737	926.882	1.248.897	3.679.138	193.542	836.724
2013	2.084.216	847.041	1.597.799	3.832.909	391.866	754.655
2014	2.259.373	352.629	1.415.293	3.838.376	347.656	813.451
2015	2.641.873	1.528.997	2.201.687	4.626.032	612.993	907.750
2016	2.567.770	1.321.658	1.733.957	4.557.958	425.749	985.149
2017	2.994.182	1.733.142	1.887.462	5.582.692	422.135	1.031.743
2018	3.216.779	1.567.189	2.303.134	7.964.193	589.496	1.234.169
2019	4.026.208	1.950.957	2.880.099	6.811.726	614.702	1.564.507
2020	4.259.332	2.575.754	3.706.658	13.304.842	673.033	2.261.131
2021	6.992.379	4.020.871	5.320.176	16.802.877	1.396.127	2.796.698
2019 Yılı Yüzdesi*		17,500				
2020 Yılı Yüzdesi*		21,064				
2021 Yılı Yüzdesi*		21,534				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilin toplam bitkisel ürün üretim değerinin Türkiye toplamına oranı alınmıştır.

Deprem bölgesindeki tarımsal üretim hektar bazında incelendiğinde, 2022 yılı itibariyle Şanlıurfa'nın 923.827 hektarla birinci olduğu, ikinci sırada 554.148 ile Diyarbakır geldiği görülmüştür. Üçüncü sırada 400.716 bin hektarla Adana gelmektedir.



Tablo 13: Depremden Etkilenen İllerde Tarım-3 (Toplam işlenen tarım alanı, hektar)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2004	23.812.992	551.656	247.033	773.589	172.486	221.715
2005	23.775.459	549.124	248.936	736.597	170.565	215.012
2006	22.981.020	513.934	237.780	703.132	187.605	202.041
2007	21.978.693	503.405	240.870	669.482	168.539	200.985
2008	21.555.242	501.884	239.222	599.630	162.952	170.893
2009	21.351.696	506.801	220.657	545.680	114.665	165.118
2010	21.383.626	492.374	207.768	584.939	137.460	160.499
2011	20.522.626	435.794	201.089	571.519	127.531	159.053
2012	20.581.039	418.449	194.730	545.635	134.263	163.603
2013	20.573.477	409.053	199.332	576.018	133.448	160.799
2014	20.697.903	430.698	197.772	589.159	132.462	161.273
2015	20.649.766	421.460	195.375	580.522	133.555	158.068
2016	20.381.943	423.036	191.665	564.106	148.082	149.660
2017	19.998.498	427.031	184.421	549.630	149.361	143.468
2018	19.723.076	411.390	182.348	548.185	158.752	135.312
2019	19.580.744	398.199	176.880	531.537	157.182	132.044
2020	19.586.384	397.801	183.310	533.198	157.997	132.392
2021	19.881.533	397.154	176.512	551.624	161.719	128.137
2022	20.169.569	400.716	166.757	554.148	152.410	127.819

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Hektar başına işlenen tarım alanı miktarı incelendiğinde, bu rakamın dönem boyunca düşüş kaydettiği gözlenmiştir. Buna göre, 2019 yılı itibariyle Türkiye toplamının %15.644 eşitken, bu oran 2020 yılında %15.562, 2021'de %15.314 ve 2022 yılında %15.260'a gerilemiştir.



Tablo 14: Depremden Etkilenen İllerde Tarım-4 (Toplam işlenen tarım alanı, hektar)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2004	221.153	288.127	393.701	1.092.075	71.144	149.645
2005	219.076	296.693	370.730	1.081.280	71.042	153.674
2006	216.754	266.674	349.037	1.041.997	68.505	144.830
2007	191.138	258.945	330.734	1.019.174	60.929	140.949
2008	193.138	246.297	314.578	1.039.815	59.041	137.018
2009	187.709	236.340	296.323	1.078.246	59.493	129.734
2010	194.836	237.257	299.915	1.155.384	61.439	153.215
2011	178.424	207.227	310.472	1.033.697	53.847	102.080
2012	172.576	209.666	255.652	957.294	55.409	108.661
2013	170.649	199.726	287.209	1.105.240	46.599	99.161
2014	167.622	203.552	296.966	1.066.906	50.861	103.940
2015	157.160	204.700	291.688	1.058.443	53.297	101.047
2016	157.225	195.041	288.430	1.014.279	53.305	102.640
2017	149.027	186.871	290.926	964.535	50.267	105.197
2018	138.100	187.356	300.012	897.014	48.105	103.220
2019	128.817	184.913	291.789	912.439	46.012	103.531
2020	130.695	185.064	296.814	884.358	46.802	99.733
2021	135.927	176.455	290.094	876.443	47.462	103.232
2022	136.830	173.572	289.887	923.827	47.901	104.150
2019 Yılı Yüzdesi*		15,644				
2020 Yılı Yüzdesi*		15,562				
2021 Yılı Yüzdesi*		15,314				
2022 Yılı Yüzdesi*		15,260				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“**”, Söz konusu yılda 11 ilin toplam bitkisel ürün üretim değerinin Türkiye toplamına oranı alınmıştır.

Deprem bölgesinde kırsal ekonomik kalkınmanın gelişimi tarımsal üretim miktarının yanı sıra hayvancılık faaliyetleri üzerinden değerlendirilmiştir. Tablo 15 ve Tablo 16’da bölgedeki hayvancılık faaliyetlerini temsil eden toplam hayvan değerinin illere göre 2003-2021 dönemindeki istatistiksel değişimleri verilmiştir. Buna göre, bölgede 2021’de 7.708.711 TL ile Şanlıurfa birinci sıradadır. Bu nedenle Şanlıurfa’nın hem tarım hem de hayvancılık faaliyetleri bakımından bölgenin lideri olduğu söylenebilir. Bunu 4.033.915 bin TL ile Adana ve 3.727.673 ile Kahramanmaraş izlemektedir.



Tablo 15: Depremden Etkilenen İllerde Hayvancılık (Canlı hayvan değeri, bin TL)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2003	14.380.595	189.776	116.913	289.095	169.446	122.301
2004	18.395.078	235.715	138.169	368.812	220.427	149.624
2005	20.919.260	277.086	142.419	406.560	268.508	157.065
2006	22.943.481	316.381	130.344	445.678	364.696	165.206
2007	24.666.222	341.318	127.871	505.551	349.260	168.095
2008	25.521.071	398.858	136.683	484.988	291.100	193.389
2009	28.145.579	480.530	159.446	490.939	316.319	223.247
2010	46.873.045	791.680	221.546	863.266	507.851	451.688
2011	60.076.917	1.031.209	250.891	1.167.267	682.117	588.261
2012	63.546.623	1.228.255	344.147	1.242.028	746.923	690.846
2013	57.656.092	913.363	322.950	1.209.914	603.007	661.894
2014	62.512.147	893.886	377.853	1.454.050	667.840	800.867
2015	73.102.253	1.106.116	412.745	1.529.577	908.334	970.253
2016	89.865.606	1.345.028	527.041	1.886.025	1.164.312	1.210.332
2017	117.796.767	1.733.560	705.322	3.333.157	1.416.526	1.631.858
2018	146.184.051	2.294.017	855.119	4.317.552	1.884.369	2.505.858
2019	165.318.007	2.242.925	1.142.688	5.847.679	2.106.984	2.390.535
2020	195.238.955	2.441.465	1.368.057	6.659.813	2.359.823	2.539.157
2021	238.675.430	4.033.915	1.259.264	7.708.711	3.145.472	3.067.407

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Hayvancılığın en düşük yapıldığı iller 411.220, 1.032.718 ve 1.259.264 TL ile Kilis, Osmaniye ve Adıyaman'dır. Bölgede yapılan hayvancılığın Türkiye toplamına oranı 2019 yılında %14.631 iken, 2020'de bu oran %14.410'e gerilemiş ve 2021 yılında %14.549 olmuştur. Bu bakımdan bölge genelinde Türkiye'deki hayvansal faaliyetlerin %15'nin yürütüldüğü ifade edilebilir.



Tablo 16: Depremden Etkilenen İllerde Hayvancılık-2 (Canlı hayvan değeri, bin TL)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2003	117.714	136.976	172.538	368.047	23.971	74.983
2004	137.477	174.498	206.297	411.495	27.063	94.856
2005	162.144	190.703	240.692	413.159	30.842	112.843
2006	191.137	206.148	243.996	427.995	27.983	108.359
2007	201.088	230.138	244.020	408.812	30.387	154.529
2008	216.012	250.831	258.239	449.156	34.717	176.572
2009	255.402	276.772	271.929	892.226	34.113	174.094
2010	431.863	474.073	399.952	1.029.407	70.968	302.888
2011	427.497	658.700	598.586	1.312.442	120.184	397.775
2012	564.278	605.401	689.640	1.109.348	169.950	429.669
2013	462.041	498.827	613.711	1.353.469	183.102	325.060
2014	486.157	520.760	779.704	1.462.884	172.774	352.525
2015	633.582	678.815	857.527	1.591.672	180.525	362.954
2016	810.343	960.814	1.041.014	2.012.808	204.830	416.545
2017	1.132.138	1.349.383	1.726.068	2.825.854	197.041	614.683
2018	1.254.533	1.536.846	2.011.031	3.748.823	270.096	734.203
2019	1.358.630	1.609.534	2.322.482	4.108.696	324.593	734.187
2020	1.595.582	1.862.480	2.667.905	5.351.280	385.181	903.586
2021	2.003.875	2.302.205	3.727.673	6.033.831	411.220	1.032.718
2019 Yılı Yüzdesi*		14,631				
2020 Yılı Yüzdesi*		14,410				
2021 Yılı Yüzdesi*		14,549				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilin toplam bitkisel ürün üretim değerinin Türkiye toplamına oranı alınmıştır.

6 Şubat 2023 tarihli Kahramanmaraş depreminin etkilediği yerlerin başında yapı stoku gelmektedir. Tablo 17 ve Tablo 18’de deprem öncesi yapı kullanma izni verilen daire sayısının 2002-2022 dönemindeki dönemsel değişimi verilmiştir. Buna göre 2022 yılı itibariyle Türkiye’de 632.174 daireye yapı kullanma izni verilirken, bölge açısından 17.320 ile Elâzığ birinci sırada, 14.766 ile Gaziantep ikinci sırada ve 10.100 ile Hatay üçüncü sırada yer almıştır. 1999 Marmara depremi sonrası Türkiye’de yapı mevzuatında değişikliğe gidilmiştir. Bu nedenle Tablo 17 ve Tablo 18 genel olarak son deprem mevzuatına göre yapılmış yapı stokunu göstermektedir. Bu nedenle deprem sonucu yıkılan binaların hangi yapı yönetmeliğine göre yapıldığı tam olarak henüz belirlenmediği için, 1999 sonrası ne kadar binanın yıkıldığı söylemek mümkün değildir. Bununla birlikte, son yapılan tespitlere göre 200 binin



üzerinde binanın ve 645 bin bağımsız bölmenin yıkıldığı, yıkılacak veya ağır hasarlı olduğu görülmektedir (CNN TÜRK, 2023). Dolayısıyla deprem sonrası iyileştirme aşamasında yüzbinlerce yeni konutun yapılması gerekmektedir. Bu bakımdan deprem nedeniyle milyarlarca dolarlık konut alt yapı maliyetleri ortaya çıkmıştır. Nitekim, TÜİK'in konut fiyatları endeksleri temel alındığında Türkiye'de 2010 yılının başında konutlar için TL/m² birim fiyatı 974.30 TL iken, 2022 yılının Aralık ayında bu rakam enflasyonun da etkisiyle 17.752, 20 TL'ye yükselmiştir (TCMB, 2023).

Tablo 17: Depremden Etkilenen İllerde Deprem Öncesi Yapı Stoku (Yapı Kullanma İzin Belgesine Göre Daire Sayısı)

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2002	161.491	1.812	124	162	868	1.077
2003	162.908	1.645	265	484	2.419	810
2004	164.994	2.117	310	159	1.882	797
2005	249.816	4.063	475	1.599	2.029	1.299
2006	295.389	6.723	870	500	2.528	3.085
2007	326.484	7.250	1.816	708	2.160	4.693
2008	357.286	8.637	954	2.312	3.751	5.181
2009	469.981	9.654	1.713	4.272	5.107	7.239
2010	429.755	9.073	1.913	1.210	4.739	2.591
2011	556.769	9.251	2.590	2.781	5.816	5.738
2012	556.331	10.824	2.944	1.535	7.624	7.127
2013	726.339	12.800	2.132	3.895	5.923	9.438
2014	777.596	12.906	3.058	5.248	6.109	16.536
2015	732.948	8.171	2.945	6.172	2.287	16.051
2016	754.174	11.393	3.332	6.536	3.966	17.711
2017	833.517	10.882	3.921	6.269	5.137	13.724
2018	894.240	14.349	3.708	6.035	6.372	13.848
2019	738.816	14.250	4.001	7.078	5.462	15.774
2020	599.999	11.531	3.242	6.800	7.746	13.307
2021	626.967	8.594	3.754	5.796	10.667	13.116
2022	632.174	9.639	4.797	6.847	17.320	14.766

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Tablo 18'de 11 ilde deprem öncesi yapı kullanma izni almış daire sayısının Türkiye'deki toplam daire sayısına oranı verilmiştir. Buna göre, bölgede yapı stoku son yıllarda hızlı bir artış göstermiştir. Artan konut talebine bağlı olarak 2019 yılında %11.766 olan daire oranı, 2020'de %13.325'e yükselmiş, 2021'de %12.629'a geriledikten sonra tekrar 2022'de %15.241 olmuştur.



Tablo 18: Depremden Etkilenen İllerde Deprem Öncesi Yapı Stoku-2 (Yapı Kullanma İzin Belgesine Göre Daire Sayısı)

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2002	1.773	928	1.553	201	10	188
2003	1.377	871	710	200	2	166
2004	1.919	963	747	172	11	268
2005	2.091	2.014	2.084	1.509	91	303
2006	3.608	1.373	1.783	467	277	1.143
2007	4.002	1.344	2.052	483	69	1.581
2008	5.626	1.330	2.590	2.264	130	1.000
2009	6.358	3.778	4.007	3.062	711	756
2010	5.928	2.303	5.292	3.327	263	1.489
2011	8.776	3.350	6.474	3.430	736	2.241
2012	9.159	4.505	4.272	4.320	348	2.943
2013	13.054	5.321	4.870	6.043	553	2.918
2014	13.035	8.568	8.223	8.626	1.027	5.912
2015	12.860	7.135	6.133	10.614	1.240	4.223
2016	12.242	8.405	6.411	7.474	1.525	2.985
2017	15.495	6.361	9.345	7.939	777	3.431
2018	14.368	5.603	7.711	10.463	940	3.874
2019	12.994	6.645	9.141	6.765	1.136	3.690
2020	10.803	7.114	7.354	6.705	1.116	4.232
2021	10.058	7.657	8.598	5.596	1.457	3.887
2022	10.100	9.135	9.743	7.586	1.938	4.483
2019 Yılı Yüzdesi*		11,766				
2020 Yılı Yüzdesi*		13,325				
2021 Yılı Yüzdesi*		12,629				
2022 Yılı Yüzdesi*		15,241				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“*”, Söz konusu yılda 11 ilin toplam yapı kullanma izni alan daire sayısının Türkiye toplamına oranı alınmıştır.

Araştırmada bölgenin sosyal kalkınma düzeyi toplam nüfus ve göç istatistikleri üzerinden değerlendirilmiştir. Tablo 19 ve Tablo 20’de deprem bölgesindeki 11 ilin 2007-2022 dönemindeki nüfus değişim istatistikleri verilmiştir. 2022 yılı itibariyle nüfus bakımından bölgenin nüfus bakımından en büyük ili 2.274.106 kişi ile Adana iken, onu 2.170,110 kişiyle Şanlıurfa ve 2.154.051 kişiyle Gaziantep izlemiştir. Nüfus bakımından en küçük iller ise 147.919 kişi ile Osmaniye, 559.405 kişiyle Osmaniye ve 591.497 kişi ile Elazığ’dır.



Tablo 19: Depremden Etkilenen İllerde Deprem Öncesi Toplam Nüfus

	Türkiye	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep
2007	70.586.256	2.006.650	582.762	1.460.714	541.258	1.560.023
2008	71.517.100	2.026.319	585.067	1.492.828	547.562	1.612.223
2009	72.561.312	2.062.226	588.475	1.515.011	550.667	1.653.670
2010	73.722.988	2.085.225	590.935	1.528.958	552.646	1.700.763
2011	74.724.269	2.108.805	593.931	1.570.943	558.556	1.753.596
2012	75.627.384	2.125.635	595.261	1.592.167	562.703	1.799.558
2013	76.667.864	2.149.260	597.184	1.607.437	568.239	1.844.438
2014	77.695.904	2.165.595	597.835	1.635.048	568.753	1.889.466
2015	78.741.053	2.183.167	602.774	1.654.196	574.304	1.931.836
2016	79.814.871	2.201.670	610.484	1.673.119	578.789	1.974.244
2017	80.810.525	2.216.475	615.076	1.699.901	583.671	2.005.515
2018	82.003.882	2.220.125	624.513	1.732.396	595.638	2.028.563
2019	83.154.997	2.237.940	626.465	1.756.353	591.098	2.069.364
2020	83.614.362	2.258.718	632.459	1.783.431	587.960	2.101.157
2021	84.680.273	2.263.373	632.148	1.791.373	588.088	2.130.432
2022	85.279.553	2.274.106	635.169	1.804.880	591.497	2.154.051

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

Tablo 20'de deprem illerindeki nüfusun Türkiye nüfusuna oranı verilmiştir. Buna göre Türkiye nüfusunun yaklaşık %16'sı depremin vurduğu bölgede yaşamaktadır. Bu durum depremden etkilenen kişi sayısının yüksek olmasına neden olmuştur. 2019 yılında bölgede yaşayan insan sayısının Türkiye nüfusuna oranı %16.378 iken, 2022 yılına gelindiğinde bu oran %16.432'ye yükselmiştir.



Tablo 20: Depremden Etkilenen İllerde Deprem Öncesi Toplam Nüfus-2

	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2007	1.386.224	722.065	1.004.414	1.523.099	118.457	452.880
2008	1.413.287	733.789	1.029.298	1.574.224	120.991	464.704
2009	1.448.418	736.884	1.037.491	1.613.737	122.104	471.804
2010	1.480.571	740.643	1.044.816	1.663.371	123.135	479.221
2011	1.474.223	757.930	1.054.210	1.716.254	124.452	485.357
2012	1.483.674	762.366	1.063.174	1.762.075	124.320	492.135
2013	1.503.066	762.538	1.075.706	1.801.980	128.586	498.981
2014	1.519.836	769.544	1.089.038	1.845.667	128.781	506.807
2015	1.533.507	772.904	1.096.610	1.892.320	130.655	512.873
2016	1.555.165	781.305	1.112.634	1.940.627	130.825	522.175
2017	1.575.226	786.676	1.127.623	1.985.753	136.319	527.724
2018	1.609.856	797.036	1.144.851	2.035.809	142.541	534.415
2019	1.628.894	800.165	1.154.102	2.073.614	142.490	538.759
2020	1.659.320	806.156	1.168.163	2.115.256	142.792	548.556
2021	1.670.712	808.692	1.171.298	2.143.020	145.826	553.012
2022	1.686.043	812.580	1.177.436	2.170.110	147.919	559.405
2019 Yılı Yüzdesi*		16,378				
2020 Yılı Yüzdesi*		16,509				
2021 Yılı Yüzdesi*		16,412				
2022 Yılı Yüzdesi*		16,432				

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“**”, Söz konusu yılda 11 ilin toplam yapı kullanma izni alan daire sayısının Türkiye toplamına oranı alınmıştır.

Tablo 21’de depremde etkilenen 11 ilde ve 2008-2021 döneminde nüfusun net göç hızına ilişkin istatistikler verilmiştir. TÜİK’in resmi veri tabanında açıkladığı üzere net göçün pozitif bir değer alması söz konusu kent nüfusunun arttığını gösterirken, negatif olması kentin göç verdiği anlamına gelmektedir. Tablo 21 incelendiğinde 2021 yılı itibariyle bölgedeki tüm illerin net göç hızının negatif olduğu görülmüştür. Yıl bazlı ortalamalar incelendiğinde ise 2019 yılında %-7.521 olan net göç hızının 2020 yılında %-1.390’da çıktığı, 2021 yılında ise tekrar %-6.437’ye düştüğü tespit edilmiştir. Ancak, net göç hızı şehir nüfusuna göre değişiklik gösterebilmekte ve yapılan göçün büyüklüğünü tam olarak yansıtamamaktadır (Birinci, 2017:83, Ünal, 2019:740). Bu bağlamda Tablo 21 üzerinden bölgenin göç yapısı hakkında açık bir şey söylemek mümkün değildir.



Tablo 21: Depremden Etkilenen İllerde Deprem Öncesi Göç (Net Göç Hızı, Binde)

	Adana	Adıyaman	Diyarbakır	Elâzığ	Gaziantep	Hatay	Malatya	Kahramanmaraş	Şanlıurfa	Kilis	Osmaniye
2008	-6,31	-14,96	-10,73	-6,41	0,59	-2,24	-3,17	0,55	-7,45	3,2	2,43
2009	-0,21	-10,49	-7,58	-3,81	1,18	-2,58	-3,25	-8,08	-4,92	-8,28	-2,44
2010	-2,06	-10,08	-6,55	-7,01	2,39	-2,68	-7,55	-7,07	-3	-6,15	-0,13
2011	-5,62	-16,81	-6,48	-5,7	4,2	-5,18	4,51	-8,77	-3,31	-13,79	-5,64
2012	-6,27	-13,79	-10,49	-2,19	1,26	-5,3	-5,59	-8,95	-7,34	-14,06	-4,05
2013	-5,72	-13,91	-7,74	0,23	-0,17	-6,79	-9,55	-4,42	-7,76	3,15	-0,53
2014	-5,35	-12,88	-6,77	-7,77	1,07	-4,27	-2,84	-3,01	-7,21	-13,05	-0,66
2015	-5,27	-9,15	-11,96	0,82	-1,25	-5,63	-5,73	-4,93	-5,5	1,4	-1,43
2016	-4,21	-3,94	-9,77	-2,64	-2,16	-2,2	0,21	-1,49	-5,72	-17,45	3,6
2017	-5,99	-7,61	-4,98	-2,82	-1,52	-4,36	-0,89	-3,05	-6,32	1,09	-0,31
2018	-8,51	-1,38	-4,02	9,77	-8,59	-3,82	2,09	-0,04	-6,02	13,65	-1,75
2019	-3,84	-11,43	-4,2	-14,95	-0,6	-4,18	-4,23	-7,79	-9,14	-16,21	-6,17
2020	0,56	-1,22	-2,18	-9,54	0,41	3,56	1,08	1,16	-4,47	-9,74	5,08
2021	-5,28	-11,42	-11,29	-2,77	-3,41	-7,79	-3,97	-7,15	-12,34	1,45	-6,84
2019 Yılı Ort.*		-7,521									
2020 Yılı Ort.*		-1,390									
2021 Yılı Ort.*		-6,437									

Kaynak: TÜİK 'den alınan veriler araştırmacılar tarafından düzenlenmiştir.

“**”, Söz konusu yılda 11 ilin ortalama göç hızı alınmıştır.

TÜİK'in resmi sayfasında net göç, belirli bir alanın aldığı göç ile verdiği göç arasındaki fark olarak tanımlanmaktadır. Aynı sitede net göç hızı, göç edebilecek her bin kişi için net göç sayısı şeklinde açıklanmıştır (Bakınız, TÜİK, İstatistiksel Veri Portalı).

SONUÇ

Türkiye doğal afetlerin sık yaşandığı bir coğrafyada yer almaktadır. Nitekim 1939'daki Erzincan ve 1999 tarihli Marmara depremleri başta olmak üzere son seksen yıllık sürede yaşanmış birçok deprem, çok sayıda canın yitirilmesine ve ağır ekonomik kayıpların ortaya çıkmasına neden olmuştur. Son olarak 6 Şubat 2023'de Kahramanmaraş'ta meydana gelen 7.8 ve 7.6 şiddetindeki depremler sadece bölge ekonomisini değil aynı zamanda ulusal ekonomi üzerinde de ağır kayıplara neden olmuştur. Yaşanan ekstrem depremler sonucu alt ve üst yapı çökmüş, yüzbinlerce bina yıkılmış ve nitelikli işgücü ve eğitim kaybı yaşanmıştır. Bunun yanında yörede turizm durmuş, tarım ve hayvancılık faaliyetleri büyük darbe almıştır. Bu araştırma çeşitli sosyo-ekonomik göstergeler üzerinden bölgede yaşanan depremlerin sosyal ve ekonomik kalkınmaya etkilerini değerlendirmeye çalışmıştır. Bölgede GSYH, dış ticaret, girişim sayısı ve turizm gibi göstergeler göz önünde bulundurulduğunda, ekonomik açıdan başat iki il olan Gaziantep ve Hatay'ın yaşanan depremden büyük kayba uğraması, depremin ekonomik maliyetlerini arttıracak en önemli unsurlar olarak görülmektedir. Bunun yanında Adıyaman, Kilis ve Osmaniye'nin bölgenin geri kalanından daha düşük bir sosyo-ekonomik yapı sergiledikleri



görülmüştür. Son dönemde bölgedeki tüm illerin net göç hızlarının negatif olduğu hesaba katılırsa, izleyen dönemde özellikle bu illerden sanayi yönünden gelişmiş batı illerine doğru göçün artması beklenebilir. Bölge ekonomisi içerisinde tarım ve hayvancılık sektörünün belirleyici bir rolü vardır. Bu sektörler bölgenin kırsal kalkınmasını destekleme yönünden önemli bir yere sahiptirler. Bilhassa bu sektörler açısından başat role sahip iki şehir olan Şanlıurfa ve Adana'da depremin diğer illere nazaran daha sınırlı yıkıma yol açması hem bölgesel hem de ulusal bazda daha fazla tarımsal ve hayvancılık kaybının ortaya çıkmasını engellemiştir.

Yaşanan depremler doğal afetler ile kalkınma arasındaki korelasyon ilişkisinin sınırlarını daha belirgin hale getirmiştir. Bu bağlamda gelecekte uygulanacak afet politikaları açısından ulusal ve kırsal kalkınmanın rolü çok önemlidir. Bu nedenle Türkiye'de afet yönetimi ile ulusal ve bölgesel (kırsal) kalkınma arasındaki organik bağın daha güçlü ele alınması, ileride yaşanabilecek afetlerin yıkıcılığının azaltılmasına önemli katkılar sağlayabilir.



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BUĞDAY TARIMINDA MUŞ EKOLOJİK KOŞULLARI AÇISINDAN BAZI SORULAR VE CEVAPLAR

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ÖZET

İnsan beslenmesinde günlük protein ve kalori ihtiyacının % 20'sini karşılayan buğday, yaklaşık 780 milyon ton yıllık üretimle, gıda güvenliği açısından dünya genelinde stratejik öneme sahiptir. Ülkemizde, ekim alanı ve üretim miktarının her ikisi yönünden, tarla bitkileri ve tahıllar içerisinde büyük bir paya sahip olan buğday, Muş ekolojik koşullarında yaygın olarak yetiştirilen önemli bir kültür bitkisidir. Çok farklı ekolojik koşullara uyum sağlamış olan buğday, ülkemizde genellikle yağışa dayalı koşullarda kışlık olarak yetiştirilir. Bu nedenle çimlenme ve çıkış, kardeşlenme, sapa kalkma, başaklanma, çiçeklenme ve tane dolum dönemlerinde çok sayıda biyotik ve abiyotik stres faktörlerine maruz kalır. Buğday, stres faktörlerinin olumsuz etkilerini ve yetiştirici hatalarını telafi etmede, büyük bir genetik ve fizyolojik yeteneğe sahiptir. Bu telafi yeteneğine rağmen bitki sağlığı olumsuz yönde etkilenebilir, verim ve kalitede çok büyük kayıplar söz konusu olabilir. Bitki sağlığı, verim ve kalitesine zarar veren olumsuz koşulların bir kısmı için önlem almak mümkün olmamakla beraber bir kısmı için mümkün olabilir. Bu nedenle buğday yetiştiricileri tarafından, yetiştirme sezonu süresince tarla gözlemleri yapılması, bitkinin ve ekolojik koşulların izlenmesi, sorunların doğru bir şekilde teşhisi, alınacak önlemler bakımından büyük önem taşımaktadır. Buğday verim ve kalitesi üzerinde etkili olan faktörlerle ilgili çok sayıda sorular sormak ve cevaplar vermek mümkündür. Ancak bu tebliğde yöre ekolojik koşulları açısından önemli olacağı düşünülen sınırlı sayıda soru ele alınmış ve yetiştiricilere yararlı olacağı düşünülen muhtemel cevaplar verilmiştir. Kışlık buğdayın vernalizasyon ihtiyacı çıkış öncesi geç sonbahar veya erken kış döneminde karşılanabilir mi, buğday bitkisi kar örtüsü ve dondurucu sıcaklıklar altında nasıl etkilenir, yeşil başak yerine beyaz başak oluşumunun muhtemel nedenleri neler olabilir gibi sorulara cevaplar verilmeye çalışılmıştır.

Anahtar Kelimeler: kışlık buğday, tarla gözlemleri, vernalizasyon, kış ve don zararı,



SOME QUESTIONS AND ANSWERS IN WHEAT FARMING FOR MUŞ ECOLOGICAL CONDITIONS

ABSTRACT

Wheat, supporting around 20% of daily protein and calorie requirement in human nutrition has a strategic importance with the production of 780 million tons in food security worldwide. Wheat has a great share in terms of both planting area and production in field crops and cereals in Turkey and it is an important cultural crop commonly grown in Muş ecological conditions. Wheat adapted to very different ecological conditions is grown as winter crop generally under rainfed conditions in Turkey. Therefore, it is exposed to many biotic and abiotic stress factors during germination and emergence, tillering, stem elongation, heading, anthesis and grain filling periods. Wheat has a great genetic and physiological ability to compensate the harmful effects of stress factors and wrong applications of growers. Despite this compensatory ability, plant health could be adversely affected and there could be very big losses in yield and quality. It may not be possible to take measurements for some negative conditions damaging to plant health, yield and quality, but it may be possible for some of them. For this reason, field observations, following up plant and ecological conditions, correctly diagnosing of problems by wheat growers have great importance for the measurements to be taken. It is possible to ask many questions and to give answers related to factors affecting wheat yield and quality. But in this presentation, limited questions thought to be important for Muş ecological conditions have been addressed and given possible answers to be useful for growers. It has been tried to give answers to questions such as whether vernalization requirement of winter wheat could be met before emergence in late fall or early winter season, how wheat plant could be affected under snow cover and freezing temperatures, what possible reasons could be about formation of white heads instead of green heads.

Keywords: winter wheat, field observations, vernalization, winter and freeze damage



1. GİRİŞ

Dünya genelinde mısır 1207 milyon ton, buğday 779 milyon ton ve çeltik 510 milyon ton yıllık üretimle (Anonymous, 2023), gıda güvenliği yönünden stratejik öneme sahip kültür bitkileridir. İnsan beslenmesinde günlük protein ve kalori ihtiyacının yaklaşık % 20'sini karşılayan buğday, üretim yönünden mısırdan sonra ikinci sırada yer almaktadır. Ülkemizde 2022 yılı rakamlarına göre yıllık toplam tahıl üretimi yaklaşık 37 milyon ton olup, bu üretim miktarı içerisinde buğday 19.5 milyon ton ile ilk sırada yer almaktadır. Buğday ekim alanı 2001 yılında 9.4 milyon hektar iken 2021 yılında 6.7 milyon hektara gerilemiştir (Anonim, 2023a). Bu gerilemeye rağmen, stratejik yönden olduğu gibi ekonomik yönden de büyük öneme sahip olan buğday, ülkemiz tarla tarımını karakterize eden düzeyde bir paya sahiptir. Muş ilinde 2021 yılı rakamlarına göre 1.6 milyon hektar alanda tarla tarımı yapılmış, 524 bin ton üretim gerçekleşmiştir. Bu üretim miktarı içerisinde buğday, yaklaşık 200 bin tonluk üretim miktarıyla şeker pancarından sonra ikinci sırada gelen bitkidir (Anonim, 2023b).

Buğday adaptasyon yeteneği çok yüksek bir kültür bitkisi olup, dünyada çok farklı ekolojik koşullara uyum sağlamıştır. Ülkemizde buğday tarımı daha çok yağışa dayalı koşullarda kışlık olarak yapılmakta, zaman zaman marjinal alanlara bile buğday ekimi yapılmaktadır. Bu nedenle yıllık yağış miktarı ve dağılımı buğday verimi, dolayısıyla üretim miktarı üzerinde çok etkili olmaktadır. Yağış miktarı ve dağılımındaki yıllara bağlı değişiklik, çok farklı iklim tiplerine sahip ülkemizde, yörelere göre de oldukça değişkenlik göstermektedir. Bu nedenle çimlenme ve çıkış, kardeşlenme, sapa kalkma, başaklanma, çiçeklenme ve tane dolum dönemlerinde çok sayıda biyotik ve abiyotik stres faktörlerine maruz kalabilmektedir.

Buğday genetik ve fizyolojik olarak, tarla bitkileri arasında stres faktörlerini ve yetiştirici hatalarını en iyi şekilde telafi edebilme yeteneğine sahip kültür bitkilerinden birisidir. Bitkinin bu yüksek telafi yeteneğine rağmen stres faktörlerinin şiddeti, süresi, etkili olduğu gelişme dönemi gibi faktörlere bağlı olarak değişmek üzere, verim ve kalite açısından çok büyük kayıplar söz konusu olabilmektedir.

Buğday yetiştiricilerinin, yetiştirme sezonu süresince tarla gözlemleri yapması, bitkiyi ve ekolojik koşulları iyi izlemesi, sorunları doğru bir şekilde teşhis etmesi, stres faktörlerinin tamamı için olmasa da bir kısmı için alınacak önlemler bakımından büyük önem taşımaktadır. Buğday verim ve kalitesini etkileyen biyotik ve abiyotik faktörlerle ilgili kuşkusuz çok sayıda sorular sorulabilir ve cevaplar verilebilir. Bu tebliğde yetiştiricilere yararlı olmak amacıyla, yöre ekolojik koşulları açısından önemli olduğu düşünülen, sınırlı sayıda soru ele alınmış ve muhtemel cevaplar verilme çalışılmıştır.



2. ÇIKIŞ OLMADAN VERNALİZASYON OLABİLİR Mİ?

Tohum genellikle % 12 ve daha az oranda nem içermekte olup, bu nem çözücü bir etki yapacak düzeyde değildir. Tohum su aldıkça dokulardaki şişme oranı önemli oranda artar. Kuru tohum içerisine su alımı çimlenme yönünden çok önemli ve çimlenmeyi başlatan temel olaydır. Su emme, tohumun kuru ve dormant bir halden kurtulup, embriyo büyümesinin başlamasında ilk anahtar olaydır. Giderek bir sıra dahilinde su emmesinin artması, enzim aktivasyonu, depo ürünlerinin parçalanması ve fide büyümesi başlar. Buğdayda çimlenme olayı, genellikle seminal köklerin ve ilk olarak primer kökün çıkışı ile başlar. Arkasından, mezokotil ve ilk yaprakları sarmakta olan koleoptil toprak yüzüne çıkıncaya kadar uzamasını sürdürür. Toprak yüzüne çıktıktan sonra koleoptil'in ucu açılır ve buğday fidesinin ilk yaprağı çıkış gösterir (Miralles ve Slafer, 2000).

Vernalizasyon, tek yıllık buğdaygillerin vejetatif dönemden generatif döneme geçmek için ihtiyaç duydukları soğuklanma ihtiyacıdır. Mutlak kışlık buğdaylarda, donma noktasına yakın düşük sıcaklıklara maruz kalma, hormonal ve bazı kimyasal değişikliklere (vernalizasyon) neden olur. Bu değişimler, ilkbaharda başaklanmanın başlayabilmesi için mutlak gereklidir. Oysa mutlak yazlık buğdaylar, bu değişikliklere yani vernalizasyona gerek duymadıklarından, ilkbaharda ekilip, aynı yıl içerisinde hasat edilebilirler (Akkaya, 1994).

Vernalizasyon sıcaklıkları 0 ile 15°C arasında değişmekle beraber, 3-10°C arasındaki sıcaklıklar en etkili sıcaklıklardır. Buğday genotipleri arasında vernalizasyon duyarlılığı yönünden büyük bir varyasyon vardır. Ayrıca vernalizasyon için buğdayın mutlaka çıkış yapmış olmasına ihtiyaç duyulmayıp, çimlenmenin başlamış olması yeterlidir. Tohumun çimlenmesi ise, tohum nem alınca başlar. Tohum çimlenmeye başladıktan sonra, toprak sıcaklığının 4-6 hafta kadar süreyle yaklaşık 10°C'nin altında olması durumunda vernalizasyon olayı gerçekleşebilir. Bu nedenle, çimlenme başladıktan sonra topraktan bitki çıkışı olmadan da vernalizasyon olayı meydana gelebilir. Düşük sıcaklık dönemi kesintiye uğrar ise vernalizasyon sürecinde geriye dönüşüm söz konusu olabilir. Devernalizasyon olarak adlandırılan bu olay, 20°C ve üzerindeki sıcaklıklarda, tarla koşullarında da meydana gelebilir. Normal zamanında ekilmiş kışlık buğdaylar, geç sonbahar ve erken kış dönemindeki düşük sıcaklık döneminde genellikle vernalize olurlar (Miralles ve Slafer, 2000).



3. KIŞ KOŞULLARI NASIL ETKİLİ OLUR?

Kışlık ekmeklik buğday çeşitleri kar örtüsüz -32 °C'lik kısa süreli düşük sıcaklıklara, kar örtüsü altında -40°C'lik sıcaklıklara dayanabilirken, makarnalık buğdayların çoğu -15 °C de önemli ölçüde zarar görebilirler (Kün, 1988). Kışa dayanıklı çeşitlerde kök tacı; -15°C'lik sıcaklığa 5-6 gün, -18°C'lik sıcaklığa 24 saat, -23°C'lik sıcaklığa ise ancak 12 saat dayanabilir (Gusta ve ark., 1982). Buğday kökleri, eksi 3-5°C'den daha düşük sıcaklıklarda ölmekle beraber, kök bölgesinde düşük sıcaklık zararı çok ender meydana gelir. Çünkü kökler toprak içerisinde olduklarından donmaya karşı korunmuş olurlar. Kışlık buğdayların kök tacı düşük sıcaklık nedeniyle öldüğü zaman bitki de tamamen ölmüş olur. Aksine kök tacı ölmedikçe, düşük sıcaklıklar yaprakları öldürmüş olsa bile, ilkbaharda yeniden büyüme mümkün olmaktadır (Fowler, 2018). Sağlıklı bitkilerde kök tacı yeşil ve kökler beyaz renkli iken, kök tacı soğuktan zarar gördüğünde yumuşak, kahverengimsi ve lapamsı bir görünüm kazanır. Kök tacının zarar gördüğü konusunda kuşkuya düşüldüğünde, topraktan dikkatlice sökülen bitkiler, saksıya alınarak, su verilir ve büyüme noktasının 2 cm kadar üzerinden kırılarak oda sıcaklığında beklemeye alınır. Kök tacının canlı olması durumunda, 3 gün içerisinde yeniden büyüme görülecektir (Klein, 1995).

Soğuğa dayanıklı kışlık buğdayın yaprakları eksi 12-18°C'lik sıcaklıklara kadar dayanabilir (Marcellos ve Burke, 1979). Yaşlı (olgunlaşmış) yapraklar, genç (gelişmekte olan) yapraklara göre soğuğa karşı daha duyarlıdır. Yapraklar daha düşük sıcaklıklara dayanıklı olmasına karşılık, daha hassas olan başakcıklar ve çiçekler -1.8 °C de zarar görebilir (Single ve Marcellos, 1974). Yaprak yüzeyindeki bazı buz aktif bakteriler (*Pseudomonas syringae*, *P.fluorescens* ve *Erwinia herbicola* gibi) buz kristallerinin oluşumunu teşvik etmekte, -3 °C de yapraklarda birkaç dakikada donma meydana gelebilmektedir. Bakterilerin olmadığı durumlarda ise, donma çok daha düşük sıcaklıklarda meydana gelmektedir (Lindlow, 1983).

Kıştan zarar gören bitkiler ilkbaharda yeşil rengini kaybeder, beyazımsı renk kazanırlar. Tarlanın sırt kısımlarında, çok alçak kısımlarında, kuzey yamaçlarında bu görünüm daha belirgin olur. Sonbahardaki kurak koşullar sekonder kök gelişmesini zayıflatarak, bitkileri düşük sıcaklık zararına karşı daha hassas hale getirir. Buğday bitkisi genetik yapısının bir özelliği olarak, don tehlikesi geçene kadar büyüme noktasını toprak yüzüne çıkarmaz. Buna rağmen sapa kalkma başladıktan sonra beklenmedik don zararı söz konusu olabilir. Tarlada genel olarak sarı renkli bir görünümün olması, boğum aralarında çökme ve renk kaybı, boğumlarda renk kaybı bitkilerin dondan zarar gördüğünün belirtileridir. Zarar görmeyen bitki ve sapsız büyümesini devam ettirerek, zarar gören bitki ve sapsızlardan daha fazla gelişir ve zarar gören kısımları örtebilirler. Bu nedenle bir tarlada bazı kısımlar



yeşil renkli ve sağlıklı olsalar bile bazı bitki kısımlarının sarı renkli olması durumunda bir zararın meydana geldiği düşünülmelidir. Sapa kalkma döneminde sağlıklı bir büyüme noktası veya başak taslağının, canlı ve beyazımsı bir görünümü vardır. Zarar gören başak taslağı ise etrafındaki dokulara yapışır, bu dokulardan kolayca ayrılamaz, renkleri beyazımsı kahverengiden giderek kahverengiye döner. Sapa kalkma döneminde don zararı ortaya çıkarsa, uzamakta olan boğum araları donabilir ve boş başak oluşumuna yol açabilir. Bu şekilde bir don zararını tespit edebilmek için, yaprak kını üst kısımdan alt kısma doğru geriye kıvrılarak açılıp, boğum araları birer birer kontrol edilmelidir. Zarar görmüş boğum arası ince, çökük ve bazen kahverengileşmiş durumdadır. Don meydana geldiği zaman boğum arasının hangi kısmı aktif bir şekilde büyüme gösteriyorsa, buna bağlı olarak zarar gören kısım boğum arasının altında, üstünde veya ortasında olabilir (Akkaya, 1994; Klein, 1995; Lollato, 2016). Gebecik veya başaklanma döneminin başında başakları etkileyecek şekilde bir don zararı olursa başağın tamamı, sadece üst kısmı, sadece alt kısmı, alt ve üst kısmı veya sadece orta kısmı olmak üzere değişik şekillerde etkilenme söz konusu olabilir. Don zararı zaman zaman, başağın uç kısmında boş ve beyazımsı bir yapının ortaya çıkmasına yol açan kuraklık zararıyla karıştırılabilir (Akkaya, 1994).

Bitkiler kışa dayanıklılık kazanmadan aniden kar yağması, daha sonra kar örtüsünün erimesi veya rüzgarla savrulması ve hemen arkasından öldürücü sıcaklıkların etkili olması durumunda, bitkiler kıştan büyük ölçüde zarar görürler. Don kabarması, buz altında boğulma, toprak suyu donmuş iken bitkinin soğuk ve kuru rüzgarlara maruz kalması gibi nedenler bitkilerin ölümüne yol açabilir. Buğday tohumları su alarak şişmiş durumda olursa, soğuk zararından etkilenerek çabucak ölürler. Ekim makinalarının ayaklarının penetrasyon derinlikleri veya tohumların üzerini örten toprak kalınlıkları yönünden söz konusu olabilen küçük farklılıklar, ekim derinliği bakımından önemli farklara yol açmakta, çıkışta ve kışa dayanıklılık kazanmada önemli farklar ortaya çıkmaktadır. Tarlada sadece bazı sıralarda, tarla başlarında veya traktör teker izlerinde kış ölümlerinin meydana gelmesi, diğer kısımlarda öyle bir etkinin olmaması, farklı ekim derinliği ve buna bağlı olarak farklı çıkış zamanı ile açıklanabilir. Yine tarla tesviyesinin bozuk olduğu durumlarda kıştan zarar görme bakımından tarlada farklılıklar ortaya çıkmaktadır. Bu nedenle, tarlanın mümkün olduğu ölçüde iyi bir tesviyeye sahip olması gerekir. Ayrıca kışa dayanıklılık ile toprak nemi arasında önemli ve olumsuz bir ilişki olduğundan, kurak topraklar kışlık buğdayların daha fazla dayanıklılık kazanması için uygun bir ortam oluşturur. Azot, genellikle kışlık buğdayın dayanıklılığını azaltırken, aşırı uygulanmamak koşuluyla fosfor ve potasyum kışa dayanıklılığı artırır. Aşırı büyümeye yol açan uygulamalar dayanıklılığı azaltırken, büyümeyi geciktiren uygulamalar dayanma yeteneğini artırır (Akkaya, 1994).



Kar örtüsü kışlık buğdayın kışa dayanıklılığı üzerinde çok önemli ve olumlu etkiye sahip olup, dış ortamdaki düşük sıcaklıkları engelleyerek topraktaki mevcut sıcaklığı koruyacak şekilde izolasyon görevi yapar. Hava sıcaklığı -34°C veya daha düşük olsa bile, 8-10 cm kalınlığındaki kar örtüsü koruyucu etki yaptığından, sıcaklık nadiren -11°C 'nin altına düşer ve kök tacı korunur (Fowler, 1983). Ancak yeterli kar örtüsü olmadığı zaman düşük sıcaklık zararı artacağı gibi, toprak nem kapasitesinde önemli düşümlere yol açar.

4. KAR KÜFÜ NASIL SORUN OLUR?

Kar küfü soğuk iklim bölgelerinde, kışlık buğdaygilleri ve tahılları etkileyen bir hastalıktır. Kar küfü hastalığı neden olan mantarların (*Typhula ishikariensis*, *Microdochium*, ve *Sclerotinia borealis* gibi) en önemli özelliği sıfırın altındaki sıcaklık derecelerinde bile etkili olmalarıdır (Shimoda ve ark., 2023). Kar küfü hastalığı, kar örtüsü altında buğday yapraklarına ve kök tacına zarar verir. Kar örtüsünün erimesinin ardından zarar görmüş kar küfü lekeli yapraklar toprağa çökmüş bir hal alırlar. *T. idahoensis* ve *T. İshikariensis* tarafından oluşturulan sclerotiumlar yuvarlağa yakın şekilli, kahverengimsi siyah renkli, *T. incarnata* sclerotiumları şekilsiz, kırmızımsı kahverengi ve kök üzerinde dada yoğundur. Kar küfü mantarı sclerotium halinde toprakta ve konukçu bitki artıklarında yaşar. Sclerotiumlar sonbaharda çimlenmesine ve hava kökenli sporlar üretmesine rağmen, enfeksiyonların çoğu kar altında topraktaki sclerotiumlardan kaynaklanan mantar hifleri vasıtasıyla olur. Kar yağışını takiben bir aylık süre içerisinde sclerotiumlar çimlenmeye ve enfeksiyon yapmaya başlar, kar örtüsü kaldıkça enfeksiyon devam eder. Kök tacının zarar görmesi ve bitki ölümleri ise kar örtüsünün 3. ayında söz konusu olur ve kar örtüsü süreci uzadıkça zarar şiddeti artar. Çok kalın kar örtüsü, zayıf ve aralıklı kar örtüsü, donmuş toprak hastalık şiddetini artırır (Murray ve ark., 1999). Kar örtüsü altındaki bitkinin fotosentez yeteneği azaldığından, karbonhidrat ve protein rezervlerinde azalma, dolayısıyla kar küfü mantarı enfeksiyonuna karşı yatkınlık söz konusu olur. Kar küfüyle mücadelede en etkin kültürel önlem olarak baklagillerle ekim nöbeti önerilmektedir (Frank ve ark., 2008).

5. BEYAZ BAŞAKLARIN MUHTEMEL NEDENLERİ NELERDİR?

Normal ve sağlıklı bir başak yeşil ve canlı bir görünüme sahiptir. Ancak çeşitli nedenlere bağlı olarak buğday tarlalarında solgun renkli veya beyaz renkli başaklara yaygın bir şekilde rastlamak mümkündür. Bu tip başaklarda beyaz renk saptan başlayabildiği gibi, sadece başak kısmında da söz konusu olabilir. Beyaz başağın muhtemel nedenleri aşağıda açıklanmaya çalışılmıştır (Akkaya, 1994; Anonim, 2023c; Babaroğlu ve ark., 2020; Klein, 1995; Lindsey ve Paul, 2016; Lollato, 2016; Sloderbeck ve ark., 2013; Wegulo, 2015).



Su toplanması ve basması olan alanlarda oksijen yetersizliğine bağlı olarak bitki ölümleri beyaz başak oluşumuna yol açabilir.

Kök tacının soğuktan zarar görmesi halinde bazı kardeşler başak oluştursa bile bu başaklar beyaz renkli olurlar. Başaklanma veya çiçeklenme dönemindeki don zararları beyaz başak oluşum nedenlerinden biridir. Don zararının etkili olduğu döneme bağlı olarak, başağın üst kısmı, alt kısmı veya her iki kısmı tane bağlamaz, anacak sap sağlıklı yeşil görünüşe sahip olabilir. Don zararı zaman zaman, başağın uç kısmında boş ve beyazımtırak bir yapının ortaya çıkmasına yol açan kuraklık zararıyla karıştırılabilir. Funguslara bağlı kök hastalıkları başağın renginin beyaz olmasına neden olabilir. Bu durumda başak çekildiğinde kolayca kopmaz. Bitki topraktan sökülüp kök kontrol edildiğinde kök sisteminin sağlıklı şekilde gelişmediği, sap dip kısmından uzunlamasına kesilip iç kısmına bakıldığında, normal renk yerine pembemsi renkte olduğu görülür. Başak yanıklık hastalığı (scab, *Fusarium head blight*), başağın tamamen veya kısmen beyaz renkli olmasına yol açar. Sap sağlıklı bir görünüme sahip olsa da genellikle başağın bazı kısımlarında, başakçıkların başağa bağlandığı noktalarda veya çiçeklerin içerisinde pembemsi kirli renkler bulunur. Başakçık kavuzları açılıp çiçekler kontrol edildiğinde, çiçeklerin öldüğü veya tane bağlamış olsalar bile beyaz renkli bir görünüşte olduğu görülür. Göçerten veya karabacak (take-all, etmeni *Gaeumannomyces graminis*) gibi mantari hastalıklar, şekil bozukluğuna yol açmadan başağın bir bütün olarak beyaz renkli olmasına ve bitki boyunun kısa kalmasına neden olur. Bu tür bitkiler başaktan tutup yukarı doğru çekildiğinde, başak kolaylıkla kopmaz. Aksine, toprak seviyesine yakın bir yerden çekildiğinde bitki kolaylıkla kopar. Bitki sapının dip kısmından yaprak kını soyulup sap incelendiğinde, rengin parlak siyah veya koyu kahve olduğu görülür.

Ergin süneler başaklar henüz yaprak kını içerisindeyken, çiçek döneminde ve tane bağlarken, saplarda beslenerek başakların beyazımsı bir renk almalarına, kurumalarına ve tane bağlamasına engel olurlar.

Kışlamış erginlerin bu şekildeki zararına akbaşak adı verilmektedir

Buğday sap kurdu (Wheat Stem Maggot, *Meromyza americana*), başağın hemen altından üst boğuma yakın yerden sapın içerisine girerek zarar yapabilir ve başağın beyaz renkli olmasına yol açabilir. Bu tip zarar görmüş bitkilerde başaklar yukarı doğru yavaşça çekildiğine başak kolaylıkla kopar. Sap dikkatlice incelendiğinde sap kurdu tarafından zarar gören yer tespit edilebilir. Bayrak yaprak ve bitki halen yeşil olmasına rağmen, üst boğum arası ve başak beyaz renklidir.

SONUÇ

Muş ekolojik koşullarında kış mevsimi uzun sürmekte, kar örtüsü kalınlık ve süreklilik yönünden yıllar arasında ve yıl içerisinde çok değişkenlik gösterebilmektedir. Uzun kış koşulları, değişken kar örtüsü ve sıcaklık buğday bitkisi üzerinde baskı oluşturmakta, beklenmeyen verim ve kalite kayıplarına yol



açabilmektedir. Bu nedenle yörede buğday tarımıyla uğraşan yetiştiricilerin, yöre ekolojik koşulları açısından kritik olan sorunlar hakkında bilgi sahibi olmaları yararlı olacaktır. Yörede etili olan faktörlerden bazıları için yetiştirici düzeyinde önlem almak mümkün olmasa bile ekim nöbeti, ekim sıklığı, derinliği ve zamanı, uygun çeşit, gübreleme gibi konularda verilecek kararlarla, bitkilerin kışı olabildiğince sağlıklı bir şekilde atlatabilmesine çalışmak gerekir.



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ÇAVDAR ÜRETİMİNİN ÖNEMİ

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ÖZET

Türkiye’de 1960 yılında, çavdarın ekim alanı 670000 hektar, üretim miktarı 700000 ton iken, 2020 yılında 104365 hektara ve 295681 tona gerilemiştir. İnsan beslenmesinde günlük protein ve kalori ihtiyacının % 20’sini karşılayan buğday, yaklaşık 780 milyon ton yıllık üretimle, gıda güvenliği açısından dünya genelinde stratejik öneme sahiptir. Ülkemizde, ekim alanı ve üretim miktarı yönünden, tarla bitkileri ve tahıllar içerisinde büyük bir paya sahip olan buğday, genellikle yağışa dayalı koşullarda kışlık olarak yetiştirilir. Telafi yeteneği çok yüksek olmasına rağmen, çok sayıda biyotik ve abiyotik stres faktörlerine maruz kalan buğdayın, verim ve kalitesinde büyük kayıplar söz konusu olabilmektedir. Bu nedenle, buğday tarımı yönünden sınırlayıcı koşullara sahip marjinal alanlarda, çavdar üretimi daha iyi bir alternatif olacaktır. Çavdar, küresel ısınmaya bağlı ekstrem iklim koşulları açısından da uygun bir seçim olacaktır. Kuvvetli bir kök sistemine sahip olan çavdar kuraklığa karşı en dayanıklı tahıl bitkisidir. Toprak nemini kullanma yeteneği çok güçlü olduğu için birim kuru madde miktarı başına buğdaydan % 20-30 daha az su tüketir. Kurağa dayanıklılık yanında kışa dayanıklılık yönünden genetik ve fizyolojik olarak güçlü bir yeteneğe sahiptir. Erozyona açık, kumlu, hafif bünyeli topraklarda bile yetişebilir, kuvvetli kök sistemi sayesinde toprağın organik madde içeriğinin artmasına yardımcı olur. Yabancı otlarla çok iyi rekabet eden çavdar, buğdayda etkili olan hastalık ve zararlılara karşı da dayanıklıdır. Bu tarımsal özelliklerine ilaveten insan sağlığı üzerindeki olumlu etkileri nedeniyle, çavdar esaslı ürünler giderek artan oranlarda marketlerde yer almaktadır. Çavdar nişastasası daha büyük moleküllere sahip olduğu için sindirim sisteminde daha uzun sürede parçalanmakta ve glukoz seviyesindeki ani artışı engellemektedir. Çavdar esaslı ürünler, LDL seviyesini ve LDL/HDL oranını düşürür, çözünemeyen lif fraksiyonlarından dolayı bağırsak fonksiyonlarını iyileştirir. Buğday unu esaslı ürünlere kıyasla, çavdar esaslı gıda ürünleri daha hızlı tokluk hissi yaratır. Özetlenen yararlar, çavdar tarımına gereken önemin verilmesinin ve marjinal koşullarda buğday tarımı yerine ikame edilmesinin uygun olacağını göstermektedir.

Anahtar Kelimeler: Çavdar, kurağa, kışa, hastalık ve zararlılara dayanma, sağlık yararları.



IMPORTANCE OF RYE PRODUCTION

ABSTRACT

In Turkey, the planting area and production of rye have decreased to 104365 hectares and 295681 tons in 2020, while it was 670000 hectares and 700000 tons in 1960. Wheat, supporting 20% of daily protein and calorie requirement in human nutrition, has a strategic importance with the production of 780 million tons in food security worldwide. Wheat with a great share in field crops and cereals in terms of planting area and production is grown as winter crop generally under rainfed conditions in Turkey. Despite its great compensatory ability, there could be big losses in yield and quality of wheat exposed to biotic and abiotic stress factors. Therefore, rye production would be a better alternative in marginal areas with limiting conditions for wheat cultivation. Rye would also be a suitable choice in terms of extreme climatic conditions due to global warming. Rye with a strong root system is the most resistant cereal crop to drought. It consumes 20-30 % less water than wheat per unit dry matter, since it has strong ability in utilization of soil moisture. In addition to its drought resistant, it has a genetically and physiologically strong ability in winter hardiness. It can grow even in sandy, light textured soils open to erosion and can help to increase soil organic matter thanks to strong root system. Rye, competing very well with weeds, is also resistant to diseases and pests effective in wheat. In addition to these agricultural traits, rye-based products are increasingly available in the markets due to its positive effects on human health. Since rye starch has larger molecules, it is broken down in a longer time in the digestive system and prevents the sudden increase in glucose level. Rye based products decrease LDL level and LDL/HDL ratio and improve bowel functioning due to the presence of insoluble fraction of fiber. Rye based food products enhance satiety rate as compared to wheat flour based product. Summarized benefits indicate that it would be appropriate to give the necessary importance to rye farming and to replace instead of wheat farming in marginal conditions.

Keywords: rye, resistance to drought, winter, diseases and pests, health benefits.



1. GİRİŞ

Dünya genelinde mısır 1207 milyon ton, buğday 779 milyon ton ve çeltik 510 milyon ton yıllık üretimle (Anonymous, 2023), gıda güvenliği yönünden stratejik öneme sahip kültür bitkileridir. İnsan beslenmesinde günlük protein ve kalori ihtiyacının yaklaşık % 20'sini karşılayan buğday, üretim yönünden mısırdan sonra ikinci sırada yer almaktadır. Ülkemizde 2022 yılı rakamlarına göre, yıllık toplam tahıl üretimi yaklaşık 37 milyon ton olup, bu üretim miktarı içerisinde buğday 19.5 milyon tonla ilk sırada yer almaktadır. Buğday ekim alanı 2001 yılında 9.4 milyon hektar iken, 2021 yılında 6.7 milyon hektara gerilemiştir (Anonim, 2023a). Bu gerilemeye rağmen, stratejik yönden olduğu gibi ekonomik yönden de önemini koruyan buğday, ülkemiz tarla tarımını karakterize eden düzeyde bir paya sahiptir. Muş ilinde 2021 yılı rakamlarına göre 1.6 milyon hektar alanda tarla tarımı yapılmış, 524 bin ton üretim gerçekleşmiştir. Bu üretim miktarı içerisinde buğday, yaklaşık 200 bin ton ile şeker pancarından sonra ikinci sırada gelmektedir (Anonim, 2023b).

Ülkemizde buğday tarımı daha çok yağışa dayalı koşullarda kışlık olarak yapılmakta, marjinal alanlara bile buğday ekilmektedir. Yıllık yağış miktarı ve dağılımı yanında, sınırlayıcı diğer koşullar etkili olmakta, buğdayın verim ve kalitesinde büyük kayıplar söz konusu olabilmektedir. Bu nedenle, buğday tarımı yönünden sınırlayıcı koşullara sahip marjinal alanlarda, çavdar üretimi daha iyi bir alternatif olacaktır. Çavdar, küresel ısınmaya bağlı ekstrem iklim koşulları açısından da daha uygun bir seçim olacaktır. Agronomik üstünlükleri yanında çavdar esaslı gıda ürünleri, bazı sağlık özellikleri yönünden de aranan niteliklere sahiptir.

Türkiye'de 1960 yılında çavdar ekim alanı 670000 hektar ve üretimi 700000 ton iken, 2020 yılında ekim alanı 104365 hektara, üretim 295681 tona gerilemiştir (Anonim, 2022). Bu rakamlardan görüldüğü gibi, son 60 yıllık süreçte, çavdar tarımında önemli bir gerileme olmuştur. Günümüzde küresel ısınmaya bağlı iklim koşulları ve tüketici tercihindeki yeni arayışlar, çavdar tarımı açısından yeni fırsatları, hatta mecburiyetleri beraberinde getirmektedir. Bu nedenle çavdar tarımına gereken önemin verilmesi ve marjinal koşullarda buğday tarımı yerine ikame edilmesi daha uygun olacaktır.

2. TÜRKİYE ÇAVDAR EKİM, ÜRETİM ve VERİM DURUMU

Çavdarın ana vatanı Türkiye olmasına ve günümüzden yaklaşık 6000 yıl önce kültüre alınmasına rağmen, ülkemizde yeterli düzeyde çavdar üretimi söz konusu değildir. Rusya, Polonya, Almanya, Ukrayna ve Belarus'da çavdar tarımı yaygın olup, dünya üretiminin % 75'inden fazlasını gerçekleştirirler (Kottmann, 2015).

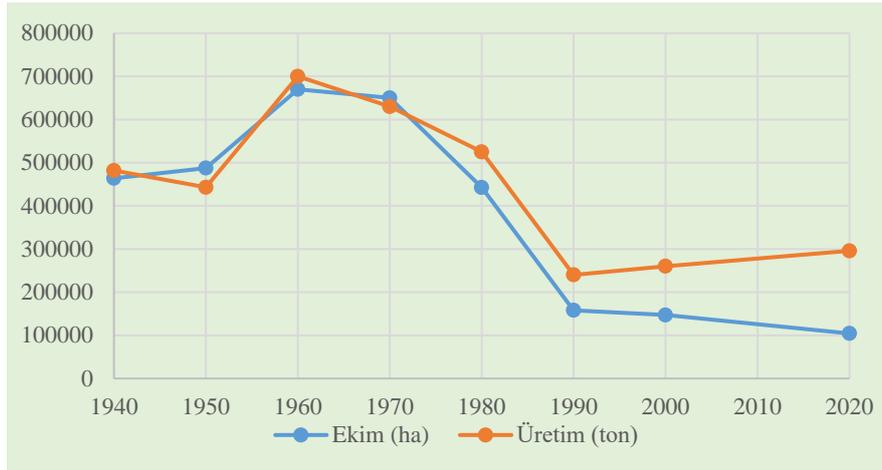
Yıllara göre Türkiye çavdar ekim alanı, üretim miktarı ve dekara verim rakamları Tablo 1'de verilmiştir. İlgili tablodan görüleceği gibi, 1940 yılında ekim alanı 463808 hektar iken, 20 yıllık süreçte artarak, 1960 yılında 670000 hektar ile en yüksek değere ulaşmıştır. Ancak bundan sonra, çavdar ekim



alanlarında giderek bir azalma olmuş ve 2020 yılında 104365 hektara kadar düşmüştür. Benzer bir süreç üretim miktarı açısından da söz konusudur. 1940 yılında 481854 ton olan üretim, 1960 yılında 700000 tonluk üretimle en yüksek miktara ulaşmış, bu yıldan sonra azalma sürecine girerek, 2020 yılında 295681 tona gerilemiştir (Anonim, 2022). Özet olarak son 60 yıllık süreçte çavdar ekim alanı ve üretiminde önemli düzeyde gerileme olmuştur (Resim 1).

Tablo 1. Yıllara göre çavdar ekim alanı, üretim miktarı ve verimi

Yıllar	Ekim alanı (ha)	Üretim (ton)	Verim (kg/da)
1940	463808	481854	104
1950	487536	442879	91
1960	670000	700000	104
1970	650000	630000	97
1980	442500	525000	119
1990	158000	240000	152
2000	147000	260000	177
2020	104365	295681	284



Şekil 1. Yıllara göre çavdar ekim alanı ve üretim miktarındaki değişim durumu

Dekara çavdar verimi, 1940 yılı ile 1980 yılı arasında 100 kg civarında seyretmiş, 2000 yılında 177 kg'a, 2022 yılında 284 kg'a ulaşmıştır. Birim alan veriminde artış sağlanmış olmakla beraber, bu artış ekim alanındaki azalmaya bağlı üretim miktarını telafi edememiş, çavdarın yıllık üretim miktarı 300000 tonun altına düşmüştür. Geçmiş yıllarda çavdar ekim alanının fazla olması yanında, buğday tarımı yapılan tarlalarda bile yoğun olarak çavdar bulunmasına müsaade edilmiştir. Çavdar buğday ile beraber hasat edilip, mahlut isimli ürün olarak tüketilmiştir.

Biyçeşitlilik giderek azalmış, insan ve hayvan beslenmesinde kullanılan kültür bitkileri giderek sınırlı sayıya düşmüştür. Geçmiş yıllarda yetiştiricilerin kendi tohumlarını kullanma mecburiyeti ve alışkanlığı, genetik farklılığın korunmasında çok önemli rol oynamıştır. Yüksek verimli yeni çeşitlerin



ıslahı, yetiştirme tekniklerindeki gelişmeler, üretim ve pazar tercihleri, ekonomik koşullar gibi nedenler buğday üretimini artırırken çavdar üretiminde azalmaya neden olmuştur. Yüksek verimli koşullar için ıslah edilen yeni buğday çeşitleri, marjinal alanlar ve ekstrem koşullar için uygun değildir. Küresel ısınmaya bağlı iklim değişikliğinin buğday tarımını riske sokması, tüketici tercihlerindeki yeni arayışlar çavdar tarımı için yeni fırsatlar yaratmaya başlamıştır.

3. ÇAVDARIN AGRONOMİK PERFORMANSI

Kuru tarımda üretimi sınırlandıran en önemli faktör kuraklıktır. Bitki fotosentez, solunum, antioksidan ve hormon metabolizması gibi fizyolojik olaylarda ayarlama yaparak kurak koşullara dayanmaya çalışır. Çavdar çok kuvvetli bir kök sistemine sahip olup, kök kuru ağırlığı buğday ve tritikaleden daha yüksektir (Sheng ve Hunt, 1991). Sadece toprak nemine bağlı koşullarda arpa, buğday ve tritikaleye göre çavdardaki verim kaybı daha düşük olmaktadır (Schittenhelm ve ark., 2014). Tahıllar içerisinde kuraklığa karşı en dayanıklı olup, kuvvetli bir kök sistemi sayesinde vejetasyon döneminde toprak nemini en iyi bir şekilde kullanma yeteneğine sahiptir. Birim kuru madde miktarı başına buğdaydan % 20-30 daha az su tüketir. Buğday, yulaf ve arpanın birkaç cm büyüebildiği veya tutunamadığı arazilerde, çavdar 1 metre veya daha yükseklikte bir büyüme gösterebilme yeteneğine sahiptir. Diploid çeşitler tetraploid çeşitlere kıyasla kurağa daha dayanıklıdır (Anonymous, 2018). Sonbahar, ilkbahar ve yaz döneminde toprak neminden daha iyi yararlanır, olgunlaşması erken olduğundan geç dönem kuraklıktan korunabilir, diğer tahılların yetişemediği kurak toprak koşullarında bile yetişebilir (McLelland, 2016). Orta ve verimli topraklarda buğdaya göre düşük verimli olmakla beraber, hafif bünyeli, düşük verimli ve zayıf drenajlı topraklarda buğdaydan daha verimlidir. Bu nedenle diğer tahılların yetiştirilemediği marjinal alanlar için çok uygun bir bitkidir.

İklim değişikliğine bağlı olarak ortaya çıkan sonbahar kuraklığı, düzensiz kar yağışları ve zayıf kar örtüleri, kışlık bitkiler üzerindeki kış ve don zararı risklerini artırmaktadır. Öte yandan aşırı kar örtüsü altında bazı patojenlerin zarar oranı artabilmektedir. Çavdarın buğdaya göre kışa daha dayanıklı olduğu için, örneğin Finlandiya'nın kuzey bölgelerinde çavdar ekimi daha yaygın durumdadır (Peltonen-Sainio ve ark., 2011). Kışlık bitkilerde değişik miktarlarda antifriz proteinleri mevcut olup, büyümeyi geriletici ve hücreler arası boşlukta buz kristali oluşumunu engelleyici etki yaparlar. Düşük sıcaklıklar çavdarda antifriz protein aktivitesini teşvik edici etki yapar. Düşük sıcaklıklara ve kısa günlere karşı gösterilen tepkiye bağlı olarak antifriz proteinlerinde birikme olur. Soğuğa dayanıklı çavdar tipleri bazı morfolojik ve biyolojik özelliklere sahiptir. Mikroselüler yapılı, kısa ve dar yapraklı rozet tipine, yatık gelişme tabiatı, kalın dış epidermis duvarı ve kısa mezokotil, derinde kardeşlenme boğumuna sahiplerdir. Sonbaharda yavaş büyüme özelliği gösterirler ve hücre özsularındaki kuru madde oranı yüksektir (Anonymous, 2018). Kışlık çavdar düşük sıcaklık zararından korunmak için



kütin, suberin ve mum gibi hücresel maddeler salgılar. Ayrıca oligosakkaridler ve kitin kışlık çavdarın soğuğa dayanmasında önemli rol oynarlar (Kong ve ark., 2020).

Çavdar tane verimi yönünden pek etkin olmadığından, buğday, arpa ve yulaftan daha düşük hasat indeksine sahiptir. Ancak vejetatif aksam verimi bakımından çok önde gelen bir bitkidir (Blount ve ark., 2013). Diğer tahıllara göre düşük tohum miktarı ve azotlu gübreleme düzeyinde, çavdarın optimum verim düzeyini koruması mümkündür (Noland, 2022). Çavdarın kardeşlenme yeteneği çok yüksek olduğundan ekim sıklığını telafi etme bakımından yüksek bir yeteneğe sahiptir. Kuvvetli kök sistemi vasıtasıyla toprağın organik madde içeriğinin artmasına yardımcı olur. Yabancı otlarla rekabet etme bakımından üstün bir yeteneğe sahiptir. Hastalık döngüsünün kırılması bakımından ekim nöbetinde çok uygun bitkidir. İlkbaharda ekildiğinde yaz ve sonbahar döneminde otlakiye olarak kullanılabilir. Sapları diğer tahıl saplarına göre daha geç parçalanma özelliğine sahip olup, toprağı erozyona karşı koruduğu gibi Sonbaharda çimlenmesi ve tarlayı örtmesi toprak erozyonun önlenmesi bakımından büyük yarar sağlar. Organik üretimde örtü bitkisi olarak kullanılabilir (McLelland, 2016). Çavdar, buğdaydaki hastalık ve zararlılara karşı dayanıklılık ıslahında kullanılan önemli bir gen kaynağı olup, istenilen karakterlerin çoğu çavdarın 1R kromozomu üzerindedir. Kahverengi pas (leaf rust, *Puccinia triticina*), sarı pas (yellow rust, *Puccinia striiformis*), kara pas (stem rust, *Puccinia graminis*) ve külleme (powdery mildew, *Blumeria graminis*) gibi hastalıklara karşı buğdayın dayanıklılığı artırmada çavdar gen kaynağı olarak kullanılmaktadır. Örneğin Petkus isimli çavdar çeşidinin 1R kromozomu, hastalıklara dayanıklılık çalışmalarında 1960 yılından beri yoğun olarak kullanılmıştır. Çavdar hastalık genleri yanında, afidler (*Schizaphis graminum*, *Diuraphis noxia*, *Rhopalosiphum padi*, *Sitobion avenae*), buğday kesik sineği (*Mayetiola destructor*), nematodlar (*Heterodera avenae*, *Heterodera filipjevi*), akarlar (*Aceria tosichell*) gibi buğday için önemli olan zararlılara karşı da dayanıklılık genlerine sahiptir (Crespo-Herrera ve ark., 2017).

Buğday ve arpaya kıyasla toprak asitliğine daha dayanıklı olan çavdar, toprak tuzluluğuna karşı arpaya benzer bir tolerans gösterir. Erken gelişme dönemleri geç gelişme dönemlerine göre, sap verimi tane verimine göre, başak ağırlığı başak sayısına göre tuzluluğa daha hassastır. Buğday, çavdar ve yulafa kıyasla arpa su baskınlarına karşı daha toleranslıdır. (Anonymous, 2018). Çavdar ayrıca 3R, 4R ve 6R kromozomları sayesinde asitli ve alüminyumlu topraklara karşı toleranslı bir bitkidir (Crespo-Herrera ve ark., 2017). Ülkemizde tahıl yetiştiriciliğinde verimi ve insan beslenmesi yönünden kaliteyi düşüren önemli sorunlarından birisi topraktaki elverişli çinko miktarı düşüklüğüdür. Çinko bakımından fakir olan topraklarda bile çavdarın sap ve tane verimi, tritikale, ekmeklik ve makarnalık buğdaya göre daha yüksek bulunmuştur (Çakmak ve ark., 1997).



4. ÇAVDARIN SAĞLIK YÖNÜ

Dünya genelinde günlük diyetinde tahıllar önemli bir enerji ve lif kaynağıdır. Özellikle tam tahıl taneleri lif yönünden oldukça zengindir. Ülkemizde buğdaya dayalı ürünler beslenmede temel ürün olma özelliğini halen korumaktadır. Ancak, günümüzde tüketici tercihlerinde tahılların sağlık üzerindeki etkileri etkili olmakta, çavdar esaslı ürünler de giderek artan oranlarda marketlerde yer almaktadır.

Tahıllar arasında en yüksek lif oranına sahip olan çavdar tanesinde, lif tanenin her tarafına dağılmış olup, çavdar endospermi buğday endosperminden daha fazla lif içerir (Andersson ve ark., 2009). Çavdar diyet lifi olarak arabinoxylan, selüloz, β -glukan, fruktan ve lignin içerir. Lif içeriği ve arabinoxylan çözünürlüğü çavdarda buğdaydan daha yüksektir. Çavdarda en bol bulunan lif arabinoxylan olup (tane kuru ağırlığının % 6-12'si), tanenin endosperm, aleron, perikarp/testa gibi çeşitli kısımlarında farklı oranlarda bulunur (Glitso ve ark., 1999). Arabinoxylanın fonksiyonel karakteristiği tanenin çeşitli öğütme fraksiyonlarına göre değişir. Örneğin suda çözünürlük endospermde % 70 iken, aleron ve perikarp/testada hemen hemen sıfır düzeyindedir (Wood, 2010). Çözülebilir diyet lifi ve fruktanlar, kalın bağırsakta kolay şekilde fermente olan maddeler oluşturur ve bağırsak bakımından yararlı etkiler yapar (Holscher, 2017; Vuholm ve ark., 2017). Çözünemeyen lif fraksiyonlarına sahip olduğu için bağırsak fonksiyonlarını iyileştirici özelliğe sahiptir (Jonsson ve ark., 2018).

İnsülin, glukozu düzenleyen asıl hormon olup, vücuttaki hücrelerin glukoz alım ve kullanımını sağlar. İnsüline az miktarda ihtiyaç duyulması yararlı bir durumdur. Çünkü yüksek insülin tepkisi, yemekten hemen sonra kan şekerinin düşmesine, hatta açlık düzeyinin altına düşmesine neden olabilir. Bu durum vücutta ani stres reaksiyonu doğurur ve açlık hissini tetikleyebilir. Sürekli yüksek insülin tepkisi ve kan şekerindeki büyük iniş ve çıkışlar kronik hastalıkların gelişmesini artırabilir (Black, 2006). Çavdar ekmeğinin, buğday esaslı ürünlere kıyasla, aynı miktar elverişli karbonhidrat sağlamasına rağmen, insülin ihtiyacını azalttığı ortaya konulmuştur (Hartvigsen ve ark., 2014; Rosen ve ark., 2009). Çavdar ekmeği tüketiminin insülin metabolizması üzerindeki olumlu etkisi, yemekten hemen sonrasında sınırlı kalmamakta, izleyen öğünde de devam etmektedir. Akşam yemeğinde, rafine buğday unuyla yapılan ekmeğin yerine, tam çavdar ekmeği veya kaynatılmış tam çavdar tanesi tüketildiğinde, yararlı etkiler ertesi gün de devam etmektedir. Sabah kahvaltısından sonra kandaki glukoz ve insülin seviyelerinin, açığa çıkan yağ asidi miktarının daha düşük olduğu tespit edilmiş ve buna 'ikinci öğün etkisi' adı verilmiştir (Ibrugger ve ark., 2014). Çavdar nişastası daha büyük molekül olduğu için sindirim sisteminde daha uzun sürede parçalanır. Buna bağlı olarak glukoz seviyesinin ani olarak artmasını engelleyici yönde etki yapar (Hartvigsen ve ark., 2014). Aynı miktarda karbonhidrat olmak üzere çavdar ekmeği ve beyaz buğday ekmeği tüketiminden sonra, glukoz konsantrasyonu her ikisinde aynı



olurken, serum insülin seviyesinin çavdar ekmeğinde daha düşük olduğu ortaya konmuş, sebebi açıklanamamıştır. Çavdarın insülin ihtiyacını azaltma özelliğine “çavdar faktörü” adı verilmiştir (Jonsson ve ark., 2018). Fermente olmamış çavdar gevreği, maya ile fermente olan çavdar gevreğine kıyasla, insülini düşürmede daha güçlü etki göstermiştir (Johansson ve ark., 2015).

Amino asit dengesi yönünden çavdar buğdaydan daha yararlı bir içeriğe sahiptir (Arendt ve Zannini, 2013). Çavdar tanesi riboflavin, tokoferol, thiamin, B6, folat, niasin ve kolin gibi vitaminler yanında potasyum, magnezyum, kalsiyum, çinko ve demir gibi mineraller bakımından zengin olup, antioksidan potansiyeline sahip biyoaktif bileşikler içerir (Kaur ve ark., 2021). Çavdar ürünlerindeki lif içerik ve kompozisyonunun (Johansson ve ark., 2018), çavdar ekmeğindeki serotinin benzer maddelerin tokluk hissini artırdığı ileri sürülmektedir (Bondia-Pons ve ark., 2011; Lankinen ve ark., 2011). Rafine buğday ekmeğine kıyasla tam çavdar lapası ve ekmeği tokluk hissini artırmakta, açlık hissi ve yeme isteğini azaltmaktadır (Isaksson ve ark., 2012; Johansson ve ark., 2015; Lee ve ark., 2016). Ayrıca, çavdar esaslı ürünlerin daha düşük vücut ağırlığına neden olduğu belirtilmiştir (Suhr ve ark., 2017). Buğday ve çavdar ekmeğinin kolesterol seviyesi üzerindeki etkilerinin karşılaştırıldığı bir çalışmada, çavdar ekmeğinin kolesterol seviyesini % 8 oranında düşürdüğü, düşük yoğunluklu lipit seviyesini önemli oranda azalttığı tespit edilmiştir (Leinonen ve ark., 2000). Başka bir çalışmada buğdaya göre, çavdar esaslı ürünlerin LDL seviyesini ve LDL/HDL oranını düşürdüğü sonucuna varılmıştır (Larke ve ark., 2008).

5. SONUÇ

Çavdarın ana vatanı olan Anadolu’da geçmişte çavdar üretimi daha fazla iken, günümüzde oldukça düşük düzeye inmiş, marjinal alanlarda bile buğday üretimi yapılır duruma gelmiştir. Oysa çavdar kurağa, kışa, hastalık ve zararlılara dayanma, yabancı otlarla rekabet, erozyona karşı toprağı koruma gibi çeşitli tarımsal özellikler yönünden buğdaydan üstün bir performansa sahiptir. Tarımsal özellikleri yanında, sağlık yönünden de olumlu etkileri söz konusudur. Bu nedenle, küresel ısınmaya bağlı ekstrem iklim olaylarının buğday üretimini tehdit ettiği marjinal koşullarda, çavdar tarımına öncelik verilmesi yerinde bir tercih olacaktır.



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ETIOLOGY, DIAGNOSIS AND TREATMENT OF UTERINE CYSTS IN MARES

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ABSTRACT

Carboxymethyl cellulose is a non-toxic anionic polysaccharide having more water solubility and low viscosity and hence may act as a novel non-penetrating cryoprotectant. Adding Carboxymethyl cellulose as supplement can increase viscosity of extender and may also preserve sperm energy by arresting motility during cooling and equilibration steps prior to freezing. Trehalose is an oligosaccharide, unlike glucose or fructose, cannot pass through plasma membrane and act as an extracellular cryoprotectant. This study was designed to evaluate the protective effects of both CMC and trehalose as cryoprotectant on ram semen extender during freeze-thawing process. Carboxymethyl cellulose in single concentration of 0.25% (w/v) and trehalose in different concentration (50, 75, 100 mM) added in tris-citric acid-glycerol extender before freezing. After semen collected from four qezel rams, samples were randomly divided in to four groups. Group 1, was the control without adding any supplements. In group 2, semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 50 mM trehalose. In group 3, semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose. Finally, in last group semen was placed in a diluent containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose. Sperm parameters (sperm motility and vitality), DNA fragmentation, plasma membrane integrity (PMI) and intracellular reactive oxygen species (ROS) were examined in all groups. The results showed that the addition of 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose improved sperm motility and vitality and plasma membrane integrity. Furthermore, sperm DNA fragmentation in group containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose was significantly lower in comparison to other experimental groups. Moreover, adding of 0.25% (w/v) Carboxymethyl cellulose and 75 mM trehalose had a tendency to decrease ROS generation compared to the other groups. In conclusion, adding exact concentrations of CMC and trehalose improved sperm parameters and plasma membrane integrity and decreased ROS generation after freeze-thawing process in ram spermatozoa. Therefore, both of them recommended as cryoprotectant.

Keywords: Carboxymethyl cellulose, trehalose, cryoprotectant, extender, ram spermatozoa



1. Introduction

Cryopreservation of mammalian sperm is a complicated technique that requires a proper balance of many factors to achieve optimal outcomes. Ram sperm is extremely vulnerable to temperature changes during freeze-thawing procedure. This has been attributed to the high amount of polyunsaturated fatty acids in their plasma membrane and insufficient level of cytoplasmic antioxidants that render sperm cells sensitive to lipid peroxidation (LPO) in presence of reactive oxygen species (ROS) (Allai et al., 2018). Cryopreservation leads to ice formation, cold shock, chemical effects induced by cryoprotectants, osmotic injury, oxidative injury, and apoptosis, finally damaging the structure and physiological function of spermatozoa (Lv et al., 2019). Furthermore, excessive production of ROS by inducing biochemical and structural alterations including ATP depletion and DNA fragmentation impairs motility, viability, and fertilizing capacity of spermatozoa (Topraggaleh et al., 2014). Various compounds have been added to extenders to enhance freezability of ram semen (Moce et al., 2010). Various monosaccharides and disaccharides have improved quality of frozen-thawed semen (Quan et al. 2012; Panyaboriban et al. 2015). Cryoprotectants are substances that reduce both the size and quantum of ice crystals formed during cryopreservation of sperm and thus reduces ice crystal-mediated damage to plasma membrane. Permeating cryoprotectants such as glycerol, polyethylene glycol and DMSO act, in part, by entering the sperm and displacing intracellular water and thus cause cellular dehydration. They also bind to intracellular water and prevent intracellular ice formation, which can damage the sperm (Amann and Pickett, 1987; Sieme et al., 2016). On the other hand, the non-permeating cryoprotectants such as disaccharides (sucrose, trehalose), polysaccharides (Ficol, dextran, methyl cellulose) and polyaminoacids (Poly-L-lysine) etc. act extracellularly as solutes and reduce freezing temperature of extender and thus reduces extracellular ice formation (Aisen et al., 2002; Ntemka et al., 2018). Carboxymethyl cellulose is a non-toxic anionic polysaccharide having more water solubility and low viscosity and hence may act as a novel non-penetrating cryoprotectant. In addition, by increasing viscosity of extender it may also assist in preserving sperm energy by arresting motility during cooling and equilibration steps prior to freezing. Moreover, in this study trehalose administered to the extender as an extracellular cryoprotectant because it cannot pass through plasma membrane (Quan et al., 2012). the glass transition temperature of trehalose (-30 °C) is much higher than that of other traditional cryoprotectants, such as ethylene glycol (-85 °C) and glycerol (-65 °C) (Pereira and Marques, 2008). Therefore, trehalose may contribute to extracellular vitrification formation and reduce ice crystal production. In addition, the cryoprotective roles of trehalose may be associated with its antioxidant activity. In Nili-Ravi buffaloes, trehalose was found to improve the activities of antioxidant enzymes in post-thaw semen (Iqbal et al., 2016). Recent studies demonstrated



that adding antioxidants to extenders before freeze-thawing process can protect spermatozoa from the deleterious effects of cryopreservation. The oxidative chain reaction is broken by antioxidants. Also, these agents reduce the oxidative stress. Supplementation of antioxidants in extenders have been shown to have a positive effect in cryopreservation of bull, goat, ram, canine, boar, and human semen quality. After thawing antioxidants improved the quality of semen parameters, integrity of plasma membrane and motility of sperm (Kumar and Mahmood, 2001).

2. MATERIALS AND METHODS

The present study was conducted in Animal Sciences Department facilities of the Faculty of Agriculture at Urmia University, Urmia, Iran. The housing area for the sheep was near the Department facilities and the male and female Qezel sheep (five rams and two ewes) were housed at this location.

2.1. Study design

Ethical considerations for animal usage and experiments were based on regulations of the urmia university animal ethics committee. Samples were randomly divided in to 4 groups each as follow:

- 1- Control group: Without adding any supplements during freeze-thawing process.
- 2- CMC 0.25% (w/v), Trehalose 50 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 50 mM trehalose.
- 3- CMC 0.25% (w/v), Trehalose 75 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 75 mM trehalose.
- 4- CMC 0.25% (w/v), Trehalose 100 mM: Semen was placed in a diluent containing 0.25% (w/v) carboxymethyl cellulose and 100 mM trehalose.

2.2. Extender preparation

Experimental extenders were prepared by using buffer of Tris-citric acid (pH 7.0, osmotic pressure 320 mOsmol Kg⁻¹. Glycerol 5%, fructose 0.2% weight/volume and egg yolk 20% volume/volume were added to the extender. Streptomycin-penicillin combination (1000 µg/ml, 1000 unit/ml) was used as antibiotics in extender. CMC at the single dose of 0.25% (w/v) and Trehalose at the rate of 50, 75,100 mM simultaneously were used to make experimental extenders. The extender without CMC and Trehalose supplementation was kept as control.

2.3. Chemicals and reagents

The carboxymethyl cellulose (CMC, Sigma-Aldrich, USA; Cat. No. C5678) and trehalose (Trehalose, Sigma-Aldrich, USA, Cat. No. 1673715) were purchased from Sigma Company. Furthermore, other materials used in this study was from Merck or Sigma-Aldrich Companies.



2.4. Collection of semen

With use of an artificial vagina (IMV, France), semen samples were obtained from the rams in the presence of an estrous ewe, two times in a week during autumn and winter seasons. After collection, ejaculates were immersed in a water bath (37 °C) until evaluation. An equal volume of semen sample from the different rams was pooled, if the sperm of the sample had a mass motility estimate of greater than 3, progressive motility greater than 70% and concentrations greater than 3×10^9 per mL. The prepared pooled sample from each day when semen collections occurred was used in the present study.

2.5. Semen cryopreservation

Samples of each experimental group were placed in 0.25 mL French straws (Minitube, Germany), sealed with polyvinyl alcohol and there was a cooling of samples from 37 to 4 °C within 3.5 to 4 hours (slow cooling). The straws were subsequently maintained at a refrigerated temperature (4 °C) for an additional 2 hours. Straws were placed horizontally on a cold rack and floated 4 cm above the surface of the liquid nitrogen in a styrofoam container for 15 min, and were subsequently plunged into the liquid nitrogen for storage. The depth of the liquid nitrogen was about 25 cm at beginning of the freezing period. The size of the freezing vessel was 55 (length) \times 32 (width) \times 45 (height). To evaluate the variables, there was thawing of straws individually in a water bath at 37 °C for 2 min (Evans and Maxwell, 1987), 1 week after freezing.

2.6. Sperm membrane integrity

Sperm plasma membrane integrity (PMI) was measured by hypoosmotic swelling test (Lu et al., 2018). Briefly, 10 μ L of semen sample was diluted with 100 μ L hypo-osmotic solution (100 mOsm/L; 4.9 g/L sodium citrate and 9.0 g/L fructose) and then incubated at 37 °C for 30 min. After the incubation period, at least 200 sperm per simple was counted and classified under 400X magnification with contrast field microscopy. Percentage of sperm with characteristic swollen-coiled tail (having intact plasma membrane) was recorded.

2.7. DNA fragmentation

DNA fragmentation was assessed by TdT-mediated dUTP Nick-end labeling (TUNEL) assay kit (Beyotime, China), following the manufacturer's instruction. Briefly, sperm samples were centrifuged and washed twice with PBS, and then spread onto poly-lysine coated glass slides. After treatment with Triton X-100, the slides were immediately incubated with the TUNEL mixture at 37 °C for 60 min and fragmented DNA was fluorescently labeled. Subsequently, slides were mounted using antifade mountant with DAPI (Beyotime, China). A total of 500 randomly selected sperm per sample was counted and analyzed using fluorescent microscopy, the percentages of sperm exhibiting green fluorescence were considered as DNA fragmentation index (DFI).



2.8. Sperm motility and vitality

Assessments of sperm motility were performed via the CASAs for all samples. Semen (a drop) was put on a warm glass slide (37 °C) and then put cover slip on it. Visual motility percentage was evaluated microscopically at 400X.

2.9. Intracellular reactive oxygen species (ROS)

Dichlorofluorescein diacetate (DCFH-DA, Beyotime, China) was used to determine intracellular ROS generation according to its characteristic of being oxidized by ROS to produce fluorescent compound dichlorofluorescein. Specifically, a total of 10×10^6 cells/mL semen sample suspension was treated with 10 μ M DCFH-DA and incubated in darkness (30 min, 37 °C). Following centrifugation and resuspension procedures, the fluorescence intensity of analyzed sample was immediately measured using the fluorescence spectrometer at excitation wavelength (488 nm) and emission wavelength (525 nm).

2.10. Statistical analyses

Data were expressed as mean \pm SD and analyzed for statistical significance by one-way ANOVA and Bonferroni's multiple comparison test using SPSS 15.0. $P < 0.05$ was considered statistically significant.

3. RESULTS

The aim of this study was evaluate the effect of single dose of CMC with varying concentrations of trehalose supplements adding simultaneously on extender as cryoprotectant before freeze-thawing process in ram spermatozoa. Both CMC and trehalose act as extracellular cryoprotectant. In our study, attempts were made by replacing some part of glycerol with other non-permeating cryoprotectant to minimize the toxic effects of glycerol and improve post-thaw recovery of ram sperm. The effects of carboxymethyl cellulose and trehalose addition on the frozen–thawed sperm motility and vitality were analyzed and the results were listed in Table 1. The motility and vitality of sperm after freeze–thaw was significantly reduced compared with the fresh samples. Supplementation with 0.25% CMC and 75 mM trehalose significantly improved the motility and vitality, in comparison to the control group without CMC and trehalose addition ($P < 0.05$). In addition, 0.25% CMC with 50 mM trehalose and 0.25% CMC with 100 mM trehalose also had a certain improvement in sperm vitality (significant difference was found in 0.25% CMC with 100 mM trehalose group, $P < 0.05$), but did not show significant effects on motility.



Table 1. Effect of carboxymethyl cellulose and trehalose addition concentration on sperm parameters after cryopreservation.

Groups (CMC + trehalose addition)	Sperm vitality	Sperm motility	
		Progressive motility	Total motility
Pre-freeze-thawing process analysis	81.7 ± 3.9	39.9 ± 3.1	67.9 ± 4.4
Control	59.4 ± 3.8b	27.9± 2.5bc	42.7 ±3.1bc
CMC+ trehalose 50mM	62.2 ± 3.8 ab	28.9 ± 2.5ac	44.5 ±2.7ac
CMC+ trehalose 75mM	64.9 ± 4.1a	30.6 ± 2.6a	46.4 ± 2.7a
CMC+ trehalose 100mM	63.7 ± 3.1a	28.9 ± 2.1ab	44.3 ±2.4ab

The average values for a series of experiments are given, a-c means in the same column with no common superscript differ significantly ($p < 0.05$). The values are expressed as mean ± SD.

The effect of adding CMC and trehalose on percentage plasma membrane integrity (PMI) of cryopreserved qezel ram semen is presented in figure 1. Our investigation demonstrated that sperm PMI was improved by supplementation of CMC simultaneously with trehalose in comparison to control group. In the group that supplementations are in dosage of 0.25% CMC with 75 mM trehalose, sperm PMI was significantly higher compared to other concentrations of these supplements.

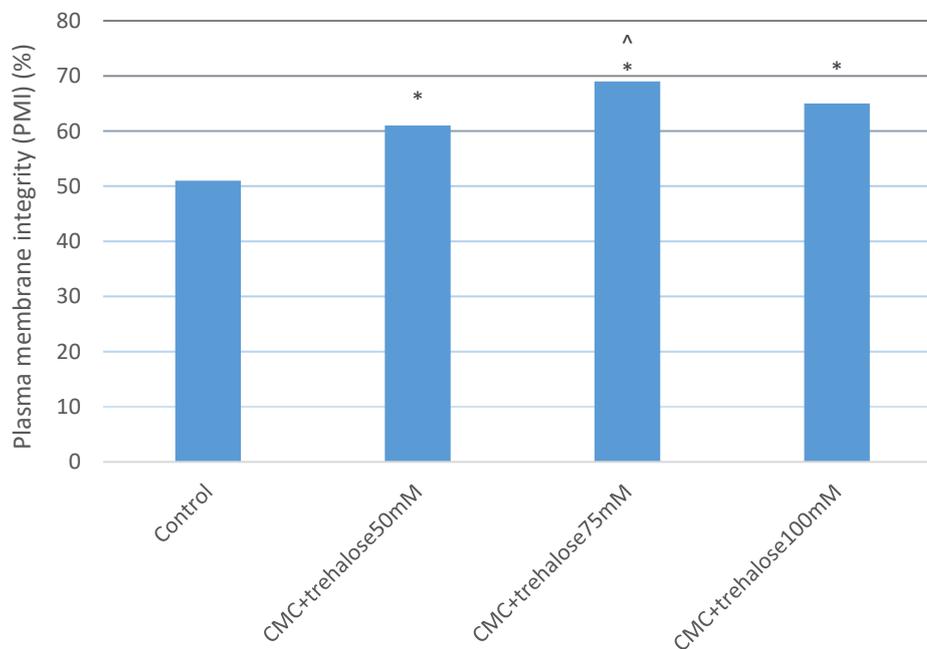


Figure 1. Effect of CMC and trehalose addition concentration on plasma membrane integrity (PMI) after cryopreservation.



Role of CMC and trehalose addition to extender on plasma membrane integrity (Mean \pm SE) of qezel ram semen after cryopreservation. * shows improvement in PMI percentage regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant improvement in PMI percentage on exact concentration of 0.25% CMC with 75 mM trehalose in comparison to other experimental groups.

The effect of adding CMC and trehalose on DNA fragmentation index (DFI) of cryopreserved qezel ram semen is presented in figure 2. Adding CMC with trehalose to ram extender before freeze-thawing process can reduce DNA fragmentation index in comparison to control group. Sperm DNA fragmentation in group containing 0.25% (w/v) Carboxymethyl cellulose and 100 mM trehalose was significantly lower in comparison to other experimental groups. In addition, figure 3 shows that addition of CMC and trehalose had a tendency to decrease ROS generation compared to control group. There was significant reduction in ROS generation when added 0.25% CMC with 75 mM trehalose in comparison to other groups.

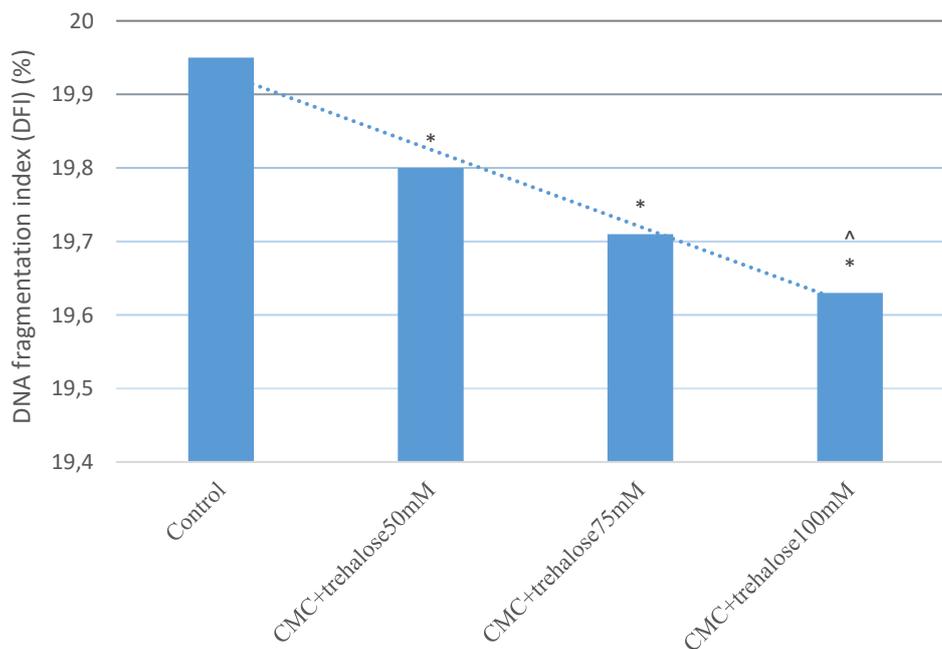


Figure 2. Effect of CMC and trehalose addition concentration on DNA fragmentation index (DFI) after cryopreservation.

Role of CMC and trehalose addition to extender on DNA fragmentation index (DFI) (Mean \pm SE) of qezel ram semen after cryopreservation. * shows reduction in DNA fragmentation index percentage regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant



reduction in DFI percentage on exact concentration of 0.25% CMC with 100 mM trehalose in comparison to other experimental groups.

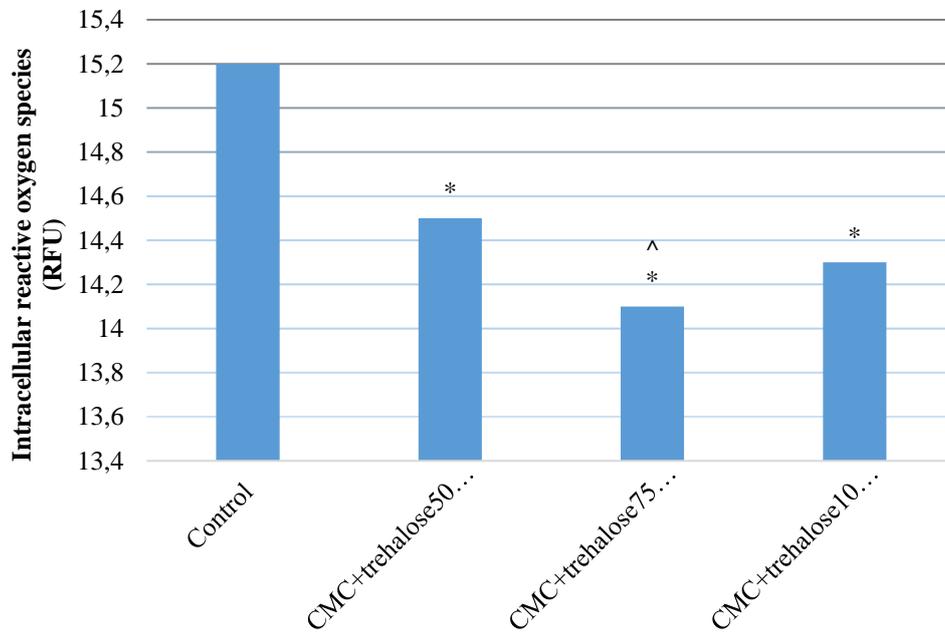


Figure 3. Effect of CMC and trehalose addition concentration on intracellular reactive oxygen species (ROS) after cryopreservation.

Role of CMC and trehalose addition to extender on intracellular reactive oxygen species (ROS) (Mean \pm SE) of qezel ram semen after cryopreservation. * shows reduction in ROS generation regarding to CMC and trehalose adding on extender compared to control group. ^ shows significant decrease in ROS generation on exact concentration of 0.25% CMC with 75 mM trehalose in comparison to other experimental groups.

4. CONCLUSION

Mammalian spermatozoa are extremely sensitive to cryoinjuries induced by the freezing and thawing processes. As an efficient cryoprotectant, trehalose has been extensively studied in cryopreservation of stock semen. Most of investigations have confirmed the positive effects of trehalose on spermatozoa during cryopreservation (Aboagla and Terada, 2003; Bucak et al., 2021). The combination of glycerol with other non-permeating and non-toxic cryoprotectants such as disaccharides, polysaccharides, polyamino acids (carboxylated ϵ -poly-L-lysine) etc was reported to result in higher post-thaw sperm recovery than glycerol alone (Aisen et al., 2002; Ntemka et al., 2018; Tariq et al., 2020). Presence of



polysaccharides increases the glass transition temperature of extender (Oldenhof et al., 2013) and thus protects sperm membrane during freezing. Carboxymethyl cellulose (CMC), a derivative of cellulose, is a low viscous and non-toxic anionic polysaccharide containing carboxymethyl groups that render enhanced water solubility. In conclusion, adding exact concentrations of CMC and trehalose to tris-citric acid-glycerol extender improved sperm parameters and plasma membrane integrity and decreased DNA fragmentation and ROS generation after freeze-thawing process in ram spermatozoa. Therefore, both of them recommended as cryoprotectant. In future investigations, by adding non-permeating cryoprotectants we can evaluate the protective effect of these cryoprptectants against reducing glycerol concentration from 5% to 4% regarding to control and decrease the adverce effect of glycerol on ram semen during freeze-thawing process.

Declaration of competing interest

There is no competing interest.



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FARKLI SIRA ARASI MESAFELERİN NOHUT MÜRDÜMÜĞÜ'NÜN (*Lathyrus cicera* L.) TOHUM VERİMİ VE BAZI VERİM KOMPONENTLERİNE ETKİSİ

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ÖZET

Dengeli ve yeterli beslenmenin temel unsurlarından olan hayvansal proteine erişim tüm insanlar için önemli bir ihtiyaçtır. Bu ihtiyacın karşılanabilmesi ise hayvanlarımızın dengeli ve yeterli beslenebilmesine bağlıdır. Hayvanların gereksinim duyduğu kaliteli kaba yem, çayır ve meralar ve yem bitkileri tarımı ile karşılanabilmektedir. Yeterli çeşitlilikte ve üstün özelliklere sahip bitkilerin üretimde kullanılması yem temininde yaşanan sorunları çözmek için katkı sağlayabilir. Çoğunlukla kültürü yapılan türlerin yanında, yaygın olarak yetiştirilmeyen fakat sahip oldukları önemli özellikleri sayesinde tarıma ve hayvanların beslenmesine önemli katkıları olabilecek türler üzerinde yapılan çalışmaların artması bu açığın kapatılmasına yardımcı olabilir. Nohut mürdümüğü (*Lathyrus cicera* L.) ülkemizde doğada yaygın bir şekilde yetişen, Mürdümük (*Lathyrus*) cinsine ait önemli türlerden bir tanesidir. İnsan beslenmesinde de kullanılabilmesine karşın ağırlıklı olarak hayvan beslenmesinde değerlendirilir. Soğuğa ve kurağa dayanıklıdır. Bu çalışmada bitkilerin verimlilik ve devamlılığı için önemli bir faktör olan sıra arası mesafenin nohut mürdümüğünün tohum verimi ve unsurları üzerindeki etkisinin ortaya konulması amaçlanmıştır. Araştırma Ankara Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü deneme tarlasında ICARDA'dan temin edilen iki farklı nohut mürdümüğü hattında sıra arası mesafenin tohum verimi ve bazı verim unsurları üzerine etkisini gözlemlemek amacıyla yürütülmüştür. 3 farklı sıra arası mesafe kullanılmıştır. Çalışmada baklalar sararıp alt yapraklar kurduktan sonra hasat edilen bitkilerde tohum verimi (kg/da), 1000 tane ağırlığı (g), bakla sayısı, bakla boyu (cm), bakla eni (cm), baklada tane sayısına ait gözlem ve ölçümler yapılmıştır. İhtiyaç oldukça toprak tarla kapasitesine ulaşıncaya kadar parsellere eşit miktarda sulama yapılmıştır. Deneme tesadüf bloklarında bölünmüş parseller deneme desenine göre 3 tekrarlamalı olarak yürütülmüştür. Ana parsellere faktör olarak "sıra arası mesafe" (20-30-40 cm), alt parsellere ise "mürdümük hatları" (809,814) yerleştirilmiştir. Elde edilen değerler MSTAT-C programı kullanılarak analiz edilmiş ve karşılaştırmalar Duncan çoklu karşılaştırma testi ile yapılmıştır. Çalışmadan elde edilen sonuçlara göre incelenen özelliklerden bakla boyu bakımından 2 farklı nohut mürdümüğü arasındaki fark %5 düzeyinde önemli bulunmuştur.

Anahtar Kelimeler: Verim, Baklagil, Yem



THE EFFECT OF DIFFERENT SOWING DENSITIES ON SEED YIELD AND SOME YIELD COMPONENTS OF *Lathyrus cicera* L.

ABSTRACT

Access to animal protein, which is one of the basic elements of a balanced and adequate diet, is an important need for all people. relieving this need depends on the balanced and adequate nutrition of our animals. The quality of roughage required by animals can be relieved by meadows and pastures and forage crops agriculture. The use of plants with sufficient variety and superior characteristics in production can contribute to solving the problems in feed supply. In addition to the mostly cultivated species, the increase in studies on species that are not widely cultivated but can contribute significantly to agriculture and animal nutrition thanks to their important characteristics can help to close this gap. *Lathyrus cicera* L. is one of the important species of *Lathyrus* genus, which is widely grown in nature in our country. Although it can be used in human nutrition, it is mainly used in animal nutrition. It is resistant to cold and drought. In this study, it is aimed to reveal the effect of sowing densities, which is an important factor for the productivity and continuity of plants, on the seed yield and components of *Lathyrus cicera* L. The research was carried out in order to observe the effect of sowing densities on seed yield and some yield components in two different *Lathyrus cicera* L. lines obtained from ICARDA in the experimental field of Ankara University, Faculty of Agriculture, Field Crops Department. Three different sowing densities were used. In the study, observations and measurements of seed yield (kg/da), 1000 seed weight (g), number of pods, pod length (cm), pod width (cm), number of seeds per pod were made in the harvested plants after the pods turned yellow and the lower leaves dried. Equal amount of irrigation was applied to the plots until the soil reached the field capacity as needed. The experiment was carried out in randomized blocks according to the split plot design with 3 replications. "Sowing densities" (20-30-40 cm) was placed as a factor in the main plots, and "*Lathyrus cicera* L. lines" (809,814) were placed in the sub-plots. Obtained values were analyzed using MSTAT-C program and comparisons were made with Duncan multiple comparison test. According to the results obtained from the study, the difference between 2 different *Lathyrus cicera* L. was found to be significant at the level of 5% in terms of pod length, which is one of the characteristics examined.

Keywords: Yield, legume, forage



1. GİRİŞ

Lathyrus cinsi, insan gıdası, hayvan yemi, yeşil gübre, süs bitkisi, ilaç gibi çeşitli amaçlarla yetiştirilen yaklaşık 160 türü bünyesinde barındıran geniş bir cinstir. Çok çeşitli kullanım alanlarının yanında protein içeriği bakımından da önemli bir yere sahiptir. (Llorent ve ark. 2017) Baklagillerden elde edilen protein hem hayvan yemi endüstrisinde hem de doğrudan hayvan beslemede önemli ve gereklidir. Tüm hayvanlar için gereken aminoasitlerin tamamını içeren bitki yoktur. Bu nedenle çeşitli bitki kaynakları bu amaç için kullanılabilirler. *Lathyrus* türleri de bunlara dahildir. Yaygın mürdümük (*Lathyrus sativus* L.) ve nohut mürdümüğü (*Lathyrus cicera* L.) gibi türler ince yapılı ve nötr topraklarda önemli bir potansiyele sahiptir. Bu iki tür ile hayvan besleme uzun bir geçmişe sahiptir ve hala dünyanın bazı bölgelerinde uygulanmaktadır. Nohut mürdümüğü daha marjinal şartlarda ürün yetiştirme sistemleri için iyi bir seçenek olarak düşünülebilir. (Hanbury ve ark. 2000) Bu türlerin olumlu özelliklerinin yanında bazı sorunları da mevcuttur. Nohut mürdümüğü ve diğer mürdümük türlerinde beslenme üzerine olumsuz etkileri olan bazı maddeler bulunmaktadır. Bunlardan en yaygın olanı bir nörotoksin olan ve Latirizm adı verilen, felce yol açan 3-(-N-oxaly)-1-2,3-diamino propionic acid (ODAP) adlı maddedir. Bu madde en fazla bitkinin tohumlarında bulunur. Son bitki ıslahı çalışmalarıyla daha düşük ODAP'lı çeşitler geliştirilmiştir. (White ve ark. 2002) Bir *L. cicera* çeşidi "Chalus", 1998 yılında CLIMA aracılığıyla ticari olarak piyasaya sürülmüştür. (Hanbury ve Siddique, 2000) Chalus'un test edilen birçok diğer *Lathyrus* türü ile karşılaştırıldığında daha yüksek verimli ve düşük ODAP seviyesine (%0.09) sahip olduğu bildirilmiştir. (White ve ark.2002) Güncel hayvan besleme çalışmaları *L. cicera* ve *L. sativus*'un düşük ODAP'lı hatlarının güvenli bir şekilde rasyona dahil edilebileceğini göstermektedir. (Yan ve ark. 2006) Sıra arası mesafe ve bitki sıklığı uygulamaları elde edilecek ürünün miktar ve kalitesini etkileyen faktörlerdendir. Çalışmada farklı sıra arası mesafelerin 2 nohut mürdümüğü hattında tohum verimi ve bazı verim unsurlarına etkisi gözlemlenmiştir.

2. MATERYAL VE YÖNTEM

Araştırma bir tarla denemesi olarak planlanıp Ankara Üniversitesi Ziraat Fakültesi deneme tarlalarında yürütülmüştür. Materyal olarak kullanılan tohumlar ICARDA'dan temin edilmiştir. İki nohut mürdümüğü hattı kullanılmıştır. (809,814) Üç farklı sıra arası mesafe uygulanmıştır. İlkbaharda kenar tesiri dikkate alınarak ekim yapılmıştır. Yabancı ot mücadelesi elle yapılmıştır. İhtiyaç duyulduğunda toprak tarla kapasitesine ulaşıncaya kadar eşit şekilde sulama yapılmıştır. Bitkiler, baklalar sararıp alt yapraklar kuruduktan sonra hasat edilmiştir. Deneme tesadüf bloklarında bölünmüş parseller deneme desenine göre 3 tekrarlamalı olarak yürütülmüştür. Ana parsellere faktör olarak "sıra arası mesafe"



(20-30-40 cm), alt parsellere ise “mürdümük hatları” (809,814) yerleştirilmiştir. Elde edilen değerler MSTAT-C programı kullanılarak analiz edilmiş ve karşılaştırmalar Duncan çoklu karşılaştırma testi ile yapılmıştır.

Çizelge 1. Araştırma yerine ait iklim verileri (Anonim 2017)

Aylar	Ort Sıcaklık (°C)		Yağış (mm)		Nispi Nem (%)	
	Araştırma yılı	Uzun yıllar	Araştırma yılı	Uzun yıllar	Araştırma yılı	Uzun yıllar
Mart	5.7	4	60.6	40.2	68.7	77.5
Nisan	13.3	9.7	14.8	47	46.2	76.8
Mayıs	13.6	14.2	30.6	46.6	63.4	73.8
Haziran	20.1	18.5	16.6	31.4	48.6	70.7
Temmuz	23	22.2	0.6	16.4	40	64.1

3. BULGULAR VE TARTIŞMA

Sıra arası mesafenin tohum verimine etkisine baktığımızda en yüksek tohum verimi 814 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir. En düşük tohum verimi 814 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Çizelge 2. Sıra arası mesafenin tohum verimine etkisi

Hatlar	Tohum Verimi (kg/da)				
	Sıra arası mesafe	20	30	40	Ort
809		70.167	72.667	35	59.278
814		59.167	75.333	30	55.111
Ort		64.667	74	32.917	

Çizelge 3. Sıra arası mesafenin 1000 tane ağırlığına etkisi

Hatlar	1000 tane ağırlığı (g)				
	Sıra arası mesafe	20	30	40	Ort
809		77.267	78.9	72.967	76.378
814		78.817	84.433	78.25	80.5
Ort		78.042	81.667	75.608	



1000 tane ağırlığında en yüksek değerler 84.43 g ile 814 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir. En düşük değerler 72.96 ile 809 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Çizelge 4. Sıra arası mesafenin bakla sayısına etkisi

Hatlar	Sıra arası mesafe	Bakla Sayısı			Ort
		20	30	40	
809		9.667	11.333	6.533	9.178
814		7.467	7.933	7.733	7.711
Ort		8.567	9.633	7.133	

Bakla sayıları bakımından en yüksek değerler 809 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir. En düşük değerler yine 809 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Çizelge 5. Sıra arası mesafenin bakla boyuna etkisi

Hatlar	Sıra arası mesafe	Bakla Boyu (cm)			Ort
		20	30	40	
809		3.333	3.3	3.1	3.244
814		3.533	3.3	3.233	3.356
Ort		3.433a	3.3ab	3.167b	

Bakla boyu bakımından sıra arası mesafeler %5 düzeyinde önemli bulunmuştur. En yüksek bakla boyu 814 numaralı hatta 20 cm sıra arası mesafeden elde edilirken en düşük bakla boyu 809 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Çizelge 6. Sıra arası mesafenin bakla enine etkisi

Hatlar	Sıra arası mesafe	Bakla Eni (cm)			Ort
		20	30	40	
809		0.833	0.8	0.767	0.8
814		0.833	0.767	0.8	0.8
Ort		0.833	0.783	0.783	

Bakla eni değerlerinde en yüksek sonuçlar 809 ve 814 numaralı hatlarda 20 cm sıra arası mesafeden elde edilirken en düşük değerler 809 ve 814 numaralı hatlarda 30 ve 40 cm sıra arası mesafelerden elde edilmiştir.



Çizelge 7. Sıra arası mesafenin baklada tane sayısına etkisi

Hatlar	Baklada Tane Sayısı				
	Sıra arası mesafe	20	30	40	Ort
809		4.267	4	3.867	4.044
814		4.2	4.267	4.067	4.178
Ort		4.233	4.133	3.967	

Baklada tane sayısı en yüksek 809 ve 814 numaralı hatlarda 20 ve 30 cm sıra arası mesafeden, en düşük değerler ise 809 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Sonuçların geneli dikkate alındığında en yüksek değerler 30 cm sıra arası mesafeden elde edilirken en düşük değerler 40 cm sıra arası mesafeden elde edilmiştir. Eyüpoğlu ve ark.(1999) Nohut bitkisinde yaptıkları çalışmada 35 cm sıra arası mesafeden en iyi değerleri elde etmişlerdir. Mekanizasyona uygunluğu ile hastalık ve zararlılarla mücadelenin daha kolay olması gibi nedenlerle mümkün olduğunca, verimi etkilemeyecek düzeyde geniş sıra arası mesafenin önerilebileceğini belirtmişlerdir. Sert ve Ceylan (2012), börülcede yaptıkları çalışmada 50, 60 ve 70 cm sıra arası mesafede deneme yürütmüş ve en iyi sonuçları 50 cm sıra arası mesafe uygulamasından elde etmişlerdir. Kökten ve Bakoğlu (2011), Elazığ şartlarında yürüttükleri denemede 20, 30 ve 40 cm sıra arası mesafelerde yaygın mürdümüğün tohum ve verimi ve verim unsurlarına etkisini inceledikleri çalışmalarında en yüksek değerleri 30 cm sıra arası mesafeden elde etmişlerdir.

4. SONUÇ

Kıraç şartlarda yetiştiricilik yapılan bölgelerde çok yıllık yem bitkilerinden yonca ve korunganın yanında tek yıllık yem bitkilerinden fiğ'e ek olarak nohut mürdümüğünün yetiştirilme olanaklarının araştırılması ve sağlanması kaba yem açığını kapatmaya yardımcı olacağı gibi aynı zamanda tane yem yönünden de yem bitkisi çeşidini artıracaktır. (Kendir 2000) Nohut mürdümüğü Güney Avrupa'da yem bitkisi ve yeşil gübre bitkisi olarak yetiştirilmektedir. Ülkemizde ise sınırlı alanlarda yaygın mürdümük, otu ve taneleri için yetiştirilmektedir. Çoğunlukla kültürü yapılan türlerin yanında yaygın olarak yetiştirilmeyen fakat sahip oldukları önemli özellikleri sayesinde tarıma ve hayvanların beslenmesine önemli katkıları olabilecek türler üzerinde yapılan çalışmaların artması bu açığın kapatılmasına yardımcı olabilir.



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FARKLI EKİM SIKLIKLARININ YAYGIN MÜRDÜMÜK'TE (*Lathyrus sativus* L.) OT VERİMİ VE BAZI BİTKİSEL ÖZELLİKLERE ETKİSİ

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ÖZET

Yaygın mürdümük (*Lathyrus sativus* L.) hayvan beslenmesinde büyük öneme sahip, besin değeri yüksek ve yem açığının kapatılmasına katkı sağlayabilecek değerli bir baklagil yem bitkisidir. Mürdümük (*Lathyrus*) cinsi içinde en fazla kültürü yapılan türdür. Kuraklığa, erken dönemde su altında kalmaya, elverişsiz toprak koşullarına dayanan, insan beslenmesinde de kullanılabilen bir türdür. Pek çok kültür bitkisinin yetiştiği koşullarda rahatlıkla yetişebilmesi ve pestisit uygulaması ve gübrelemeye ihtiyaç duymaması, çeşitli stres faktörlerine dayanımı bu türü baklagil ıslahı bakımından önemli bir kaynak haline getirmektedir. Bu çalışmada bitkilerin verimliliği ve sürekliliği için önemli olan sıra arası mesafenin yaygın mürdümük üzerindeki etkisinin ortaya konulması amaçlanmıştır. Araştırma Ankara Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü deneme tarlasında ICARDA'dan sağlanan üç farklı yaygın mürdümük hattında sıra arası mesafenin ot verimi ve bazı bitkisel özelliklere etkisini gözlemlemek amacıyla yürütülmüştür. Üç farklı sıra arası mesafe uygulanmıştır. Çalışmada yaş ot verimi(kg/da), kuru ot verimi (kg/da), biyolojik verim(kg/da), bitki boyu (cm), dal sayısı, ilk meyve bağlama yüksekliğine (cm) ait gözlem ve ölçümler yapılmıştır. İhtiyaç duyuldukça toprak tarla kapasitesine erişinceye kadar parsellere eşit miktarda sulama yapılmıştır. Tam çiçeklenme döneminde her parselde 1m² alandan biçilen bitkiler tartılarak yaş ot verimi, elde edilen yaş otların 70 °C'de 48 saat boyunca kurutulup tartılmasıyla da kuru ot verimi belirlenmiştir. Deneme tesadüf bloklarında bölünmüş parseller deneme desenine göre 3 tekrarlamalı olarak yürütülmüştür. Ana parsellere faktör olarak "sıra arası mesafe" (20-30-40 cm), alt parsellere ise "mürdümük hatları" (790,794,803) yerleştirilmiştir. Elde edilen değerler MSTAT-C programı kullanılarak analiz edilmiş ve karşılaştırmalar Duncan çoklu karşılaştırma testi ile yapılmıştır. Çalışmadan elde edilen sonuçlara göre biyolojik verim, bitki boyu ve ilk meyve bağlama yüksekliği bakımından üç farklı yaygın mürdümük hattı arasındaki fark %5 düzeyinde önemli bulunmuştur.

Anahtar Kelimeler: Verim, baklagil, yem



THE EFFECT OF DIFFERENT SOWING DENSITIES ON FORAGE YIELD AND SOME PLANT CHARACTERISTICS IN *LATHYRUS SATIVUS* L.

ABSTRACT

Lathyrus sativus L. is a valuable legume forage crop that has great importance in animal nutrition, has high nutritional value and can contribute to closing the feed deficit. It is the most cultivated species in the *Lathyrus* genus. It is a species that can be used for human nutrition, which is resistant to drought, being under water in the early period, and unfavorable soil conditions. The fact that it can easily grow under the conditions in which many cultivated plants grow, and that it does not need pesticide application and fertilization, makes this species an important resource for legume breeding, its resistance to various stress factors. In this study, it is aimed to reveal the effect of sowing densities, which is important for the productivity and continuity of plants, on *Lathyrus sativus* L. The research was carried out in order to observe the effect of sowing densities on grass yield and some vegetal characteristics in three different *Lathyrus sativus* L. lines provided by ICARDA in the experimental field of Ankara University, Faculty of Agriculture, Field Crops Department. three different sowing densities were applied. In the study, observations and measurements were made regarding the wet forage yield (kg/da), hay yield (kg/da), biological yield (kg/da), plant height (cm), number of branches, first fruit setting height (cm). As needed, equal amounts of irrigation were applied to the plots until the soil reached the field capacity. Fresh grass yield was determined by weighing the plants cut from 1 m² area in each plot during the full bloom period, and dry grass yield was determined by drying and weighing the fresh grass obtained at 70 °C for 48 hours. The experiment was carried out in randomized blocks according to the split plot design with 3 replications. “Sowing densities” (20-30-40 cm) was placed as a factor in the main plots, and “*Lathyrus sativus* L. lines” (790,794,803) were placed on the sub-plots. Obtained values were analyzed using MSTAT-C program and comparisons were made with Duncan multiple comparison test.

According to the results obtained from the study, the difference between three different *Lathyrus sativus* L. lines in terms of biological yield, plant height and first fruit setting height was found to be significant at the level of 5%.

Keywords: Yield, legume, forage



1. GİRİŞ

Lathyrus cinsi, hayvan ve insan beslenmesinde kullanılabilen aynı zamanda yeşil gübre ve süs bitkisi olarak da değerlendirilebilen çok yönlü değerli bir baklagil yem bitkisidir. Bu cinse dahil yaklaşık 160 tür bulunmaktadır. Protein içeriğinin yüksekliği beslenme bakımından bitkinin önemini artırmaktadır. (Llorent ve ark. 2017) Baklagillerden sağlanan protein doğrudan insan ve hayvan beslenmesinde önemli olduğu gibi hayvan yemi endüstrisi için de değerli bir kaynak oluşturur. Çok çeşitli baklagil kaynaklarına dahil olan *Lathyrus* türleri de bu amaçla değerlendirilebilir. Yaygın mürdümük (*Lathyrus sativus* L.) mürdümük türleri içinde en fazla yetiştirilen türdür ve nötr ve ince yapılı topraklarda güzel sonuçlar verebilir. (Hanbury ve ark. 2000) Aynı zamanda olumsuz şartlarda fazla girdiye gereksinim duymadan yetişebilmesi de çiftçilerin maliyeti açısından önemlidir. (Arslan 2016) Hastalık ve zararlılara karşı da çok hassas değildir. (Campbell 1997)

Mürdümüğün olumlu özelliklerine rağmen bazı sorunları da bulunmaktadır. Yaygın mürdümük ve diğer mürdümük türlerinde insan ve hayvanlarda sinir sistemi bozukluklarına neden olan bazı maddeler mevcuttur. (Jackson ve Yunus 1984) Bunlardan en yaygını ve yaygın mürdümükte de çeşitli oranlarda bulunan, bir nörotoksin olan ve Latirizm adlı hastalığa yol açan 3-(-N-oxalyl)-1-2,3-diamino propionic acid (ODAP) adlı maddedir. Bu madde en yüksek oranda bitkinin tohumlarında bulunmaktadır. Son çalışmalarla daha düşük oranda ODAP içeren çeşitler geliştirilmiştir. (White ve ark. 2002) Bu çeşitlerin rasyona katılması insan ve hayvan sağlığı açısından önem taşımaktadır. (Yan ve ark. 2006)

Sıra arası mesafe ile bitki sıklığı uygulamalarının elde edilecek ürünün miktar ve kalitesine etkisi bulunmaktadır. Çalışmada farklı sıra arası mesafelerin 3 yaygın mürdümük hattında ot verimi ve bazı bitkisel özelliklere etkisi gözlemlenmiştir.

2. MATERYAL VE YÖNTEM

Araştırma bir tarla denemesi olarak planlanarak Ankara Üniversitesi Ziraat Fakültesi deneme tarlalarında yürütülmüştür. Denemede kullanılan tohumlar ICARDA'dan temin edilmiştir. Üç yaygın mürdümük hattı kullanılmıştır. (790,794,803) Üç farklı sıra arası mesafe uygulanmıştır. İlkbaharda kenar tesirine dikkat edilerek ekim yapılmıştır. Yabancı ot mücadelesi elle yapılmıştır. İhtiyaç duyulduğu zaman toprak tarla kapasitesine erişinceye kadar eşit miktarda sulama yapılmıştır. Bitkiler, baklalar sarardıktan ve alt yapraklar kuruduktan sonra hasat edilmişlerdir. Deneme şansa bağlı bloklarda bölünmüş parseller deneme desenine göre 3 tekrarlamalı olarak yürütülmüştür. Ana parsellere faktör olarak "sıra arası mesafe" (20-30-40 cm), alt parsellere ise "mürdümük hatları"



(790,794,803) yerleştirilmiştir. Elde edilen sayısal değerler MSTAT-C programı ile analiz edilmiş ve karşılaştırmalar Duncan çoklu karşılaştırma testi ile yapılmıştır.

Çizelge 1. Araştırma yerine ait iklim verileri (Anonim 2017)

Aylar	Ort Sıcaklık (°C)		Yağış (mm)		Nispi Nem (%)	
	Araştırma yılı	Uzun yıllar	Araştırma yılı	Uzun yıllar	Araştırma yılı	Uzun yıllar
Mart	5.7	4	60.6	40.2	68.7	77.5
Nisan	13.3	9.7	14.8	47	46.2	76.8
Mayıs	13.6	14.2	30.6	46.6	63.4	73.8
Haziran	20.1	18.5	16.6	31.4	48.6	70.7
Temmuz	23	22.2	0.6	16.4	40	64.1

3. BULGULAR VE TARTIŞMA

Çizelge 2. Sıra arası mesafenin yaş ot verimine etkisi

Hatlar	Yaş ot verimi (kg/da)				Ort
	Sıra arası mesafe	20	30	40	
790		2063.33	2090	2101.66	2085
794		2188.33	2100	2118.33	2135.55
803		2003.33	2180	2173.33	2118.88
Ort		2085	2123.33	2131.11	

Sıra arası mesafenin yaş ot verimine etkisine baktığımızda en yüksek değerler 794 numaralı hatta 20 cm sıra arası mesafeden elde edilirken en düşük değerler 803 numaralı hatta 20 cm sıra arası mesafeden elde edilmiştir.

Çizelge 3. Sıra arası mesafenin kuru ot verimine etkisi

Hatlar	Kuru ot verimi (kg/da)				Ort
	Sıra arası mesafe	20	30	40	
790		426.33	441.56	423.23	430.37
794		463	417.1	396.06	425.38
803		398.96	454.26	476.4	443.21
Ort		429.43	437.64	431.9	

Kuru ot veriminde en yüksek değerler 803 numaralı hatta 40 cm sıra arası mesafeden elde edilirken en düşük değerler 794 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir.



Çizelge 4. Sıra arası mesafenin biyolojik verime etkisi

Hatlar	Biyolojik verim (kg/da)			Ort	
	Sıra arası mesafe	20	30		40
790		783.33	790	627.33	733.55b
794		838.33	1025	895.33	919.55a
803		858.33	849	730	812.44ab
Ort		826.66	888	750.89	

Biyolojik verim bakımından hatlar %5 düzeyinde önemli bulunmuştur. En yüksek değerler 794 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir. En düşük değerler 790 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.

Çizelge 5. Sıra arası mesafenin bitki boyuna etkisi

Hatlar	Bitki boyu (cm)			Ort	
	Sıra arası mesafe	20	30		40
790		71.86	74.96	81.2	76.01b
794		87.26	88.13	87.86	87.75a
803		84.8	82.2	82.46	83.15a
Ort		81.311	81.76	83.84	

Bitki boyu bakımından hatlar %5 düzeyinde önemli bulunmuştur. En yüksek değerler 794 numaralı hatta 30 cm sıra arası mesafeden elde edilirken, en düşük değerler 790 numaralı hatta 20 cm sıra arası mesafeden elde edilmiştir.

Çizelge 6. Sıra arası mesafenin dal sayısına etkisi

Hatlar	Dal sayısı			Ort	
	Sıra arası mesafe	20	30		40
790		6.33	5.73	4.73	5.6
794		7.33	5.6	4.26	5.73
803		5.8	5.4	7.4	6.2
Ort		6.48	5.57	5.46	

Dal sayısında en yüksek değerler 794 numaralı hatta 20 cm sıra arası mesafeden, en düşük değerler ise 794 numaralı hatta 40 cm sıra arası mesafeden elde edilmiştir.



Çizelge 7. Sıra arası mesafenin ilk meyve bağlama yüksekliğine etkisi

Hatlar	İlk meyve bağlama yüksekliği (cm)				Ort
	Sıra arası mesafe	20	30	40	
790		23.93	22.53	28.06	24.84b
794		30.46	29.66	30.13	30.08a
803		31.46	30.33	28.73	30.17a
Ort		28.62	27.51	28.97	

İlk meyve bağlama yüksekliği değerlerinde hatlar %5 düzeyinde önemli bulunmuştur. En yüksek değerler 803 numaralı hatta 20 cm sıra arası mesafeden, en düşük değerler 790 numaralı hatta 30 cm sıra arası mesafeden elde edilmiştir. Sabancı ve ark.(2016) Kırşehir’de yürüttükleri, yaygın mürdümük genotiplerinin ot verimi ve bazı kalite değerlerini inceledikleri çalışmada en yüksek değerleri 20 cm’lik sıra arası mesafe uygulamasından elde ettiklerini bildirmişlerdir. Devi ve ark. (2018) yaygın mürdümükte farklı sıra arası mesafe ve fosfor dozlarının verim unsurlarına etkisini araştırdıkları çalışmalarında en iyi sonucu 20x10 cm sıra arası mesafe uyguladıkları bitkilerden elde etmişlerdir. Ghaza ve ark. (2021) 10, 20 ve 30 cm sıra arası mesafe uyguladıkları yaygın mürdümükte kuru ot verimi bakımından en iyi sonucu 10 cm sıra arası mesafe uygulamasından elde ettiklerini bildirmişlerdir.

4. SONUÇ

Hayvancılıkla geçimini sağlayan üreticilerin en büyük sorunlarından biri kalitesi yüksek ve düşük maliyetli kaba yem gereksiniminin karşılanamıyor olmasıdır. Bu ihtiyacın giderilmesi durumunda yem verimi ve kalitesinde önemli artışların olacağı, bunun sonucu olarak hayvansal proteine erişimin de kolaylaşacağı öngörülmektedir. (Aksu 2019)

Kıraç şartlara uyum sağlayabilen türlerin iyileştirilmesi ve üretime katılması küresel ısınma ve kuraklık sorunuyla mücadeleye de yardımcı olacaktır. Tek yıllık bir tür olan yaygın mürdümük ekim nöbetine girerek toprağın iyileşmesine, tarlanın değerlendirilmesine, ve yem çeşitliliğine katkı sağlayacaktır. (Kendir 1999)



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DIYARBAKIR EKOLOJİK KOŞULLARINDA MERCİMEK GENOTİPLERİNİN BAZI TEKNOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ*

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ÖZET

Mercimek (*Lens culinaris*, Medik), küresel gıda güvenliğine önemli katkı sağlayan yemeklik tane baklagiller arasında yer almaktadır. Ürünün tarımı yaygın olarak, yarı kurak veya marjinal alanlarda yapılmakta ve yetiştirme sezonu süresince çeşitli çevresel stres faktörlerine maruz kalmaktadır. Farklı mercimek genotiplerinin tane kalitesini belirlemek amacıyla 2021-2022 kışlık yetiştirme sezonunda, 25 mercimek genotipi ile Diyarbakır ekolojik koşullarında tesadüf blokları deneme desenine göre 4 tekrarlamalı yürütülen tarla çalışmasından elde edilen tanelerde teknolojik özellikler incelenmiştir. Araştırma sonucuna göre, mercimek genotiplerine göre değişmekle birlikte kuru ağırlık 3.36-6.22 g; yaş ağırlık 5.85-9.49 g; kuru hacim 52.0-54.67 ml; yaş hacim 105.0-110.0 ml; su alma kapasitesi 0.020-0.043 g/tane; su alma indeksi %0.273-1.753; şişme kapasitesi 0.01-0.07 ml/tane ve şişme indeksi % 1.25-5.00 arasında değişmiştir.

Anahtar Kelimeler: Kırmızı mercimek, genotip, tane, kalite



DETERMINATION OF SOME TECHNOLOGICAL CHARACTERISTICS OF LENTIL GENOTYPES UNDER ECOLOGICAL CONDITIONS OF DIYARBAKIR

ABSTRACT

Lentil (*Lens culinaris*, Medik) is among the edible grain legumes that make an important contribution to global food security. The cultivation of the product is widely carried out in semi-arid or marginal areas and is exposed to various environmental stress factors during the growing season. In order to determine the grain quality of different lentil genotypes, the technological properties of the grains obtained from the field study carried out according to the randomized blocks trial design with 4 replications in the 2021-2022 winter growing season with 25 lentil genotypes in Diyarbakır ecological conditions were investigated. Although it varies according to lentil genotypes, dry weight, wet weight, dry volume, wet volume, water intake capacity, water uptake index, swelling capacity, and swelling index ranged between 3.36 and 6.22 g; between 5.85 and 9.49 g; between 52.0 and 54.67 ml; between 105.0 and 110.0 ml; between 0.020 and 0.043 g/grain; between 0.273 and 1.753 %; between 0.01 and 0.07 ml/grain between 1.25 and 5.00%.

Keywords: Red lentil, genotype, seed, quality



GİRİŞ

Mercimek (*Lens culinaris* Medik), protein açısından zengin bir serin mevsim baklagil bitkisi olup, tarımın ilk günlerinden beri insanların beslenmesinin önemli bir parçası olmuştur. Mercimek eski yıllardan beri yemeklik baklagiller içerisinde insan beslenmesinde çok fazla kullanılan türlerinden bir tanesidir (Şehirli, 1988; Kaya, 2010). Mercimek, soya fasulyesinden sonra en yüksek oranda protein içeren baklagildir (Roy ve ark., 2010). Mercimeğin protein içeriği genetik faktörlerden ve çevre koşullarından etkilenmekte olup; %22–30 arasında değişmektedir (Bhatty, 1984). Mercimek proteinleri, ağırlıklı olarak globulinler (%50–65) ve albuminlerden (%10–25) oluşmaktadır (Boye ve ark., 2010; Jarpa-Parra ve ark., 2017). Mercimeklerin protein içeriğinin yaklaşık %80'ini depo proteinleri oluşturmaktadır ve kalan kısım, enzimler veya beslenmeyi kısıtlayıcı proteaz inhibitörleri, lektinler gibi bileşiklerdir (Gutiérrez-Urbe ve ark., 2016). Mercimek ayrıca çözünür ve çözünmez lif, vitaminler, mineraller (sodyum (Na), bakır (Cu), potasyum (K), magnezyum (Mg), fosfor (P), kalsiyum (Ca), demir (Fe), manganez (Mn) ve çinko (Zn)) ve antioksidan bileşikler bakımından da oldukça zengindir (Urbano ve ark., 2007; Yadav ve ark., 2007). Kolon kanseri, diyabet, hemoroid, kardiyovasküler hastalıklar ve obezite benzeri hastalıkların tümü, çoğunlukla lifli gıdaların daha az tüketilmesinden kaynaklanmaktadır (Trowell ve ark., 1985). Bu nedenle mercimek benzeri yüksek lifli taneli baklagillerin tüketilmesi insan metabolizmasının sağlıklı bir yapıya kavuşmasını sağlayabilir ve yukarıda belirtilen hastalıklara yakalanma riskini azaltabilir.

Yetersiz beslenme ve yoksulluk, yakın gelecekte tüm dünyayı etkileyecek ve endişe edilmesi gereken başlıca sorunlar olarak kabul ediliyor. Dünyanın farklı kıtalarındaki erken uygarlıklardan bu yana, baklagiller, tahıllarla birlikte dengeli beslenmenin bir parçası olmuştur. Halk arasında bakliyat olarak bilinen baklagiller, hayvan yemlerinin yanı sıra insanların günlük beslenmesinde diyet proteinidir. Protein açısından zengin tahıl baklagiller olmadan vejetaryenler için sürdürülebilir bir diyet mümkün olmayabilir. Şu anda 7.976 milyar (Eylül 2022) olan dünya nüfusunun 2050 yılında 9.7 milyar olması ve nüfus artışına paralel olarak da gıda üretim talebinin %70 artması beklenmektedir (Anonim, 2023). Tarım uzmanları, mevcut üretim ile artan nüfusun gıda talebini karşılamasının zor olacağını belirtmektedirler. Nitekim küresel baklagil talebi, 1975-76'da 26-27 milyon tondan 2007'de 43-44 milyon tona yükselmiş fakat üretim, aynı oranda artmamıştır. Uluslararası Kuruluşlar tarafından yayınlanan “Dünyada Gıda Güvenliği ve Beslenme Durumu Raporuna göre Dünya’da kronik beslenme yetersizliği yaşayan insan sayısı 821 milyona ulaşmıştır (FAO, 2017). Beslenme ile ilgili öngörülerde protein alımının orta ve düşük gelirli ülkelerde 2050 yılında kişi başı 57 g olacağı, bu ülkelerdeki hayvansal kaynaklı protein alımının 25 g’ı geçmeyeceği şeklindedir. Ayrıca gelecekte Dünya’nın en önemli beslenme sorunu olarak, protein yetersizliğine dikkat çekilmiştir.



Bu çalışma mercimek genotiplerinin teknolojik özelliklerini ve bu özellikler için genetik varyasyonu değerlendirmek amacıyla yapılmıştır.

MATERYAL VE YÖNTEM

Araştırmada, ICARDA'dan temin edilen ve önceki çalışmalarda öne çıkmış 22 kırmızı mercimek genotipi ile 3 adet tescilli çeşit (Fırat-87, Çağıl ve Tigris) olmak üzere toplam 25 adet kırmızı mercimek genotipi materyal olarak kullanılmıştır.

Denemeler, Diyarbakır/Sur ilçesi GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü deneme alanında (37° 30 ve 38° 43 Kuzey enlemleri ile 40° 37 ve 41° 20 Doğu boylamları, 570 m yükseklik) yürütülmüştür. Araştırmanın yürütüldüğü Diyarbakır ili karasal iklimi yansıtmaktadır. Yazları çok sıcak ve kurak, kışları ise daha az yağışlı ve soğuktur. Araştırmanın yürütüldüğü Diyarbakır ili 2021-2022 vejetasyon dönemi ve uzun yıllar iklim verileri, Çizelge 1'de verilmiştir. Çizelge 1'den görüleceği gibi, vejetasyon süresince en düşük sıcaklık ortalaması Ocak (2.0 °C) ayında görülürken, en yüksek sıcaklık ortalaması Haziran (31.7 °C) ayında görülmüştür. Vejetasyon süresi boyunca toplam 285.5 mm yağış düşmüştür.

Çizelge 1. Araştırmanın Yürütüldüğü Diyarbakır İli 2021-2022 Yetiştirme Sezonunu ile Uzun Yıllara İlişkin Önemli Meteorolojik Parametreler*

Aylar	Sıcaklık (°C)			Toplam Yağış (mm)
	Min.	Max.	Ort.	
Eylül-2021	19.7	29.2	25.4	0.0
Uzun Yıllar	16.0	33.3	25.1	5.4
Ekim-2021	12.9	24.1	18.6	22.2
Uzun Yıllar	10.1	25.4	17.5	32.8
Kasım-2021	8.2	17.0	11.4	15.2
Uzun Yıllar	4.2	16.3	9.7	55.1
Aralık-2021	-0.4	9.4	3.9	15.6
Uzun Yıllar	-0.2	9.2	4.0	72.2
Ocak-2022	-8.7	8.9	2.0	39.9
Uzun Yıllar	-2.2	6.7	1.8	70.6
Şubat-2022	2.6	11.8	7.0	26.8
Uzun Yıllar	-1.0	9.2	3.7	67.6
Mart-2022	0.3	13.2	5.7	63.8
Uzun Yıllar	2.5	14.5	8.3	66.8
Nisan-2022	8.1	21.3	16.8	11.2
Uzun Yıllar	7.0	20.4	13.8	69.1
Mayıs-2022	11.4	28.3	18.4	83.4
Uzun Yıllar	11.3	26.7	19.3	44.3
Haziran-2022	20.4	31.7	27.6	7.4
Uzun Yıllar	16.6	33.6	26.1	8.7

* Uzun Yıllar: 1929 – 2021 yılları arası veri grubu değerlendirilmiştir.



Araştırmanın yürütüldüğü Diyarbakır ili Eylül-Haziran dönemine ait uzun yıllar iklim verilerine bakıldığında ise en sıcak ay ortalaması 33.6°C (Haziran) ve en soğuk ay ortalaması ise 1.8 °C' (Ocak) olarak kaydedilmiştir. Uzun yıllar yıllık toplam yağış ortalaması 492.2 mm olup bunun büyük bir kısmı kış aylarında düşmektedir (Anonim, 2022).

Deneme alanı toprakları (0-30 cm) killi-tınlı, toplam tuz değerine göre orta tuzlu (% 0.400), organik madde açısından düşük (% 1.66), toprak pH bakımında alkali (pH: 8.07) ve CaCO₃ içeriği (%7.93) ile orta seviyedir.

YÖNTEM

Denemeler tesadüf blokları deneme desenine göre 4 tekrarlamalı olarak 2021-2022 yetiştirme döneminde yürütülmüştür. Ekimler, sıra uzunluğu 6 m, sıra arası 0.20 m ve her parsel 6 sıradan oluşacak şekilde yapılmıştır. Her parsel 0.2 x 6 m x 6 m = 7.2 m² ve her parselde 300 tohum/m², 300 x 7.2 m² =2160 adet tohum gelecek şekilde ekimler yapılmıştır. Bloklar arasına 2 m boşluk bırakılmıştır. Ekimler, 16 Kasım 2021'de mibzer ile yapılmıştır. Hasat olgunluğuna gelen parsel kenarları bir sıra, parsel başı ve sonunda 0.5 cm kenar tesiri bırakıldıktan sonra 9 Haziran 2022 tarihinde hasat yapılmıştır. Hasat edilen tanelerde Tohumluk Tescil ve Sertifikasyon Merkezi (TTSM)'nin tarımsal değerleri ölçme denemeleri teknik talimatına göre Laboratuvar şartlarında kuru ağırlık (g), yaş ağırlık (g), su alma kapasitesi (g/tane), su alma indeksi (%), kuru hacim (ml), ıslak hacim (ml), şişme kapasitesi (ml/tane) ve şişme indeksi (%) ölçümleri yapılmıştır (Anonim, 2021).

Elde edilen veriler, tesadüf blokları deneme deseninde analiz edilmiştir. İstatistikî analizler, JMP ve GenStatRelease14.1 (Copyright 2011, VSN International Ltd.) versiyonu kullanılarak yapılmış, önemli çıkan ortalamalar, TUKEY testine göre gruplandırılmıştır (Gauch, 1988).

BULGULAR VE TARTIŞMA

Diyarbakır ekolojik koşullarında 2021-2022 kışlık yetiştirme döneminde 25 kırmızı mercimek genotipinde incelenen özelliklerden; kuru ağırlık (g), yaş ağırlık (g) ve kuru hacim (ml) bakımından genotipler arasında istatistiki olarak önemli farklılıklar bulunmuştur. İncelenen özelliklere ait ortalama değerler ve oluşan gruplar, Çizelge 2'de verilmiştir.

Çizelge 2'den görüldüğü gibi kuru ağırlık değeri genotiplere göre değişmekle birlikte 3.36- 6.22 g arasında değişmiş, DB 2012-21 genotipinin en yüksek ve Fırat87 çeşidinin ise en düşük kuru ağırlık değerine sahip oldukları saptanmıştır. Aktaş, (2021), Midyat kırmızı mercimek yerel genotipi ile yürüttüğü çalışmada, kuru ağırlık değerinin 3.85 g ile 5.05 g arasında değiştiğini ve ortalama değerin ise 4.46 g olduğunu belirtmiştir. Koç ve Akdeniz (2019) 5 çeşit kırmızı mercimek genotipi (İpek, Seyran, Tigris, Evirgen ve Fırat) ile yürüttükleri çalışma sonucunda kuru ağırlığın 3.06-3.71 g arasında değiştiğini belirtmişlerdir.



Mercimek genotiplerinin yaş ağırlık değerleri genotiplere göre değişmekle birlikte 5.85-9.49 g arasında değişmiş, DB 2012-15 en yüksek ve Tigris çeşidinin ise en düşük yaş ağırlık değerine sahip oldukları saptanmıştır (Çizelge 2). Mercimekte yaş ağırlık değeri genotiplere göre değişebileceği yapılan çalışmalarda belirtilmiştir (Koç ve Akdeniz, 2019).

Mercimek genotiplerinin kuru hacim değerleri genotiplere göre değişmekle birlikte 52.00-54.67 ml arasında değişmiş, DB 2012-15 genotipi ilk sırada yer alırken, Fırat87 çeşidi ise son sırada yer almışlardır. Aktaş (2021), kuru hacim değerinin genotiplere göre 52.5- 58 ml arasında, Koç ve

Çizelge 2. Diyarbakır Ekolojik Koşullarında, 2021-2022 kışlık yetiştirme döneminde, Kırmızı Mercimek genotiplerinde kuru ağırlık, yaş ağırlık, kuru hacim ve yaş hacim değerlerine ilişkin ortalamalar ve oluşan gruplar

Genotip	Kuru Ağırlık (g)	Yaş Ağırlık (g)	Kuru Hacim (ml)	Yaş Hacim (ml)
08S 40111-01	4.15 hij*	7.50 fg	52.67 abc	105.00
08S 40114-20	3.43 k	6.31 h	52.33 bc	105.00
08S 40120-01	4.37 ghı	7.68 ef	53.33 abc	110.00
08S 41102-029	4.52 e-h	8.40 cd	53.67 abc	106.67
09S 83183-01	4.91 def	9.15 ab	54.00 abc	106.67
09S 83192-03	4.17 hij	7.71 ef	52.67 abc	110.00
Çağıl	3.61 k	6.30 h	53.33	105.00
DB 2012-15	5.96 ab	9.49 a	54.67 a	110.00
DB 2012-2	4.84 d-g	9.26 ab	54.00 abc	110.00
DB 2012-20	4.16 hij	6.14 h	52.00 c	105.00
DB 2012-21	6.22 a	8.74 bc	53.88 abc	106.67
DB 2012-22	5.34 cd	8.85 bc	54.01 abc	106.67
DB 2012-23	3.83 jk	6.98 g	53.00 abc	106.67
DB 2012-24	4.97 de	9.14 ab	53.00 abc	110.00
DB 2012-3	5.68 bc	9.09 ab	53.67 abc	108.33
DB 2012-4	5.72 abc	9.13 ab	53.67 abc	108.33
DB 2012-5	5.80 abc	9.32 ab	54.33 ab	110.00
DB 2012-6	5.54 bc	8.44 cd	54.00 abc	108.33
DB 2012-9	5.52 bc	8.38 cd	52.67 abc	105.00
Fırat87	3.36 k	6.14 h	52.00 c	106.67
ILL 10690	4.15 hij	7.53 fg	53.67 abc	105.00
ILL 10826	3.86 ijk	6.97 g	53.67 abc	106.67
ILL 8110	4.43 fgh	8.14 de	53.33 abc	108.33
ILL 8128	4.94 def	9.20 ab	53.67 abc	106.67
Tigris	3.56 k	5.85 h	54.00 abc	105.00
Ortalama	4.68	7.99	53.35	107.27

*) Farklı harf ile gösterilen ortalamalar, Tukey testine göre ≤ 0.05 hata sınırları içinde birbirinden istatistiksel



Akdeniz (2019) ise 52.2-52.6 ml arasında değişebileceğini belirtmişlerdir. Çizelge 2'den görüldüğü gibi mercimek genotiplerinin yaş hacim değerleri bakımından genotipler arasında istatistiki olarak önemli farklılıklar saptanmamıştır. Yaş hacim değerleri genotiplere göre değişmekle birlikte 105.0-110.0 ml arasında değişmiş ve ortalama olarak 107.27 olarak saptanmıştır. Bulgularımıza benzer şekilde, mercimekte yaş hacim değeri genotiplere değişebileceği belirtilmiştir (Aktaş, 2021; Koç ve Akdeniz, 2019).

Diyarbakır ekolojik koşullarında 2021-2022 kışlık yetiştirme döneminde 25 kırmızı mercimek genotipinde incelenen özelliklerden; su alma kapasitesi (g/tane), su alma indeksi (%) ve şişme indeksi (%) değerleri bakımından genotipler arasında istatistiki olarak önemli farklılıklar bulunmuştur. İncelenen özelliklere ait ortalama değerler ve oluşan gruplar, Çizelge 2'de verilmiştir.

Çizelge 3'den görüldüğü gibi, mercimek genotiplerinin su alma kapasitesi değerleri genotiplere göre değişmekle birlikte 0.02-0.043 g/tane arasında değişmiş ve ortalama 0.033 g/tane olarak saptanmıştır. DB 2012-2 mercimek genotipi en yüksek değere sahip olurken, DB 2012-20 genotipi ise en düşük su alma kapasitesi değerine sahip olduğu saptanmıştır. Su alma kapasitesi, mercimekte pişme süresini etkileyen önemli bir kalite özelliği olup, tanenin su almasına bağlı olarak oluşan ağırlık artışının ifadesidir (Köse, 2018). Su alma kapasitesi yönünden genotipler arasında önemli varyasyonlar olup, bu değerlerin artması pişme kalitesini pozitif yönde etkilemektedir (Kaya, 2010; Karayel, 2012). Denemede elde ettiğimiz su alma kapasitesi ortalamalarına benzer olarak, Özer ve Kaya (2010) su alma kapasitesini 0.028–0,053, Jood ve ark. (1998) 0.019 ile 0.026 g/tane, Sharif ve ark. (2014) 0.018-0.022; Rani ve Grewal (2014) 0.018–0.030 g/tane, Küçükaya ve ark. (2019) 0.027-0.033 g/tane, Köse (2018) 0.032-0.064 g/tane arasında değiştiğini belirlemişlerdir. Bu sonuçlar denememizde elde ettiğimiz sonuçlara göre yüksek bulunmuştur. Bu farklılıkların denemelerde kullanılan çeşitlerin genotipik farklılıklarından kaynaklandığı düşünülmektedir. Kaya (2010), mercimek genotiplerinin su emme kapasitesinde önemli farklılıklar olduğunu ve daha büyük tohumlar için daha yüksek değerler bildirmiştir.

Araştırmada incelenen mercimek genotiplerinin su alma indeksi değerleri genotiplere göre değişmekle birlikte %0.273-1.753 arasında değiştiği ve genotiplerin ortalamasının %0.836 olduğu belirlenmiştir. 09S 83192-03 mercimek genotipi en yüksek değere sahip olurken, Tigris çeşidi ise en düşük su alma indeksi değerine sahip olduğu saptanmıştır. Koç ve Akdeniz (2019), mercimekte su alma indeksinin genotiplere göre %0.75-1.11 arasında değiştiğini belirtmişlerdir. Bu bulgular çalışmamızdaki değerler ile benzerlik göstermektedir.



Çizelge 3. Diyarbakır Ekolojik Koşullarında, 2021-2022 kışlık yetiştirme döneminde, Kırmızı Mercimek genotiplerinde Su Alma Kapasitesi (g/tane), Su Alma İndeksi (%), Şişme Kapasitesi (ml/tane), ve Şişme İndeksi (%) değerlerine ilişkin ortalamalar ve oluşan gruplar

Genotip	Su Alma Kapasitesi (g/tane)	Su Alma İndeksi (%)	Şişme Kapasitesi (ml/tane)	Şişme İndeksi (%)
08S 40111-01	0.030 bcd *	0.560 ab	0.02	1.947 ab
08S 40114-20	0.030 bcd	0.770 ab	0.03	2.223 ab
08S 40120-01	0.030 bcd	1.513 ab	0.07	3.053 ab
08S 41102-029	0.040 ab	0.653 ab	0.03	1.807 ab
09S 83183-01	0.040 ab	0.550 ab	0.03	1.667 ab
09S 83192-03	0.040 ab	1.753 a	0.07	3.887 ab
Çağıl	0.030 bc	0.440 ab	0.02	1.677 ab
DB 2012-15	0.037 ab	0.887 ab	0.05	2.167 ab
DB 2012-2	0.043 a	1.233 ab	0.06	2.500 ab
DB 2012-20	0.020 d	0.713 ab	0.03	2.500 ab
DB 2012-21	0.023 cd	0.540 ab	0.03	2.083 ab
DB 2012-22	0.033 abc	0.657 ab	0.04	2.640 ab
DB 2012-23	0.030 bcd	0.953 ab	0.04	2.223 ab
DB 2012-24	0.040 ab	1.407 ab	0.07	5.000 a
DB 2012-3	0.033 abc	0.813 ab	0.05	2.360 ab
DB 2012-4	0.033 abc	0.813 ab	0.05	2.360 ab
DB 2012-5	0.037 ab	0.970 ab	0.06	2.333 ab
DB 2012-6	0.030 bcd	0.773 ab	0.04	2.083 ab
DB 2012-9	0.030 bcd	0.420 ab	0.02	1.947 ab
Fırat 87	0.030 bcd	1.397 ab	0.05	3.333 ab
ILL 10690	0.030 bcd	0.313 ab	0.01	1.390 ab
ILL 10826	0.030 bcd	0.780 ab	0.03	1.943 ab
ILL 8110	0.040 ab	1.117 ab	0.05	2.500 ab
ILL 8128	0.040 ab	0.607 ab	0.03	1.807 ab
Tigris	0.023 cd	0.273 b	0.01	1.250 b
Ortalama	0.033	0.836	0.039	2.35

*) Farklı harf ile gösterilen ortalamalar, Tukey testine göre ≤ 0.05 hata sınırları içinde birbirinden istatistiksel

Aynı çizelgeden görüleceği gibi, mercimek genotiplerinin şişme kapasitesi değerleri genotiplere göre değişmekle birlikte 0.02-0.07 ml/tane arasında değişmiştir. Bulgularımıza benzer şekilde Koç ve Akdeniz (2019), şişme kapasitesinin 0.03-0.24 ml/tane arasında değiştiğini belirtmişlerdir. Mercimek tohumunun şişme kapasitelerinin (ml/tane); Jood ve ark. (1998) 0.018 ile 0.025, Sharif ve ark. (2014) 0.018-0.024, Rani ve Grewal (2014) 0.030 – 0.050 ve Köse (2018) 0.023-0.055 ml/tohum arasında değiştiğini bildirmişlerdir.

Mercimek genotiplerinin şişme indeksi değerleri genotiplere göre değişmekle birlikte % 1.254-5.00 arasında değişti ve genotiplerin ortalamasının %2.350 olduğu belirlenmiştir. DB 2012-24 mercimek genotipi en yüksek değere sahip olurken, Tigris çeşidi ise en düşük su alma indeksi değerine sahip



olduğu saptanmıştır (Çizelge 3). Bulgularımıza benzer şekilde, Koç ve Akdeniz (2019) şişme indeksinin % 1.92-2.46 arasında değiştiğini belirtmişlerdir.

SONUÇ

Diyarbakır ekolojik koşullarında yetiştirilen mercimek genotiplerinin teknolojik özelliklerini ve bu özellikler bakımından genetik varyasyonun değerlendirildiği araştırma sonucunda, DB 2012-15, DB 2012-2, DB 2012-21, DB 2012-24, DB 2012-4 ve DB 2012-5 mercimek genotiplerinin kuru ağırlık, yaş ağırlık, kuru hacim, su alma kapasitesi, su alma indeksi ve şişme indeksi bakımından öne çıktıkları belirlenmiştir. Bu genotipler sahip oldukları bu teknolojik özellikleri ile araştırmada incelenen genotiplerden daha erken pişecek genotipler olacağı söylenebilir.

TEŞEKKÜR

Bu çalışma, TÜBİTAK tarafından desteklenen 119 N 507 Nolu “Akdeniz havzasında mercimek ve nohut biyolojik çeşitliliğinin agronomik, fenotipik ve moleküler karakterizasyonu” projeden elde edilen verilerinden üretilmiştir.



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DİYARBAKIR EKOLOJİK KOŞULLARINDA MERCİMEK GENOTİPLERİNİN FENOLOJİK ve VERİM ÖĞELERİNİN BELİRLENMESİ*

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ÖZET

Mercimek (*Lens culinaris* Medik), protein açısından zengin bir serin mevsim baklagil bitkisi olup, tarımın ilk günlerinden beri insanların beslenmesinin önemli bir parçası olmuştur. İklim değişikliği ile birlikte, mercimek tarımının yapıldığı bölgelerde mercimeğin fenolojisi ve tane verimi önemli derecede etkilenmektedir. Çalışma, Diyarbakır ekolojik koşullarında 2021-2022 kışlık yetiştirme sezonunda 25 mercimek genotipi ile tesadüf blokları deneme desenine göre 4 tekrarlamalı olarak yürütülmüştür. Varyans analizi sonucuna göre, incelenen özelliklerden ana dal sayısı dışında tüm özelliklerde genotipler arasında istatistiki olarak önemli farklılıklar belirlenmiştir. Araştırma sonucunda, çiçeklenmeye kadar geçen gün sayısı 137.0-143.5 gün ve olgunlaşmaya kadar geçen gün sayısı 177.0-183.5 gün bitki boyu 31.0-40.5 cm, ilk bakla yüksekliği 12.8-21.0 cm, bitkide ana dal sayısı 2.1-2.6 adet, bitkide toplam bakla sayısı 36.8-58.3 adet, bitkide tane sayısı 34.8-54.3 adet, bitkide tane ağırlığı 1.19-2.54 g, bin tane ağırlığı 32.0-50.3 g, tane verimi 203.6-306.6 kg/da arasında değiştiği saptanmıştır. DB 2012-2, DB 2012-3 ve DB 2012-4 genotiplerinden 300 kg/da üzerinde verim alındığı, kontrol çeşit ve diğer genotiplere göre daha yüksek verim ve daha erken çiçeklenen genotipler olarak belirlenmiştir.

Anahtar Kelimeler: Kırmızı mercimek, verim, tane iriliği, verim öğeleri



DETERMINATION OF PHENOLOGICAL AND YIELD COMPONENTS OF LENTIL GENOTYPES UNDER ECOLOGICAL CONDITIONS OF DİYARBAKIR

ABSTRACT

Lentil (*Lens culinaris* Medik) is a protein-rich cool season legume plant that has been used by humans since the early days of agriculture. With the climate change, the phenology and seed yield of lentils are significantly affected in the regions where lentil cultivation is carried out. With this study, the phenology and yield components of different lentil genotypes are investigated, and it is aimed to determine the suitable lentil genotypes for the agricultural region. The research was carried out with 25 lentil genotypes in the winter growing season of 2021-2022, according to the randomized blocks experimental design with 4 replications. As a results of the analysis of variance, statistically significant differences were determined between the genotypes in all traits except the number of branches. As a result of the research, phonologically; flowering days and physiological maturation days ranged between 137.0 and 143.5 days; between 177.0 and 183.5 days respectively. As yield and yield components: it was determined that plant height; first pod height, number of main branches per plant, total number of pods per plant, number of seeds per plant, seed weight per plant, thousand seed weight varied between 31.0-40.5 cm, 12.8-21.0 cm, 2.1-2.6, 36.8-58.3, 34.8-54.3, 1.19-2.54 g, 32.0-50.3 g, respectively. According to the genotypes the seed yield values varied from 203.6 to 306.6 kg/da. DB 2012-2, DB 2012-3 and DB 2012-4 genotypes higher yielded more than 300 kg per da and were determined as higher yield and earlier flowering genotypes compared to control cultivars and other genotypes.

Keywords: Red lentil, yield, seed size, yield components



GİRİŞ

Mercimek (*Lens culinaris* Medik) büyük oranda kendine tozlanan, $2n=14$ kromozoma sahip, tanesinde %23-31 gibi yüksek oranda protein bulunduran önemli bir serin iklim yemeklik tane baklagil bitkisidir (Şehirli, 1988). Mercimeğin orijininin ve ilk kültüre alındığı yerin verimli hilal denilen Mezopotamya ve Güney Türkiye olduğu tahmin edilmektedir. Mercimek bu bölgeden Mısır, Yunanistan ve Avrupa'ya yayılmıştır. Sıcağa ve kurağa diğer türlere göre daha toleranslı olmasının yanı sıra, fakir topraklarda yetişebilen bir bitki olması nedeniyle, kışlık tahıl-nadas ekim nöbetinin uygulandığı kurak bölgelerimizde ekim nöbetine girerek birim alan verimini artırmada ve nadas alanlarımızı azaltmada önemli bir değere sahiptir. Aynı zamanda tane hasadı sonrasında kalan bitki artıklarından elde edilen samanının, yüksek besin içeriği nedeni ile hayvan beslenmesinde de ayrı bir önem taşımaktadır. Mercimek, insan ve hayvan beslenmesinin yanı sıra, toprak verimliliğinin korunmasında ve iyileştirilmesinde rol oynayan önemli bir serin mevsim baklagil bitkisidir (Ersinke ve ark., 2011). Dünya mercimek ekim alanı 4.8 milyon hektar, üretimi ise 5.73 milyon ton'dur. Üretimde Kanada, Hindistan ve Avustralya ilk üç sırada yer almakta olup, Türkiye ekim alanı olarak 6. üretimde 4. ve verimde ise 15. sıradadır (FAO, 2020). Dünya mercimek piyasası 2020 yılına, iklim değişikliğine bağlı doğal afetler nedeni ile mercimek üretiminde azalma beklentisi ile başlamıştır. Bu beklentinin yanında pandemiyle birlikte baklagillere olan talebin artması, lojistik sektöründe yaşanan sıkıntılar ve ihracatçı ülkelerin uyguladığı ulusal karantinalar sonucunda uluslararası piyasalarda mercimek fiyatlarında artışları oluşmuştur. Türkiye mercimek ekim alanının yaklaşık 243 bin ha, üretimin 371 bin ton olduğu ve verimin ise 150 kg/da ile ülkemizde nohut ve fasulyeden sonra en fazla üretilen yemeklik tane baklagildir. Türkiye kırmızı mercimek tüketimi kişi başı 4.4 kg/yıl dır. Ülkemizde kırmızı mercimek üretiminin yaklaşık %96'sı Güneydoğu Anadolu Bölgesi'nde; ağırlıklı olarak Diyarbakır, Şanlıurfa, Mardin, Batman ve Siirt illerinde yapılmaktadır (TÜİK, 2021). Ülkemiz, 1980 ve 1990'lı yılların başlarında kırmızı mercimek üretimi ile Dünya pazarlarına hakim bir ülke iken, bugün Kanada, Avustralya ve son zamanlarda ise ABD'nin ihracata yönelik üretim faaliyetlerinden dolayı mercimek ithalatçısı ülke konumuna gelmişlerdir. Bu ülkelerin ihracatlarındaki artışların nedenleri arasında; örgütlü pazarlama faaliyetleri, yeterli mekanizasyon, hastalık ve zararlılarla etkin mücadele, kaliteli ve yüksek verimli tohumluk kullanımı, düşük maliyetli üretim ve yüksek verim değeri sayılabilir (Özel, 2005). Güneydoğu Anadolu bölgesi, kırmızı mercimek üretiminin yüksek bir oranını karşıladığı için bölgede yetiştirilen eski ve yeni geliştirilecek olan çeşitlerin değerlendirilmesi önemlidir. Türkiye'de son 20 yıl içerisinde ıslah edilmiş bazı Kırmızı Mercimek çeşidinin (Fırat-87, Şakar, Çağır, Seyran, Çiftçi) sertifikalı tohumlukları, Güneydoğu Anadolu Bölgesinde büyük oranda yayılmış ve baskın duruma geçmiştir (Düzgün ve Toğay, 2021).



Fakat gerek iklim değişikliğinin oluşturacağı olumsuz faktörler ve gerek iç ve dış pazardaki taleplerdeki değişiklikler dikkate alındığında, kırmızı mercimek üretiminde sürdürülebilirliğin sağlanabilmesi için mevcut çeşitlerden daha üstün özelliklere sahip yeni çeşitlerin geliştirilmesi zorunlu hale gelmiş bulunmaktadır.

Bu çalışma ile farklı mercimek genotiplerinin fenolojisi ve verim komponentleri incelenerek, bölge tarımına uygun mercimek genotiplerinin belirlenmesi amaçlanmıştır.

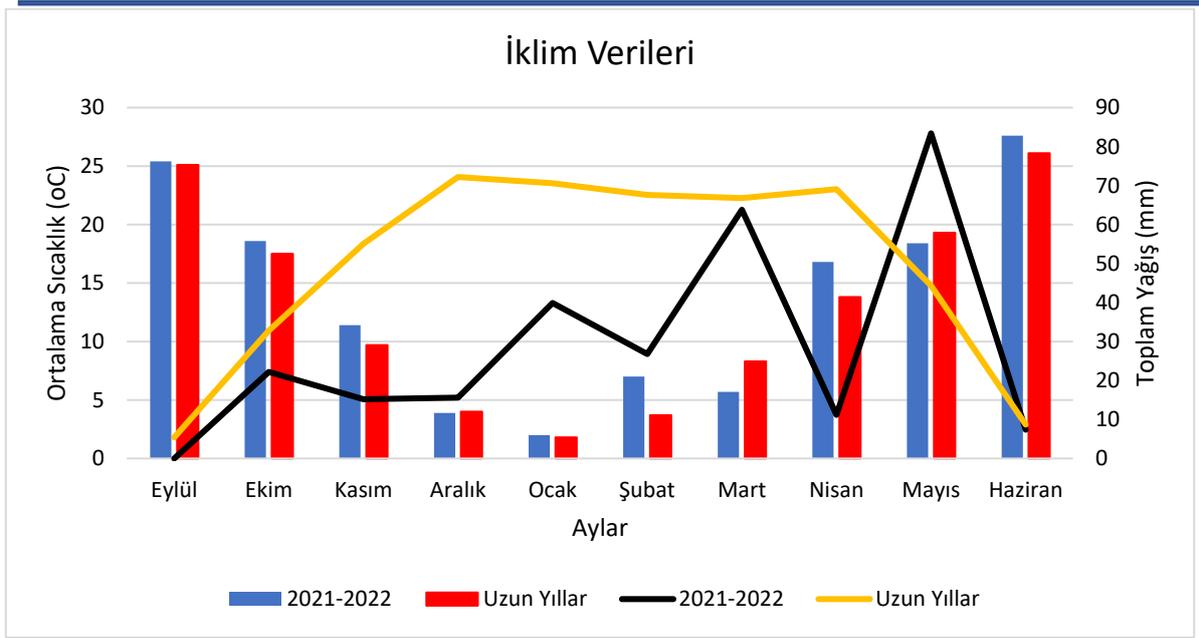
MATERYAL VE YÖNTEM

Araştırmada, ICARDA'dan temin edilen ve önceki çalışmalarda öne çıkmış 22 kırmızı mercimek genotipi ile 3 adet tescilli çeşit (Fırat-87, Çağıl ve Tigris) olmak üzere toplam 25 adet kırmızı mercimek genotipi materyal olarak kullanılmıştır.

Denemeler, Diyarbakır/Sur ilçesi GAP Uluslararası Tarımsal Araştırma ve Eğitim Merkezi Müdürlüğü deneme alanında (37° 30 ve 38° 43 Kuzey enlemleri ile 40° 37 ve 41° 20 Doğu boylamları, yükselti 570 m) yürütülmüştür.

Araştırmanın yürütüldüğü Diyarbakır ili karasal iklimi yansıtmaktadır. Yazları çok sıcak ve kurak, kışları ise daha az yağışlı ve soğuktur. Araştırmanın yürütüldüğü Diyarbakır ili 2021-2022 vejetasyon dönemi ve uzun yıllar iklim verileri Grafik 1'de verilmiştir. Vejetasyon süresince en düşük sıcaklık ortalaması Ocak (2.0 °C) ayında görülürken, en yüksek sıcaklık ortalaması Haziran (27.6 °C) ayında görülmüştür (Grafik 1). Vejetasyon süresi boyunca toplam 285.5 mm yağış düşmüştür.

Uzun yıllar iklim verilerine bakıldığında ise en sıcak ay ortalaması 26.11°C (Haziran) ve en soğuk ay ortalaması ise 1.8 °C' (Ocak) olarak kaydedilmiştir. Uzun yıllar yıllık toplam yağış ortalaması 492.5 mm olup bunun büyük bir kısmı kış aylarında düşmektedir (Anonim, 2022).



Grafik 1. Araştırmanın Yürütüldüğü Diyarbakır İli 2021-2022 Yetiştirme Sezonunu ile Uzun Yıllara İlişkin Önemli Meteorolojik Parametreler (Uzun Yıllar: 1929 – 2021 yılları arası veri grubu)

Deneme alanı toprakları (0-30 cm) killi-tınlı, toplam tuz değerine göre orta tuzlu (% 0.400), organik madde açısından düşük (% 1.66), toprak pH bakımında alkali (pH: 8.07) ve CaCO₃ içeriği (%7.93) ile orta seviyedir.

YÖNTEM

Denemeler tesadüf blokları deneme desenine göre 4 tekrarlamalı olarak 2021-2022 yetiştirme döneminde yürütülmüştür. Ekimler, sıra uzunluğu 6 m, sıra arası 0.20 m ve her parsel 6 sıradan oluşacak şekilde yapılmıştır. Her parsel 0.2 x 6 m x 6 m= 7.2 m² ve her parselde 300 tohum/m², 300 x 7.2 m² =2160 adet tohum gelecek şekilde ekimler yapılmıştır. Bloklar arasına 2 m boşluk bırakılmıştır. Ekimler, 16 Kasım 2021'de mibzer ile yapılmıştır. Hasat 9 Haziran 2022'de tarihinde yapılmıştır. Hasat edilen parseller kurutulmaya bırakıldıktan sonra harman işlemi elle yapılmıştır. Araştırmamızda, çiçeklenme ve olgunlaşma gün sayısı, bitki boyu, ilk bakla yüksekliği, bitkide ana dal, bitkide toplam bakla ve tane sayısı, bitki tane verimi, 1000 tane ağırlığı ve tane verimi karakterine ait gözlem ve ölçümleri yapılmıştır (Anonim, 2021).

Elde edilen veriler, tesadüf blokları deneme deseninde analiz edilmiştir. İstatistikî analizler, JMP ve GenStatRelease14.1 (Copyright 2011, VSN International Ltd.) versiyonu kullanılarak yapılmış, önemli çıkar ortalamalar, Tukey testine göre gruplandırılmıştır (Gauch, 1988).



BULGULAR VE TARTIŞMA

Diyarbakır ekolojik koşullarında 2021-2022 kışlık yetiştirme döneminde 25 kırmızı mercimek genotipinde incelenen özelliklerden; çiçeklenmeye kadar geçen gün sayısı (gün), olgunlaşmaya kadar geçen gün sayısı (gün), bitki boyu (cm), ilk bakla yüksekliği (cm), bakımından genotipler arasında istatistiki olarak önemli farklılıklar bulunmuştur. İncelenen özelliklere ait ortalama değerler ve oluşan gruplar, Çizelge 1’de verilmiştir.

Çizelge 1’den görüldüğü gibi, mercimek genotiplerinde saptanan çiçeklenmeye kadar geçen gün sayısı değerleri 137.0-143.5 gün arasında değişmiştir. İncelenen genotiplerden Fırat87 çeşidi geçici; DB 2012-4 mercimek genotipinin en erkenci genotip olduğu belirlenirken DB 2012-21, DB 2012-6, DB 2012-3, 08S 40111-01, 08S 41102-029, DB 2012-15, DB 2012-22, 09S 83192-03, ILL 10826, 08S 40120-01, DB 2012-5, ILL 8110, 09S 83183-01, DB 2012-2, DB 2012-9, ILL 8128, DB 2012-24 ve ILL 10690 mercimek genotipleri erken çiçeklenebilen genotipler olarak belirlenmiştir. Araştırmada kullanılan kontrol çeşitleri ise genellikle geç çiçeklenen çeşitler olarak belirlenmiştir. Erken çiçeklenme, sıcaklık ve kuraklık stresinin verimi önemli derecede etkilediği Güneydoğu Anadolu bölgesi için önemli bir parametredir. Bu durum dikkate alındığında erkencilik, verimi etkileyen önemli bir faktör olarak değerlendirilebilir. Biçer ve Şakar (2011) mercimekte çiçeklenme gün sayısının 145.8-161.5 gün, Öktem (2016) 117.6-127.9 gün, Doğan ve Doğan (2020) 143.7-158.8 gün arasında değiştiğini belirtmişlerdir.

Mercimek genotiplerinin olgunlaşmaya kadar geçen gün sayısı değerleri genotiplere göre değişmekle birlikte 177.0-183.5 gün arasında değişmiştir (Çizelge 1). İncelenen genotiplerden Fırat87 en geç olgunlaşan çeşit olurken; DB 2012-21 ve DB 2012-24 mercimek genotipleri en kısa sürede olgunluğa ulaşan genotipler olarak belirlenirken DB 2012-20, DB 2012-22, 08S 40114-20, Çağıl, DB 2012-15, DB 2012-23, DB 2012-5, 09S 83183-01, 08S 40120-01, ILL 8128, Tigris, 08S 41102-029, DB 2012-4, DB 2012-3, DB 2012-2, 08S 40111-01, 09S 83192-03 ve ILL 10690 mercimek genotipleride istatistiksel olarak aynı grupta yer almışlardır.

Erkenci genotipler terminal kuraklık stresinden etkilenmedikleri için strese bağlı verim kayıplarından daha az etkilenmektedirler. Bu nedenle yüksek verimli ve erkenci çeşit geliştirebilmek bitki ıslah programlarının önemli hedeflerden biridir (Kumar ve Srivastava, 2015). Olgunlaşma süresi, bitkinin hem genetik yapısı hem de çevre faktörlerinden etkilenebilen bir özelliktir. Farklı çevrelerde yapılan çalışmalarda fizyolojik olgunlaşma süresinin mercimek genotiplerine göre değiştiği bildirilmiştir (Biçer ve Şakar, 2007b; Koç ve Akdeniz, 2019). Aydoğan ve ark. (2005) Haymana, Esenboğa ve Kadınhanı’nda yaptıkları araştırmalarında; Fırat-87 ve Seyran-96 çeşitlerini lokasyonlara göre değişmekle beraber geç olgunlaşan çeşitler olarak bildirmişlerdir. Diyarbakır’da Yerli Kırmızı



mercimek çeşidinin geç olgunlaşan (Türk ve Atıkyılmaz, 2000; Biçer ve Şakar, 2007a), Siirt koşullarında ise erken olgunlaşan bir çeşit olduğu bildirilmiştir (Erman ve ark., 2005).

Çizelge 1. Diyarbakır ekolojik koşullarında, kırmızı mercimek genotiplerinde saptanan çiçeklenmeye kadar geçen gün sayısı, bakla bağlamaya kadar geçen gün sayısı, bitki boyu ve ilk bakla yüksekliği değerlerine ilişkin ortalamalar ve oluşan gruplar

Genotip	Çiçeklenmeye kadar geçen gün sayısı (gün)	Olgunlaşmaya kadar geçen gün Sayısı (gün)	Bitki boyu (cm)	İlk bakla yüksekliği (cm)	Bitkide dal sayısı (adet)	ana sayısı
08S 40111-01	138.8 b-f*	178.0 cd	33.3 bc	14.8 b-e	2.1	
08S 40114-20	139.8 bcd	179.8 bcd	32.8 bc	12.8 e	2.5	
08S 40120-01	138.0 c-f	179.3 bcd	33.3 bc	15.3 b-e	2.3	
08S 41102-029	138.8 b-f	179.0 bcd	32.5 bc	15.3 b-e	2.1	
09S 83183-01	137.8 c-f	179.5 bcd	33.3 bc	13.3 de	2.2	
09S 83192-03	138.3 c-f	178.0 cd	33.5 bc	15.3 b-e	2.2	
Çağıl	139.5 b-e	179.8 bcd	32.3 bc	15.5 b-e	2.4	
DB 2012-15	138.5 c-f	179.8 bcd	33.8 bc	16.3 a-e	2.3	
DB 2012-2	137.8 c-f	178.3 cd	31.8 c	13.8 cde	2.1	
DB 2012-20	141.0 b	180.0 bcd	37.0 ab	18.8 ab	2.5	
DB 2012-21	139.3 b-f	177.5 d	34.3 bc	18.5 abc	2.1	
DB 2012-22	138.5 c-f	180.0 bcd	32.8 bc	15.5 b-e	2.2	
DB 2012-23	140.0 bc	179.8 bcd	33.5 bc	15.0 b-e	2.6	
DB 2012-24	137.3 ef	177.0 d	31.0 c	16.5 a-e	2.3	
DB 2012-3	139.0 b-f	178.5 cd	32.8 bc	15.8 b-e	2.4	
DB 2012-4	137.0 f	178.8 bcd	32.3 bc	16.3 a-e	2.3	
DB 2012-5	138.0 c-f	179.8 bcd	34.8 bc	17.8 a-d	2.1	
DB 2012-6	139.3 b-f	181.0 abc	32.8 bc	14.8 b-e	2.1	
DB 2012-9	137.5 def	181.0 abc	33.5 bc	16.0 b-e	2.1	
Fırat 87	143.5 a	183.5 a	40.5 a	21.0 a	2.6	
ILL 10690	137.3 e	178.0 cd	31.0 c	14.0 b-e	2.1	
ILL 10826	138.3 c-f	180.8 abc	35.5 abc	15.5 b-e	2.1	
ILL 8110	138.0 c-f	181.8 ab	33.5 bc	16.5 a-e	2.1	
ILL 8128	137.5 def	179.3 bcd	34.5 bc	17.8 a-d	2.2	
Tigris	139.8 bcd	179.3 bcd	31.8 c	15.3 b-e	2.2	
Ortalama	138.7	179.5	33.5	15.9	2.2	
DK (%)	0.61	0.65	5.71	11.23	9.64	
F	**	**	**	**	Ö.D.	

*) Farklı harf ile gösterilen ortalamalar, Tukey testine göre ≤ 0.05 hata sınırları içinde birbirinden istatistiksel olarak farklıdır.

Çizelge 1'den görüldüğü gibi, mercimek genotiplerinde saptanan bitki boyu değerleri, 31.0-40.5 cm arasında değişmiştir. En yüksek bitki boyu değeri, Fırat 87 çeşidinden saptanırken DB 2012-2, Tigris, DB 2012-24 ve ILL 10690 mercimek genotipleri istatistiki olarak aynı grupta yer almış ve en düşük değere sahip olmuşlardır. Bitki boyunun genotiplerin yetiştirildiği ekolojik şartlara göre önemli ölçüde değiştiği bildirilmiştir (Çölkesen ve ark., 2005; Çokkızgın ve ark., 2005, Erman ve ark. 2005). Çölkesen ve ark. (2005), Kahramanmaraş ve Şanlıurfa koşullarında mercimek çeşitlerinin bitki boylarının 40.53 ile 51.90 cm olduğunu, Kahramanmaraş koşullarında Fırat 87 çeşidinin uzun,



Şanlıurfa koşullarında ise Seyran 96 çeşidinin kısa boylu çeşitler olduğunu bildirmişlerdir. Biçer ve ark. (2007 b), Diyarbakır koşullarında Fırat 87 çeşidinin uzun boylu (30.0- 31.0 cm) olduğunu bildirmişlerdir.

Araştırmada, ilk bakla yüksekliği değerleri mercimek genotiplerine göre değişmekle birlikte 12.8-21.0 cm arasında değişmiştir (Çizelge 1). Biçer ve Şakar (2007a) ilk bakla yüksekliğinin 10.83-14.50 cm, Erman ve ark. (2005) 10-16 cm arasında değiştiğini belirtmişlerdir.

Çizelge 2. Diyarbakır ekolojik koşullarında kırmızı mercimek genotiplerinde saptanan bitkide toplam bakla, tane sayısı, bitkide tane ağırlığı, 1000 tane ağırlığı ve tane verimi değerlerine ilişkin ortalamalar ve oluşan gruplar*

Genotip	Bitkide toplam bakla sayısı (adet)	Bitkide tane sayısı (adet)	Bitkide tane ağırlığı (g)	1000 tane ağırlığı (g)	Tane verimi (kg/da)
08S 40111-01	41.5 b*	37.5 b	1.53 b-g	40.8 gh	233.5 b-e
08S 40114-20	37.5 b	34.8 b	1.20 g	34.5 ijk	242.6 a-e
08S 40120-01	44.5 b	42.0 b	1.79 b-e	42.5 efg	297.4 ab
08S 41102-029	42.0 b	39.8 b	1.84 bcd	46.3 a-e	264.4 a-e
09S 83183-01	40.0 b	37.5 b	1.80 b-e	47.8 abc	293.2 ab
09S 83192-03	37.3 b	36.5 b	1.57 b-g	43.0 d-g	245.0 a-e
Çağıl	43.8 b	39.5 b	1.27 efg	32.0 k	248.9 a-e
DB 2012-15	46.0 ab	41.5 b	2.08 ab	50.3 a	263.1 a-e
DB 2012-2	45.8 ab	41.0 b	2.03 abc	49.5 ab	306.6 a
DB 2012-20	38.5 b	37.0 b	1.22 fg	33.0 jk	214.6 cde
DB 2012-21	36.8 b	34.8 b	1.57 b-g	45.0 c-f	258.5 a-e
DB 2012-22	40.3 b	37.8 b	1.77 b-f	46.8 a-d	273.4 a-e
DB 2012-23	49.0 ab	45.5 ab	1.69 b-g	37.0 hij	260.2 a-e
DB 2012-24	41.3 b	38.5 b	1.79 b-e	46.5 a-e	279.5 a-d
DB 2012-3	37.8 b	36.5 b	1.74 b-g	47.8 abc	302.0 ab
DB 2012-4	43.5 b	41.5 b	1.91 bcd	46.0 b-e	303.2 ab
DB 2012-5	58.3 a	54.3 a	2.54 a	46.8 a-d	263.5 a-e
DB 2012-6	40.8 b	36.8 b	1.69 b-g	46.0 b-e	244.7 a-e
DB 2012-9	41.5 b	37.8 b	1.69 b-g	44.8 c-g	275.1 de
Fırat 87	38.8 b	35.5 b	1.19 g	33.5 jk	209.4 e-d
ILL 10690	41.0 b	39.3 b	1.61 b-g	41.0 fgh	261.9 a-e
ILL 10826	40.0 b	39.0 b	1.49 c-g	38.3 hi	241.6 a-e
ILL 8110	40.8 b	37.8 b	1.69 b-g	44.8 c-g	203.6 e
ILL 8128	43.8 b	40.0 b	1.82 b-e	45.5 b-e	280.0 abc
Tigris	39.8 b	38.5 b	1.37 d-g	35.5 ijk	243.1 a-e
Ortalama	42.0	39.2	1.68	42.6	260.3
DK (%)	11.16	10.04	12.26	3.65	10.05
F	**	**	**	**	**

*)Farklı harf ile gösterilen ortalamalar, Tukey testine göre ≤ 0.05 hata sınırları içinde birbirinden istatistiksel

Aynı çizelgeden izlendiği gibi, mercimeğin bitkide ana dal sayısı değerleri genotiplere göre değişmekle birlikte 2.1-2.6 adet arasında değişmiştir. Biçer ve Şakar (2007a) bitkide dal sayısı yönünden çeşitler arasındaki farklılıkların önemli olduğunu ve dal sayısının 3.73-3.57 adet/bitki arasında değiştiğini bildirmiştir.



Diyarbakır ekolojik koşullarında 2021-2022 kışlık yetiştirme döneminde 25 kırmızı mercimek genotipinde incelenen özelliklerden; bitkide toplam bakla sayısı (adet), bitkide tane sayısı (adet), bitkide tane ağırlığı (g), 1000 tane ağırlığı (g) ve tane verimine (kg/da) bakımından genotipler arasında istatistiki olarak önemli farklılıklar bulunmuştur. İncelenen özelliklere ait ortalama değerler ve oluşan gruplar, Çizelge 2’de verilmiştir.

Çizelge 2’den görüldüğü gibi mercimek genotiplerinin bitkide toplam bakla sayısı değerleri genotiplere göre değişmekle birlikte 37.3-58.3 adet arasında değişmiş olup incelenen genotipler içerisinde DB 2012-5 mercimek genotipi ilk sırada yer alırken DB 2012-23, DB 2012-15 ve DB 2012-2 genotipleri de aynı istatistiki grubu paylaşmışlardır. Kumar ve ark. (2007), Roy ve ark. (2012) genotip ve genotip x çevre interaksiyonun bitkide bakla sayısı açısından önemli olduğunu, bundan dolayı bu özelliğin çevreye bağımlı olduğunu bildirmişlerdir. Mercimekte bakla sayısının kalıtım derecesinin orta ve düşük düzeyde olması, bu özelliğin çevre faktörlerinden etkilendiğini gösterebilmektedir (Chauhan ve Singh, 1998; Çiftçi ve Ülker, 2001; Biçer ve Şakar, 2007 a). Ayrıca yüksek sıcaklık ve yüksek nem ve bu çevresel faktörlerin birlikte oluşturacağı abiyotik stress koşullarında mercimekte bakla sayısını azaltabileceği gibi, baklanın tane doldurmasını da engellemektedir (Tambal ve ark., 2000; Biçer ve Şakar, 2007b).

Araştırmada incelenen mercimek genotiplerinin bitkideki tane sayısı değerleri genotiplere göre değişmekle birlikte 34.8-54.3 adet arasında değişmiş olup incelenen genotipler içerisinde DB 2012-5 mercimek genotipi en yüksek tane sayısına sahip olurken DB 2012-23 genotipi de aynı istatistiki grubu paylaşmıştır (Çizelge 2).

Çizelge 2’den izlendiği gibi, mercimek genotiplerinin bitkide tane ağırlığı değerleri genotiplere göre değişmekle birlikte 1.19-2.54 g arasında değişmiş olup incelenen genotipler içerisinde DB 2012-5, mercimek genotipi en yüksek tane ağırlığı değerine sahip olurken, bunu DB 2012-15 ve DB 2012-2 mercimek genotipleri izlemiştir.

Mercimeğin yüksek sıcaklığa toleransı düşük olup, kuraklık ve sıcaklık stresi koşullarında bitkide çiçek kurumaları ve boş bakla miktarı artmakta ve bitkinin tane doldurma kapasitesi azalmaktadır. Stres koşulları özellikle çiçeklenme ve bakla bağlama dönemlerinde daha da etkili olmaktadır. Bu duruma Türk ve ark. (2004) ve Biçer ve Şakar (2011) tarafından da değinilerek; yarı kurak koşullarda bakla dolmuş zamanında yüksek sıcaklık ve düşük nemin verimi azalttığı, bakla sayısı ve tane sayısı yüksek olan hatlar da ise küçük, cılız ve zayıf tane görüldüğü bildirilmiştir.

Diyarbakır koşullarında, mercimeğin bakla bağlama dönemi sıcak ve nispeten kurak döneme denk gelmesi nedeniyle bitki üzerinde çok sayıda çiçek kurumakta ve bakla bağlayamamaktadır. Bu yüzden erkenci ve yüksek bakla oluşturan çeşit elde etmek önem kazanmaktadır (Biçer ve Şakar, 2007a).



Nitekim yağış dağılımı bakla bağlama döneminde düzenli ise mercimek verimi yüksek olur (Bejiga ve ark., 1995), nemli koşullarda verim, kurak koşullara göre daha yüksektir ancak bazı kurak periyotlardaki yüksek verim ise çiçeklenme dönemindeki kuraktan kaçma ile ilişkilidir (Silim ve ark., 1993).

Araştırmada incelenen mercimek genotiplerinin bin tane ağırlığı değerleri genotiplere göre değişmekle birlikte 32.0-50.3 g arasında değişmiş olup incelenen genotipler içerisinde DB 2012-15 mercimek genotipi en yüksek bin tane ağırlığı değerine sahip olurken, bunu DB 2012-2, 09S 83183-01, DB 2012-3, DB 2012-22, DB 2012-5, DB 2012-24 ve 08S 41102-029 mercimek genotipleri izlemiştir. En düşük bin tane ağırlığı değeri ise Çağıl mercimek çeşitlerinde saptanmıştır. Biçer ve Şakar (2007a) Diyarbakır'da 1000 tane ağırlığı yönünden çeşit ve hatlar arasındaki farklılıkların önemli olduğunu ve değerlerin 29.83 g ile 47.80 g arasında değiştiğini, Gupta ve ark. (1996) Hindistan'da 100 tane ağırlığının 1.22-5.17 g, Erman ve ark. (2005) Siirt'te bin tane ağırlığı 26.3-65.5 g arasında değiştiğini bildirmişlerdir. mercimekte bin tane ağırlığının çeşide ait bir karakter olmasına karşın çevrenin bu karakter üzerinde güçlü bir etkisi bulunmaktadır (Erksine ve ark., 2011; Biçer ve Şakar, 2007a).

Çizelge 2'den izleneceği gibi, mercimek genotiplerinin tane verimi değerleri genotiplere göre değişmekle birlikte 203.6- 306.6 kg/da arasında olup, incelenen genotipler içerisinde DB 2012-2, mercimek genotipi en yüksek tane verimi değerine sahip olurken, en düşük tane verimi değeri ise ILL 8110 mercimek genotipinde saptanmıştır. Araştırmada 08S 40111-01, DB 2012-20, DB 2012-9, Fırat87 ve ILL 8110 dışında ki genotipler, tane verimibakımından istatistiksel olarak ilk grubu paylaşmışlardır.

Tane verimi genotipik bir özellik olup çevre şartlarından da önemli ölçüde etkilenmektedir. Bir fenotipin kendi genotipi ile çevresi arasındaki interaksiyonun bir sonucu olmasından, bir genotipin bütün çevrelerde aynı fenotipi sergileyememesinden ve farklı genotiplerin özel bir çevreye farklı şekilde tepki göstermelerinden kaynaklanabilir (Ahmad ve Pandey 1983). Ayrıca bu farklılık yıllar arasındaki yağış miktarı ve dağılımından kaynaklanmış olabilir. Yağış dağılımı ve verim arasındaki ilişkileri bildiren çok sayıda araştırma vardır. Nitekim, yağış dağılımı bakla bağlama döneminde düzenli ise mercimek verimi yüksek olmaktadır (Bejiga ve ark., 1995), nemli koşullarda verim, kurak koşullara göre daha yüksektir. Ancak bazı kurak periyotlardaki yüksek verim ise çiçeklenme dönemindeki kuraktan kaçma ile ilişkilidir (Silim ve ark., 1993). Tohum verimindeki varyasyonun %80'inin mevsimsel yağışlardan kaynaklanabileceği Erksine ve Ashkar (1993) tarafından da bildirilmiştir. Çiftçi ve Ülker (2001), kışlık mercimekte tane verimi bakımından çeşitler arasında istatistiki olarak farklılıkların olduğunu, Aydoğan ve ark. (2005) Haymana, Esenboğa, Kadınhanı ve Yozgat'ta lokasyon x çeşit interaksiyonunun 0.01 seviyesinde önemli olduğunu ve tane veriminin



83.6-187.2 kg/da arasında değiştiğini, Fırat-87 ve Özbek çeşidinin tüm çevrelere iyi uyum gösterdiğini, Seyran-96 çeşidinin ise kötü çevrelere kötü uyum gösterdiğini bildirmişlerdir. Biçer ve Şakar (2007a), Yerli Kırmızı çeşidinin her iki deneme yılında da tüm deneme ortalaması ve en düşük hat ortalamasından daha düşük verim değerine sahip olduğunu, ICARDA kökenli hatların yüksek verimli olduğunu bildirmiştir. Turan (2003) Harran ovasında tane veriminin 107 kg/da ile 288 kg/da, Erman ve ark. (2005) Siirt'te 152-297.5 kg/da, Biçer ve Şakar (2007b) Diyarbakır'da 116.0 kg ile 206.3 kg/da arasında değiştiğini bildirmişlerdir. Araştırmada elde edilen bulgularımızı, bildirilen sonuçlarla uyum içerisinde olduğu görülmektedir.

SONUÇ

Farklı mercimek genotiplerinin fenolojisi ve verim komponentlerinin incelenerek, bölge tarımına uygun mercimek genotiplerinin belirlemesi amacıyla yürütülen araştırma sonucunda, genotipler arasında verim ve verim komponentleri bakımından önemli varyasyon saptanmıştır. Bu durum ileride yapılacak ıslah çalışmalarında mevcut materyalden faydalanılarak bölge koşullarına uygun, erken çiçeklenebilen, yüksek verimli çeşitlerin geliştirilebileceğini gösterebilmektedir.

Araştırma sonucunda, DB 2012-24, DB 2012-4, DB 2012-9, DB 2012-2, ILL 10690 ve ILL 8128 erken çiçeklenebilmelerinden dolayı erkencilik ıslahında değerlendirilebilir. Ayrıca, DB 2012-2, DB 2012-3 ve DB 2012-4 mercimek genotiplerinin verim ve verim komponentleri bakımından araştırmada incelenen diğer genotiplerden öne çıkmıştır. Bu neden ile bölge için yüksek verimli çeşit geliştirme için yapılacak ıslah çalışmalarında değerlendirilmesi önerilebilir.

TEŞEKKÜR

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KURAKLIK STRESİ ALTINDAKİ BİTKİLERDE PGPR İZOLATLARININ ETKİLERİ

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ÖZET

Fosil yakıtların kullanımıyla birlikte ortaya çıkan ve sera gazı olarak adlandırılan karbondioksitin (CO₂) atmosferik değerinde meydana gelen artışlar, günümüzde küresel ısınma ve iklim değişikliği şeklinde tanımlanmaktadır. Isı değerlerinde meydana gelen artışlara bağlı olarak su kaynaklarının gün geçtikçe azalması, bir abiyotik stres faktörü olan kuraklığın ortaya çıkmasına olanak sağlamıştır. Kuraklık stresi, bitki gelişimini etkileyen en önemli stres faktörlerinden biri olduğundan kuraklığa bağlı olarak tarım alanlarında ciddi oranlarda azalmalara neden olabileceği öngörülmektedir. Kuraklığın bitkiler üzerindeki etkilerini azaltmada yeni yöntemlerin denenmesi ve geliştirilmesi günümüzde uygulanması gereken en acil kararlardan bir olmalıdır. Bu bağlamda önümüzdeki yıllarda etkisini dahada hissedebileceğimiz kurak stresinin tarım üzerindeki etkisini azaltmada birtakım çalışmalar yürütülmüştür. Bu çalışmalardan biri olan PGPR izolatlarının, kuraklığın yıkıcı etkilerini azaltmada ciddi faydalar sağladığı anlaşılmıştır. Bu faydalar arasında özellikle biyotik ve abiyotik stres faktörlerine karşı bitkide direnç sağlamada ve bitkinin besin elementleri alınımı üzerinde etkili oldukları anlaşılmıştır. Ayrıca bitkinin gerek fizyolojik ve gerekse morfolojik gelişmelerine katkı sağladıkları ortaya konulmuştur. Bitkiler ile simbiyotik yaşam sürdüren rizobakterilerin, tarımda etkili olarak kullanılması bitkilerde sadece besin elementlerinin alınımında değil aynı zamanda kuraklık stresinin etkisini azaltmada da ayrıca faydalı olduğu görülmektedir. Kurak şartlara uyumlu çeşitler geliştirmek uzun yıllara yayılan çalışmalar olduğundan, halihazırda rizobakterilerin tarımda etkin bir şekilde kullanımı ayrıca önemini ortaya koymuştur. Bu anlamda gerek yeni PGPR izolatlarının tespit edilmesi ve gerekse bitkilerdeki mekanizmalarının ayrıntılı olarak belirlenmesi kurak şartlarda tarımın yapılabilmesine imkân sağlayabilecektir.

Anahtar Kelimeler: Kuraklık stresi, pgpr, rizobakteri, tarım



EFFECTS OF PGPR INSULATIONS ON PLANTS UNDER DROUGHT STRESS

ABSTRACT

The increase in the atmospheric value of carbon dioxide (CO₂), which is called greenhouse gas and occurs with the use of fossil fuels, is defined as global warming and climate change today. Due to the increase in temperature values, the decrease in water resources day by day has enabled the emergence of drought, which is an abiotic stress factor. Since drought stress is one of the most important stress factors affecting plant growth, it is predicted that it may cause serious reductions in agricultural areas due to drought. Trying and developing new methods to reduce the effects of drought on plants should be one of the most urgent decisions to be implemented today. In this context, some studies have been carried out to reduce the impact of drought stress on agriculture, the effects of which may be felt even more in the coming years. It has been understood that PGPR isolates, one of these studies, provide serious benefits in reducing the devastating effects of drought. Among these benefits, it has been understood that they are effective in providing resistance in the plant against biotic and abiotic stress factors and on the uptake of nutrients by the plant. In addition, it has been revealed that they contribute to the physiological and morphological developments of the plant. The effective use of rhizobacteria, which maintain a symbiotic life with plants, in agriculture seems to be beneficial not only in the uptake of nutrients in plants but also in reducing the effect of drought stress. Since developing varieties compatible with arid conditions are long-term studies, the effective use of rhizobacteria in agriculture has also demonstrated its importance. In this sense, the detection of new PGPR isolates and the detailed determination of their mechanisms in plants will enable agriculture to be carried out in arid conditions.

Keywords: Drought stress, pgpr, rhizobacteria, agriculture



KURAKLIĞIN TANIMI VE ETKİLERİ

Dünya nüfusunda meydana gelen artışlar ve buna bağlı olarak enerji duyulan gereksinimden dolayı hemen hemen bütün enerji gereksinimini fosil yakıtlardan sağlamış olduk. Ancak bu durum atmosferde belli bir oranda bulunan karbondioksit oranının artmasına neden olmuştur. Atmosferdeki karbon oranında meydana gelen bu artışlar neticesinde, küresel ısınma ve iklim değişikliği kavramları gündeme gelemeye başlamıştır. Dünya ısındıkça tatlı su buharlaşmaya başlamış ve yerküre bunun bir neticesi olarak yıkıcı etkiye sahip olan kuraklık ile yüz yüze kalmıştır.

Kuraklık, toprak, bitki ve su döngüsünde bitkisel üretim bakımından önemli düzeyde risk barındıran en büyük doğal afetlerden birisidir (Lamber ve ark., 2008). Daha geniş bir ifadeyle, bitki büyümesini, gelişmesini engelleyen ve aynı zamanda bitki verimliliğini de sınırlayan en etkin ve olumsuz abiyotik streslerden biri olan kuraklık (Shao ve ark., 2009; Anjum ve ark., 2011a), bitkide fizyolojik, morfolojik ve biyokimyasal gibi birçok değişikliğe sebep olmaktadır (Dere ve Daşgan, 2019; Anjum ve ark., 2011b). Ayrıca solunumda, fotosentezde, bitki besin maddesi ve su alımında, organik maddelerin mekanizmasında, enzimatik faaliyetlerde, transkripsiyon faktörlerinde ve stres proteinlerini kodlayan genler üzerinde baskının yanı sıra moleküler anlamda karmaşık fizyo-biyokimyasal ve aşırı ekspresyon gibi birçok işlevde olumsuz etkiye neden olmaktadır (Saba ve ark., 2001; Villalobos ve ark., 2004; Farooq ve ark., 2009). Kuraklığa bağlı olarak fotosentez faaliyeti azaldığından dolayı bitkinin vejetatif gelişimi gerilemektedir. Uzun süren kuraklığa bağlı olarak bitkide gövde gelişiminin gerilediği, yapraklarda sararmaların, yaprak alanında ve yaprak sayısında azalmaların olduğu bilinmektedir. Bu durum bitkinin hacimsel olarak zayıf görünmesine neden olmaktadır (Asraf ve Floomad, 2007; Nam, 2010; Amira ve Qados, 2011; Örs, 2015).

Akbaş (2014), kuraklığı genel olarak, azalış gösteren yağışlar ve artan sıcaklık etmenlerine bağlı olarak, bir veya birçok mevsime yayılmış iklim olayı şeklinde ifade etmiştir. Küresel ısınmanın Türkiye’de su rezervleri üzerindeki etkilerini inceleyen Küçükklavuz (2009), iklim değişikliğinin en önemli sonuçlarından birinin su kaynaklarında hissedileceğini ve sahip olduğu farklı iklim koşullarından dolayı ülkemizin bu durumdan daha fazla etkilenebileceğini ifade etmiştir. Kurak koşullarda bitkilerde görülebilen morfolojik değişiklikler arasında yaprak yüzeyinin daralması neticesinde transpirasyon oranında azalmaların görülmesi ve gövdeye oranla köklerde hacimsel olarak artışın daha fazla olduğu görülmektedir. Ayrıca kuraklık stresine bağlı fotosentezde yer alan bileşiklerin kök bölgesine yönlendirilmesiyle köklerde hızlı bir gelişim sağlanırken, fotosentez hızında azalmalar görülmektedir. Bu düşüş karşısında bitkide filizlerin gelişmesi engellenmektedir (Öztürk ve ark., 1992). Kuraklığa bağlı olarak bitkilerdeki su miktarı ve turgor basınçlarında azalmalar meydana



gelirken bitkiler, hücre bölünmelerini ve büyümelerini durdurmak için stomalarını kapatırlar. Böylelikle fotosentez faaliyeti yavaşlar, verim ve kalitede azalmalar meydana gelirken (Karagöz ve ark., 2018), üretimdeki düşüğe bağlı olarak tüketimde meydana gelen yetersizlikler, beslenme ve sağlık problemlerinin ortaya çıkmasına neden olmaktadır (Dalal ve ark., 2006). Bitkiler kuraklık stresine karşı iyon ve hormon mekanizmalarıyla cevap verirler. İyon mekanizmasında stomalara bağlı halde bulunan potasyum iyonu alınarak stomaların açılması sağlanırken, hormon mekanizmasında ise bitki hücresinde artış gösteren absisik asit (ABA) düzeyine bağlı olarak stomaların kapanması sağlanır (Çırak ve Esenal, 2006). Stomaların kapanması neticesinde bitkinin karbondioksit alımında düşüş meydana gelir ve bu durum fotosentez aktivitesinin azalmasına neden olur. Kuraklık stresine verilen bu tip tepkiler bitkinin genetik yapısına bağlı olarak değişkenlik gösterebilir (Chaves ve ark., 2002).

PGPR TANIMI VE ETKİLERİ

Bitkilerin kök çevresinde ve rizosfer olarak adlandırılan bu kısımda mikroorganizmalar yaşamaktadırlar. Bu mikroorganizmalar, topraktaki fizyokimyasal faaliyetlerin bütünü üstlenmektedirler. Toprakta yaşayan mikroorganizmaların büyük bir çoğunluğu bakterilerden oluşmaktadır. Yapılan birçok çalışmanın neticesinde bitki kök bölgesinde yaşayan bazı bakterilerin bitkilerde faydaya dönük olumlu tesirde bulunduğu tespit edilmiştir (İmriz ve ark., 2014).

Kloepper ve ark., (1980) tarafından bu faydacı bakteriler, PGPR (Plant Growth Promoting Rhizobacteria) olarak adlandırıldılar. Ayrıca bu tip bakteriler, bitkiye sağlamış oldukları birçok faydadan ötürü Probiyotik Rizobakteriler şeklinde de anılmaktadırlar (Ram ve ark., 2013). Birçok faydaya sahip olan bu bakteriler (PGPR), ağır metal ve fosforu çözebilme, havadaki serbest azotu bağlayabilme, hormon üretebilme, su ve mineral madde alımını artırma, bitki kök gelişimini destekleme ve enzim faaliyetini artırma gibi mekanizmalarla bitki gelişimini teşvik ederler (Okon ve Kapulnik, 1986; Ferreira ve ak., 1987; Dejordjevic ve ark., 1987; Bashan ve ark., 1993). Birçok araştırmacı Rizobakterilerin geniş kullanım alanlarına dair çok sayıda çalışmalar yürütmüşlerdir. Bu çalışmalardan bazıları; pestisitlerin parçalaması (Ahemad ve Khan, 2012), ağır metal detoksifikasyonu (Wani ve ark., 2010; Ma ve ark., 2011), tuzluluk toleransı (Mayak ve ark., 2004), hastalık ve zararlılara karşı biyolojik mücadele (Altın ve ark., 2005; Hynes ve ark., 2008; Şevik, 2010; Annapurna ve ark., 2011; Manivannan ve ark., 2012; Yıldız ve ark., 2012; Tozlu ve ark., 2012) ve kuraklık stresiyle mücadele (Tunçtürk ve ark., 2021; Çirka ve ark., 2022a, Çirka ve ark., 2022b, Çirka, 2022) şeklinde yapılmışlardır.

Antioksidan enzimi bitkilerde kuraklık stresine karşı toleransında önemli bir görev üstlenmektedir. Stres faktörlerinin bitkide meydana getirdiği negatif etkileri bertaraf etmede PGPR bakterileri bitkide antioksidan enzim faaliyetini artırarak bitkinin kuraklık stresine karşı dayanımını artırabilir (Tien ve



ark., 1979). Glutasyon redüktaz ve glutasyon S-transferaz enzimleri bu mekanizmanın ortaya çıkmasında önemli bir role sahiptirler (Crozier ve ark., 1988).

KURAKLIK STRESİ ÜZERİNDE RİZOBAKTERİLERİN ETKİSİ

Tohum çimlenmesi, kök nodülasyonu, saçak kök gelişimi, çiçeklenme ve meyve tutumu üzerinde düzenleyici etki gösteren etilen hormon düzeyi, bitkilerde biyotik ve abiyotik stres altında gereğinden fazla üretildiğinden dolayı bitki gelişimi engellenmektedir (Yang ve ark., 2008). Buna karşın PGPR'ın ürettiği 1-aminoklopropan-1-karboksilat (ACC) deaminaz, etilen hormonunun artış düzeyini dengelemek kaydıyla bitkide büyüme ve gelişmeyi teşvik eder (Glick, 1995; Glick ve ark., 1998).

Shakir ve ark., (2012) tarafından yürütülen bir çalışmada, yarı kurak iklimde yetiştirilen buğday bitkisinde Pakistan'ın güney Punjab lokasyonunda 30 rizobakteri izole edilmiş ve buğday tohumları ACC-deaminaz aktivitesi gösteren bakteriler ile inoküle edilerek ekilmiştir. Çalışma neticesinde bitkide artan etilen hormon düzeyinin bu rizobakteriler tarafından düşürüldüğü ve bitkide gövde-kök uzunlukları, yanal kök sayılarında ve kitlelerinde kayda değer artışların olduğunu tespit etmişlerdir. Çalışma sonucunda araştırmacılar, ACC-deaminaz içeren rizobakterilerin stres altında bitkideki etilen hormonun düzeyini düşürdüğünü ve bunun bir neticesi olarak kuraklık stresinin etkisini bertaraf ettiğini bildirmişlerdir.

Gerek laboratuvarlarda ve gerekse tarla koşullarında yürütülen çalışmalarda, ACC-deaminaz faaliyeti gösteren rizobakteriler kullanılmıştır. Çalışmalarda bu bakterilerin, bitki gelişimini engelleyen gereğinden fazla su (Grichko ve Glick, 2001.) ve kuraklık stresine karşı bitkiyi muhafaza ettiği saptanmıştır (Mayak, 2004).

Azaltılmış su koşullarında PGPR izolatların etkinliğini araştıran Şelem ve ark. (2021), istatistiksel olarak bitkide gövde uzunluğunun, kök ve gövde yaş ağırlığının, epidermal hücre sayısının önemli çıktığını rapor etmişlerdir. Su stresi altındaki arazilerde tarla bitkilerinde yapılan PGPR uygulamasıyla büyüme hızı ve verim parametreleri incelenmiş ve rizobakterilerin bitkilerde kök gelişmesine katkı sağlayarak kuraklık stresinin etkisini azalttığı tespit edilmiştir. Ayrıca bu bakterilerin bitki besin alımına katkı sağladığı ve bu durumun tahıllarda daha etkili olduğu tespit edilmiştir (Khan ve Bano, 2019). Kuzey Kore'de yürütülen bir çalışmada tuz ve kuraklık stresine karşı PGPR bakterilerinin bitkilerdeki dayanıklılığı desteklediklerini ve ayrıca toprakta bulunan azot ve fosforun daha etkili bir biçimde almasını sağlamışlardır. Böylelikle yapay gübrelerin daha az kullanılmasını sağlayarak su kirliliğini de azalttığını bildirmişlerdir (Yang ve ark., 2009).

Bezelye bitkisinde kuraklık stresinin etkilerini PGPR izolatlarıyla iyileştirme üzerine yapılan bir çalışmada Arshad ve ark. (2008), bakteri uygulamalarındaki bitkilerin kontrol gruplarına göre daha az etkilendiği belirlenmiş ve bu durumun bitkide besin elementi alımının ve verimin olumlu etkilendiğini



tespit etmişlerdir. Yapılan bir çalışmada Wang ve ark. (2012), kuraklık stresine maruz bırakılan hıyar bitkisinde 3 farklı rizobakteri suşu kullanmış ve bitkilerde bazı biyokimyasal faaliyetlere bakılmıştır. Çalışmada, bakteri aşılı bitkilerin yapraklarının daha koyu olduğunu, yapraklardaki monodehydroascorbate (MDA) enzim düzeyinin azaldığını ve süperoksit dismutaz (SOD) aktivitesini arttırdığını belirtmişlerdir.

Sera koşullarında kuraklık stresine maruz bırakılan fasulye bitkisinde *Paenibacillus polymyxa* suşları ile *Rhizobium* bakterileri ve farklı kombinasyonlarıyla yapılan bir çalışmada Figueiredo ve ark. (2008), *Rhizobium* bakterilerinin tek başına kullanıldığı uygulamalar ile *Paenibacillus polymyxa* suşları ve *Rhizobium* bakterileri kombinasyonu arasında fark olduğunu, kombinasyon uygulamalarından daha iyi içsel hormon düzeylerini ve azot içeriğini aldıklarını rapor etmişlerdir. Lim ve ark. (2013) tarafından yürütülen bir çalışmada, kuraklık stresine dayanıklı bir biber çeşidi kullanılmış ve bu çeşide *Bacillus licheniformis* K11 inoküle edilmiştir. Çalışma neticesinde bakteri aşılı bitkilerdeki canlılığın kontrol gruplarına göre 15 gün daha fazla olduğunu, bakteri aşılı bitkilerde 6 farklı stres hormonu tespit ettiklerini ve bitkideki değişimleri *Bacillus licheniformis* K11 bakterisinin oksin ve ACC deaminaz sentezlemesiyle ilişkili olduğunu söylemişlerdir.

Çakmakçı ve ark. (2012) tarafından fosfor çözücü ve azot bağlayıcı rizobakterilerin çay klonunda verim ve besin içeriklerine dair etkilerinin araştırıldığı bir çalışmada, PGPR'in bitkide gelişmeyi teşvik ettiği, yapraklarda makro ve mikro besin elementi alımını arttırdığını bildirmişlerdir. Elma bitkisi üzerinde yapılan çalışmada Karlıdağ ve ark. (2007), PGPR uygulamaları neticesinde elma yapraklarında Mg elementi hariç Ca, Mn, Fe, K, P ve Mn içeriklerinde artışa neden olduğunu rapor etmişlerdir. Domates bitkisinde PGPR'ların etkileri araştıran Yagmur ve Güneş (2021), çalışmada kontrol grubuna göre bakteri uygulamalarını yapıldığı gruplarda verimin %20 oranında artış sağladığını bildirmişlerdir. Çilekte PGPR uygulamalarının kök ve yaprak büyümesi, verim ve meyve kalitesi üzerindeki etkisinin iyi olduğunu rapor etmişlerdir. Kuraklık stresi altında yetiştirilen mısır bitkisinde Fallik ve ark. (1989)'nın yürüttükleri bir çalışmada, bitkide ABA düzeyinde artış sağlandığını fakat gibberellin, sitokin ve oksin seviyelerinde azalmanın olduğunu ancak PGPR uygulamalıyla bu değişmelerin ters yönde değiştiğini bildirmişlerdir.

SONUÇ

Değişen ve gelişen dünya ile birlikte insan nüfusundaki hızlı artış ve bu hızlı artışın enerji gereksinimlerini karşılamada kaynak olarak fosil yakıtlar kullanılmıştır. Ancak fosil yakıtların kullanımına bağlı olarak karbondioksitin atmosferik oranı gün geçtikçe bir artış olarak ortaya çıkmış ve bu ısı değerindeki artışlar küresel ısınma meydana gelmesini sağlamıştır. Küresel ısınmayla birlikte



yerkürede bulunan tatlı su kaynakları buharlaşmaya başlamış ve böylece kuraklık denilen abiyotik stres faktörü ortaya çıkmıştır.

Kuraklık stresinin bitkiler üzerindeki yıkıcı etkileri bilinen bir gerçek olmuştur. Bu yıkıcı etkiler neticesinde bitkilerde verim ve verim parametreleri olumsuz bir şekilde etkilenmiştir. Bu durum, hızla artan dünya nüfusunun gıda teminini tehdit edebilecek konuma gelebilmiştir. Kuraklık stresiyile mücadele etmenin en etkin yollarında biri dayanıklı çeşit geliştirmekle mümkün olabileceği gibi PGPR izolatlarının tarımda etkin bir şekilde kullanmasıyla da mümkün olabilir. Diğer bir ifadeyle, yeni rizobakteri türlerinin tespit edilmesi ve bu anlamda tarla koşullarında daha etkin araştırmaların yapılması, kuraklık stresiyile mücadelede izlenebilecek yollardan biri olacağına inanıyorum. Nitekim bitkiler üzerinde bu anlamda yapılan çalışmalarda olumlu sonuçların alındığı ve bu sonuçların daha sonra yapılacak çalışmaları teşvik edebileceğini düşünüyorum.



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İLK DÖNEM İSLAM TARİHİNDE SU KAYNAKLARI VE SULAMA SİSTEMLERİNİN YÖNETİMİ

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ÖZET

İslam tarihinde Hz. Peygamber döneminden itibaren suyun tarım alanındaki kullanımıyla ilgili bazı meselelerin gündeme geldiği bilinmektedir. Ancak çöl ikliminin hâkim olduğu ve yağmur sonrası akıntıların nadiren tarımda kullanılabilirdiği, daha çok kuyu suları ile bahçelerin sulandığı bu dönemin aksine müslümanlar yakın zamanda Mezopotamya Bölgesi ve Nil Vadisi dahil olmak üzere dünyanın bilinen başlıca nehirlerini ve tarım arazilerini hakimiyetleri altına almışlardı. Aynı zamanda bu topraklar üzerinde yaşamakta olan pek çok çiftçi de İslam hakimiyetine alınmış oldu. İslam dininin bir gereği olarak bu insanlara din ve inanç noktasında asla bir baskı yapılamazdı. Aksine kendi dinlerinde devam etmek isteyen vatandaşların bu temel hak ve hürriyetleri bizzat devlet tarafından güvence altına alınmalıydı. Bununla birlikte bu bölgelerdeki hakimiyetle birlikte tarımın kontrol ve yönetimi de müslümanların eline geçmişti. Hz. Peygamber Medine’de nadiren görülen yağmur akıntılarının tarım alanında düzenli bir şekilde kullanılabilmesi için bazı kıstaslar belirlemişti. Bölgede tarımın desteklenmesi ve gıda temini açısından son derece önemli bir rol oynayan su kuyuları konusunda da teşvikler yapmış ve bir kuyu kazarak su çıkarmayı etrafındaki belirli bir araziye sahip olmak için yeterli görmüştü. Ancak bir ihyâ faaliyeti ile hak sahibi olan kimse üç yıl boyunca bu arazi üzerinde herhangi bir tarım faaliyeti yapmazsa o toprağın kendisinden geri alınacağı bildirilmişti. Zira asıl amaç tarımsal üretimi artırmak ve böylece bölgedeki maddi sıkıntılara çözüm sağlamaktı. Râşid Halifeler döneminde dünyanın en büyük nehirlerine ve en verimli tarım arazilerine sahip olan müslümanlar tarım hayatını yakından takip etmişler gerekli ölçüm ve takiplerle bölge tarımını canlı tutmaya çalışmışlardı. Bir taraftan büyük fetih hareketleri devam ederken ve müslümanlar savaşlarla meşgulken fethedilen bölgelerdeki kanalların bakımı ve sulama sisteminin genişletilmesi gibi çalışmalara da önem vermişlerdi. Ayrıca burada İslâm öncesinden itibaren önem arz eden bataklıkların kurutulması meselesiyle de ilgilenmişlerdi. Zira bu büyük nehirler göz ardı edildiğinde geniş arazilerin bataklığa dönüşmesi mümkündü. Dönemle ilgili bazı örnekler üzerinden yapılan değerlendirmelere ek olarak *Kitâbü'l-Harâc, el-ahkâmü's-Sultâniyye* ve *Siyasetnâme* gibi devlet yöneticilerine rehberlik gayesiyle kaleme alınan eserlerde bu konuların nasıl işlendiği üzerinde durulmuştur. Böylece erken dönem İslam tarihinde suyun tarım alanındaki kullanımı ve sulama sistemleriyle ilgili birtakım tespitler yapılmıştır.

Anahtar Kelimeler: İslam tarihi, tarım, su kaynakları, sulama sistemleri



MANAGEMENT OF WATER RESOURCES AND IRRIGATION SYSTEMS IN EARLY ISLAMIC HISTORY

ABSTRACT

It is known that some issues related to the use of water in agriculture have been discussed since the time of the Prophet. However, unlike this period, when the desert climate was dominant and the post-rain streams were rarely used in agriculture, mostly gardens were irrigated with well water, Muslims had recently dominated the world's major rivers and agricultural lands, including the Mesopotamian Region and the Nile Valley. At the same time, many farmers living on these lands were taken under Islamic rule. As a requirement of the religion of Islam, these people could never be pressured in terms of religion and belief. On the contrary, these fundamental rights and freedoms of citizens who wanted to continue in their own religion should have been guaranteed by the state itself. However, with the dominance in these regions, the control and management of agriculture passed to the Muslims. The Prophet had set some criteria for the regular use of rain flows, which are rarely seen in Medina, in the field of agriculture. It also provided incentives for water wells, which play an extremely important role in supporting agriculture and food supply in the region. He considered digging a well to extract water as sufficient to own a certain area of land around the well. However, if a person who has a right with an ihya activity did not do any agricultural activities on this land for three years, that land would be taken back. Because the main purpose was to increase agricultural production and thus to provide a solution to the financial problems in the region. During the caliphs, the Muslims, who had the world's largest rivers and the most fertile agricultural lands, followed the agricultural life closely and tried to keep the agriculture of the region alive. On the one hand, while the great conquest movements were continuing and the Muslims were busy with wars, they also gave importance to the works such as the maintenance of the canals in the conquered regions and the expansion of the irrigation system. In addition, they were also interested in the issue of draining the swamps, which had been important since pre-Islamic times. Because when these great rivers were ignored, it was possible for large lands to turn into swamps. In addition to the evaluations made on some examples related to the period, it has been emphasized how these issues are handled in the works written for the purpose of guiding the state administrators. Thus, some determinations were made about the use of water in agriculture and irrigation systems in the early Islamic history.

Keywords: Islamic history, agriculture, water resources, irrigation systems



1. GİRİŞ

İnsan için hayati bir değere sahip olan su, insanlık tarihinde yerleşik hayatın da temelini oluşturmuştur. Ancak pek tabidir ki suyun, yerleşik hayatın oluşumundaki başat rolü sadece içme suyu olması açısından değil aynı zamanda suladığı topraklardaki verimi arttırarak gıda teminini mümkün kılmasıyla doğrudan ilgilidir. Bu nedenle son yüzyıllara kadar yerleşik hayatın ve şehirleşmenin ortaya çıkıp gelişmesinde su kaynakları açısından yeterli olan verimli toprakların merkezi rol oynadığı bilinmektedir. Nitekim Fırat, Dicle ve Nil gibi büyük nehirlerin hayat verdiği topraklar tarih boyunca yoğun nüfuslara ev sahipliği yapmıştır.

Suyun tarımla olan ilişkisi sadece büyük nüfusların gıda temininde değil aynı zamanda devletlerin kalkınması ve medeniyetlerin gelişmesinde de oldukça etkili olmuştur. Zira son yüzyıllara kadar devletlerin en önemli gelir kaynaklarından biri tarım bölgelerinden her yıl düzenli olarak toplanan vergilerdi. Dolayısıyla devletler bir anlamda sahip oldukları verimli tarım arazileri ve üzerlerindeki çiftçileri oranında zengin ve güçlüydüler. Elde ettikleri bu güç ise medeniyetlerin inşasında son derece önemliydi. Nitekim Fırat ve Dicle nehirlerinin suladığı Mezopotamya bölgesinin “Medeniyetler Beşiği” olarak bilinmesi bunun başlıca örneklerinden biridir.

Tarımın bu değerinden ötürü söz konusu tarım arazilerine sahip olan devletler mümkün olduğunca bu arazileri en verimli şekilde işletmek durumundaydılar. Tarım politikaları hassasiyetle takip edilmeli, su imkanları mümkün olduğunca verimli bir şekilde kullanılarak sulama sistemleri geliştirilmeliydi. Devletler üzerlerine düşen sorumlulukları yerine getirdikten sonra çiftçilerden toprağı işlemesini ve gerekli vergiyi ödemesini bekleyebilirlerdi. Müslümanlar da Hz. Peygamber’den itibaren hâkim oldukları tarım alanlarının verimli bir şekilde yönetilmesi ve su kaynaklarının tarımda daha iyi kullanılabilmesi için bir takım tedbirler almışlar ve politikalar belirlemişlerdi. Bu sunumda erken dönem İslâm tarihinde su kaynakları ve sulama sistemlerinin tarım alanındaki kullanımı üzerinde durulacaktır.

Hz. Peygamber Medine’de nadiren görülen yağmur akıntılarının tarım alanında düzenli bir şekilde kullanılabilmesi için bazı kıstaslar belirlemiştir. Bölgede tarımın desteklenmesi ve gıda temini açısından son derece önemli bir rol oynayan su kuyuları konusunda da teşvikler yapmış ve bir kuyu kazarak su çıkarmayı etrafındaki belirli bir araziye sahip olmak için yeterli görmüştü. Ancak bu şekilde hak sahibi olan kimse üç yıl boyunca bu arazi üzerinde herhangi bir tarım faaliyeti yapmazsa o toprağın kendisinden geri alınacağını bildirmişti. Zira asıl amaç tarımsal üretimi arttırmak ve böylece bölgedeki maddi sıkıntılara çözüm sağlamaktı.

Râşid Halifeler döneminde dünyanın en büyük nehirlerine ve en verimli tarım arazilerine sahip olan müslümanlar tarımı yakından takip etmişler gerekli ölçüm ve takiplerle bölge tarımını canlı tutmaya



çalışmışlardı. Bir taraftan büyük fetih hareketleri devam ederken ve müslümanlar savaşlarla meşgulken fethedilen bölgelerdeki kanalların bakımı ve sulama sisteminin genişletilmesi gibi çalışmalara da önem vermişlerdi. Ayrıca burada İslâm öncesinden itibaren önem arz eden bataklıkların kurutulması meselesiyle de ilgilenmişlerdi. Zira bu büyük nehirler göz ardı edildiğinde geniş arazilerin bataklığa dönüşmesi mümkündü.

Dönemle ilgili bazı örnekler üzerinden yapılan değerlendirmelere ek olarak *Kitâbü'l-Harâc, el-ahkâmü's-Sultâniyye* ve *Siyasetnâme* gibi devlet yöneticilerine rehberlik gayesiyle kaleme alınan eserlerde bu konuların nasıl işlendiği üzerinde durulmuştur. Böylece erken dönem İslam tarihinde suyun tarım alanındaki kullanımı ve sulama sistemleriyle ilgili birtakım tespitler yapılmıştır.

2. HZ. PEYGAMBER DÖNEMİNDE TARIMSAL SU KAYNAKLARININ YÖNETİMİ

Hz. Peygamber'in doğup büyüdüğü Mekke şehri tarıma elverişli olmayan bir vadide bulunmaktaydı. Çöl şartlarının hâkim olduğu bir coğrafyada aşırı sıcak ve kurak ikliminin yanı sıra dağlık, taşlık arazileriyle bilinen bu şehirde tarih boyunca tarımdan bahsetmek çok güçtür. Belirli mevkilerinde kısıtlı oranlarda üretilen tarım ürünlerinin halkın geçimi hatta gıda tedariki açısından kayda değer bir katkısından bahsetmek de mümkün değildir.¹ Bu nedenle Mekkeliler ticaret gibi alanlara yoğunlaşmışlardı. Ayrıca Araplar tarafından kutsal kabul edilen Kâbe'nin burada bulunması onlar için bir gelir kaynağı sağlamaktaydı.

Dolayısıyla Mekke'de eskiden beri varlığı bilinen Zemzem Kuyusu'nun veya burada yerleşik hayata geçilirken açılan su kuyularının tarımla doğrudan ilgisi yoktu.² Şehrin tarıma elverişsiz bu yapısına ek olarak İslâm'ın Mekke dönemi boyunca Hz. Peygamber'in herhangi bir otoritesi bulunmadığından burada su kuyularıyla ilgili bir tasarrufta bulunması mümkün değildi.

Hicretten sonra ise Hz. Peygamber'in bütün şehirde lider olarak tanındığı bir dönem başladı. Aynı zamanda Medine Hicaz Bölgesi'ndeki önemli tarım şehirlerinden biriydi. Dolayısıyla İslâm dünyasında ilk defa burada su kaynaklarının tarımda kullanımıyla ilgili düzenlemeler yapılmıştı. Bilhassa hurma üretiminin yapıldığı bu şehirde bahçelerin sulanması önemli tarım işlerinden biriydi. Burada herhangi bir akarsu kaynağı bulunmadığı için bahçelerin sulanması büyük oranda kuyu sularıyla yapılmaktaydı. Nitekim genelde bahçelerin içerisinde kuyuların mevcut olduğu rivayetlerden anlaşılmaktadır. Hatta kaynaklarda zikredilen pek çok kuyudan sadece bazılarının içme suyu kaynağı olarak kullanıldığı bildirilmektedir.³ Bu durumda kuyuların daha çok sulama amacıyla kazıldığının ispatıdır. Nitekim kuyulardan çekilen sularla ağaçların sulandığını anlatan çeşitli rivayetler de

¹ İbn Hişam, *es-Sîretü'n-Nebeviyye*, I, 236; Makdisî, *Ahsenü't-Tekâsîm*, s. 71.

² Yâkût el-Hamevî, "Mekke", *Mucemü'l-Büldân*, V, 187.

³ Bkz. İbn Şebbe, *Târihu'l-Medine*, I, 146-147, 152-153, 165-169; Ya'kûbî, *Kitâbu'l-Büldân*, s. 96-97.



mevcuttur. Hatta kuyulardan çekilen suların taşınmasıyla hurma ağaçlarının sulanması oldukça zahmetli işlerden birisiydi. Bununla birlikte maddi sıkıntıların yaşandığı Medine’de bazı kimseler için bir iş imkanıydı. Örneğin müslümanlardan bazıları belirli miktar hurma veya maddi bir gelir karşılığında yahudilerin bahçelerini sulardı.⁴

Kuyuların Medine tarımındaki bu önemli rolü nedeniyle şehirde çokça kuyu bulunmaktaydı. Ancak bunlar bahçeler gibi özel mülk vasfındaydılar. Herhangi bir şekilde başkalarının hak iddia etmesi veya izinsiz olarak kendi bahçesini sulamasına izin verilmezdi. Bununla beraber içme suyu olarak kullanılması noktasında insanların menedilemeyeceği bizzat Hz. Peygamber tarafından bildirilmişti. Yani suyun hayati değerinden dolayı herkesin herhangi bir kuyudan su içme hakkı vardı. Ancak tarım alanlarının sulanmasında durum böyle değildi. Sahibinin izni esastı.

Kuyuların yönetimiyle ilgili olarak bilhassa kuyu kazma noktasında yapılan teşvikler önem arz etmektedir. Zira Medine her ne kadar bölgedeki tarı alanlarından biri olsa da maddi imkanları kısıtlı olan ve gıda temininde güçlüklerin yaşandığı bir şehirdi. Dolayısıyla tarımsal üretimini arttırılması bu problemlerin çözümü açısından önemliydi. Ayrıca Hz. Peygamber’in buraya hicretinden sonra İslam’a giren herkesin Medine’ye gelmesi şehirde bir nüfus artışına sebep olmuştu. Bu nedenle Hz. Peygamber kim sahihsiz/ölü bir arazide kuyu kazarsa her yönden etrafındaki belirli bir arazinin kendisine verileceğini ilan etmişti. Bazı rivayetlerde her yönde 40 zira olarak ifade edildiği görülmektedir. Ayrıca eğer buradan su çıkıp akmaya başlarsa suyun aktığı her mesafe için böyle bir teşvik söz konusuydu. Bu teşvikin amacı kullanım dışı atıl arazileri tarıma açmak ve üretime katkı sağlamaktı. Nitekim bu şekilde bir ihyâ faaliyeti ile toprak üzerinde hak sahibi olanlar üç yıl boyunca tarımsal bir faaliyet yapmazlarsa arazi üzerindeki haklarını kaybederlerdi.⁵

Hz. Peygamber kuyular dışında yağmur sonrası oluşan kısa süreli akıntılarının tarımda kullanılması konusunda bir ölçüt belirlemiştir. Zira kısa süreli bu sular çiftçiler arasında tartışmalara sebep olmaktadır. Bir defasında bu konuda tartışan iki sahâbî Hz. peygambere geldiklerinde sulama yapan kimsenin ekin tarlaları için parmaklara ve meyve ağaçları için topuklara ulaşınca suyu sonraki komşusu için bırakmasını uygun görmüştü.⁶ Aksi halde akış yönüne göre yukarıdaki çiftçilerin suyu kendi bahçelerinde daha fazla tutmak istemeleri diğerlerinin mağdur olmasına sebep oluyordu.

Hz. Peygamber’in suyun tarımda kullanımıyla ilgili getirdiği önemli kararlardan biri de sulama maliyetinin vergilendirmede dikkate alınmasıydı. Buna göre müslümanların toprak mahsullerinden alınan vergi miktarı yarı yarıya düşürülmüştü. Elde edilen mahsulden onda bir oranında alındığı için

⁴ İbn Mâce, Rehûn, 6.

⁵ Ebû Yusuf, *Harac*, s. 182; Yahya b. Adem, *Harac*, s. 118.

⁶ Buhârî, Şirb ve’l-Musâkât, 8.



“öşür/onda bir” olarak adlandırılan bu verginin sulamayla üretilen mahsullerde öşürün yarısı yani yirmide bir oranında alınması uygun görülmüştü.⁷ Çünkü çöl ikliminin etkin olduğu Arap Yarımadası’nda nispeten verimli bir bölge olan Medine’de dahi bahçe ve tarlaların su ihtiyacının karşılanması oldukça zor, meşakkatli ve masraflı bir işti. Hz. Peygamber adil bir vergi sistemi için bu hususu dikkate almıştı.

3. SONRAKİ DÖNEMDE TARIMSAL SU KAYNAKLARININ YÖNETİMİ

Hz. Peygamber’in vefatından sonra Hz. Ebû Bekir’in halife seçilmesiyle başlayan Hulefâ-yi Râşidîn döneminde müslümanlar dönemin iki büyük gücü olan Bizans ve Sâsânîler üzerine akınlar gerçekleştirmeye başladılar. Kısa bir süre sonra Sâsânîler’in bütün topraklarını hakimiyetleri altına alırlarken Bizans’tan ise Suriye, Filistin ve Mısır gibi çok büyük bölgeleri almayı başardılar. Dünyanın en büyük nehirleri ile en verimli tarım merkezleri de bu fetihlerden sonra müslümanların kontrolüne geçmişti.⁸ Fırat ve Dicle nehirlerinin bereketlendirdiği Mezopotamya ile Nil nehrinin suladığı Mısır tarih boyunca büyük nüfuslara ev sahipliği yapan medeniyet merkezleriydi. Ancak bu toprakların üzerlerindeki binlerce çiftçi ile hakimiyet altına alınması aynı zamanda büyük sorumluluklar gerektiriyordu. Özellikle tarımın gerekli tedbir, teşvik ve takiplerle iyi organize edilmesi çok önemliydi. Zira bu insanların geçimlerinin yanı sıra devlet hazinesi için en büyük gelir buradan sağlanmalıydı. Ayrıca artık çok geniş sınırlara sahip olan ve güvenlik başta olmak üzere çeşitli hizmet sahalarında büyük bütçelere ihtiyacı olan bir devlete dönüşmüşlerdi.

Halkın geçimi, refahın yükselmesi ve devlet hazinesinin güçlü olması açısından yukarıda bahsi geçen bu arazileri fetheden ikinci halife Hz. Ömer tarım politikalarıyla bizzat ilgilenmişti. Öncelikle fethedilen toprakların ve üzerindeki çiftçilerin ganimet sayılmasını yasaklamış, onları askerlere dağıtmayı doğru bulmamıştı. Bu çiftçileri topraklarında bırakarak karşılığında sistemli ve adil bir vergi alınmasını kararlaştırmıştı. Böylece topraklar devletin kontrolünde milletin ortak malı olmuş gelirler de bütün müslümanlara dağıtılmış ve çeşitli hizmetler için kullanılabilmişti. Bunlara ek olarak Hz. Ömer fetihlerle elde edilen arazileri ölçtürmüş ve insanlara maddi imkanlarına, arazilerinin ölçüsüne ve toprağın verimliliğine göre vergiler belirlenmesi için talimatlar vermişti.⁹

Müslümanların nehirler ve sulama sistemleriyle ilgili çalışmalarına bakıldığında bu işlere ehemmiyet verdikleri anlaşılmaktadır. Nitekim büyük savaşların devam ettiği bu ortamlarda bile bazı kanal faaliyetlerinin yürütüldüğü görülmektedir. Sulama sistemlerinin onarımı veya açılan kanallarla bu

⁷ Buhârî, Zekât, 55; İbn Mâce, Zekât, 17.

⁸ Bk. Fatih Oğuzay, *Hulefâ-yi Râşidîn Döneminde Tarım ve Toprak Sistemi*, 119-268.

⁹ Ebû Yusuf, *Kitâbu'l-Harâc*, s. 110-118; Yahya b. Adem, *Kitâbu'l-Harâc*, s. 40-42; İbn Zenceveyh, *Emvâl*, s. 182; Belâzurî, *Fütûhu'l-Büldân*, s. 370- 375; Ayrıca bk. Oğuzay, *Hulefâ-yi Râşidîn Döneminde Tarım ve Toprak Sistemi*, 279-291.



sistemlerin genişletilmesi ilk andan itibaren üzerinde durulan bir mesele olmuştu. Zira bu çalışmalar tarım arazilerinin genişletilmesi, sulu tarım faaliyetleriyle verimin artması için gerekliydi. Böylece insanların geçiminin yanı sıra her yıl alınacak olan vergi miktarı da artacaktı. Ayrıca artan tarımsal üretimi gıda tedarikini kolaylaştırıp ve hatta ticarete güç verip refah artışına katkı sağlayacaktı.

Yukarıda sayılan bu etkileri nedeniyle su kanallarıyla ilgili projelerin bizzat devlet tarafından yapılması veya desteklenmesi gerekirdi. Ayrıca bu türden çalışmaların çiftçiler arasında organize edilmesi oldukça zor olduğu gibi maliyetinin veya işgücünün onlar tarafından karşılanması da mümkün değildi. Nitekim bu meseleleri ele alan alimler nehir ve kanallarla ilgili işlerin devletin sorumluluğunda olduğunu ve bu işlerde masraftan kaçınılmaması gerektiğini ifade etmişlerdir. Aksine bu alanda yapılan yatırımların hem halkın memnuniyetine ve geçim kolaylığına vesile olacağı hem de devlet gelirlerini arttıracığını belirtmişlerdir.

Nehirlerin ve sulama sistemlerinin ihmal edilmesi tarım alanlarının azalmasına sebep olacaktı. Kanalların bakımlarının yapılmaması tarımdaki verimi düşürmekle kalmayacak bazı toprakların tarım dışı kalmasına ve hatta terk edilmesine sebep olabilecekti. Nitekim uzun müddet devam eden Bizans-Sâsânî savaşlarına İslâm fetihleri de eklenince devletler bu türden faaliyetler için yeterli bütçe ve zaman ayırmakta sıkıntılar yaşamışlardı. Dolayısıyla müslümanlar aslında pek çok problemle birlikte bu toprakları teslim almış oldular. Bu açıdan zerinde durulması gereken konulardan birisi bataklıklar meselesidir. Bilhassa Fırat-Dicle nehirlerinin birleştiği Güney Mezopotamya bölgesi tarih boyunca sulak, bataklık bir kesim olarak tasvir edilmektedir. İhmal durumunda bölgedeki bataklıkların genişlemesi mümkün olduğu gibi aksine açılan kanallarla mücadele edildiğinde ise tarım alanlarının genişletilmesi ve yeni verimli arazilerin tarıma açılması mümkün olmaktadır. Bu nedenle bataklıklar müslüman idarecilerin takip ettiği ve devletin üzerinde çalıştığı bir konu olmuştur. Bazen bu amaçlarla bataklıklar imkân sahibi kimselere ıslah etmesi ve tarıma açması karşılığında verilmişti.

Hz. Peygamber sonrasında suyun tarımda kullanımının vergi miktarlarının belirlenmesinde etkili olduğu görülmektedir. Ancak Hz. Peygamber döneminde sulamadaki zorluk esas alınarak yarı yarıya vergi indirime gidilirken sonrasında ise doğal nehir ve akarsular ile sulama sistemlerinin ulaştığı arazilerin verimi dikkate alınarak çorak arazilere göre daha fazla vergiye tabi tutulmuştu. Ayrıca sel baskınları gibi afetlerin hasadı telef etmesi gibi durumlarda çiftçilerden vergi yükümlülüğü kaldırılırdı.¹⁰

Nehirlerle ilgili dikkat çeken bir düzenleme de mevcuttur. Rivayetlere göre Hz. Ömer döneminde İslâm hakimiyetine alınan Nil nehriyle ilgili bölge halkının ilginç bir uygulaması vardı. Halk nehrin

¹⁰ Mâverdî, *Ahkâmu 's-Sultâniyye*, s. 190.



verimliliğini sağlamak ve suyunun azlığı veya çokluğu gibi nedenlerle oluşabilecek zararlarından emin olmak için her yıl bir kız çocuğunu güzelce giydirip süsleyerek nehre atıyordu. Bu haber halifeye geldiğinde bunu derhal yasaklamıştı. Ayrıca insanların bu batıl inançla bir bağlantı kurmamaları için Nil Nehri'nin o yıl düzenli ve verimli olması için dua etmiş hatta bu amaçla yazdığı bir kâğıdı nehre attırmıştı.¹¹

Emevîler ve Abbasiler dönemlerinde de nehirler ve sulama kanallarıyla ilgili politikalar geliştirilmiş ve uygulanmıştı. İlk Emevî halifesi Muaviye b. Ebû Süfyân'ın bataklıkların kurutulması için çalışmalar başlattığı bilinmektedir. Onun döneminden itibaren valilerin önemli görevlerinin başında bataklıkların kurutulması ve kanalların açılması gelmekteydi. Meşhur Irak valisi Haccâc'ın da bataklıkların kurutulması için halifeden üç milyon dirhem istediği bilinmektedir. Valilerin bu konulardaki yoğun çabalarına rağmen Emevîler döneminde bataklıklar oldukça geniş arazileri işgal ediyordu.¹²

Abbasîler de tarım alanlarının kontrolüne çok önem vermişler bu nedenle nehirler ve sulama sistemleriyle yakından ilgilenmişlerdi. Büyük bütçeler ayırarak gerek bataklıkların ıslahı gerekse eski sulama sistemlerinin yeniden açılması ve yeni kanalların ilavesiyle tarımı geliştirmek için büyük çabalar sarfetmişlerdi. Bu işler için milyonlarca dirhem ayrıldığı ve Abbasiler döneminde Mezopotamya'da birçoğu yeni açılmış yüzlerce kanalın bulunduğu aktarılmaktadır. Bunun sonucu olarak mamur ve bereketli köylerin bu arazilerde dizildiği tasvir edilmekte devletin de bu alanda yaptığı harcamaları vergiden telafi ettiği bazı örneklerle ifade edilmektedir. Ayrıca insanların küçük bir araziden gıdalarını karşılayabildiği ve refahın yükseldiği anlaşılmaktadır.¹³

Devletin ve devlet adamlarının yaptırdığı kanallar dışında kabile reislerinin, toprak sahiplerinin veya sermayedarların da kanallar kazdırdığı anlaşılmaktadır. Zira pek çok kanal sahiplerinin ismiyle anılmaktaydı. Bu da fetihlerden itibaren müslümanların tarıma ne kadar önem verdiklerini ve büyük çabalar harcayarak yüksek maliyetli bu işlere giriştiklerini göstermektedir.

¹¹ İbn Abdülhakem, *Fütûhu Mısır ve'l-Magrib*, s. 203-204; İbn Kesîr, *el-Bidâye ve'n-Nihâye*, X, 96-97.

¹² Belâzurî, *Fütûhu'l-Büldân*, s. 411-413; Mâverdî, *el-Ahkâmü's-Sultâniyye*, s. 234-235; Özaydın, "Hâlid b. Abdullah el-Kasrî", *DİA*, XV, 282.

¹³ Belâzurî, *Fütûhu'l-Büldân*, s. 500-519; Makdisî, *Ahsenü't-Tekâsîm*, s. 117; Abbasiler Dönemi kanal çalışmalarlarıyla ilgili örnekler için bk. Mustafa Demirci, *İslam'ın İlk Üç Asrında Toprak Sistemi*, 282-288.



4. TARIMSAL SU KAYNAKLARI VE SULAMA SİSTEMLERİYLE İLGİLİ İLKELER VE UYGULAMALAR

Su kuyuları, yağmur sonrasında oluşan geçici akıntılar, nehirler ve sulama kanallarıyla ilgili çeşitli problemlerin ilk dönem İslâm tarihinde gündeme geldiği görülmektedir. Bilhassa Hz. Peygamber'den sonra gerçekleşen fetih hareketleriyle dünyanın en verimli tarım bölgeleri üzerindeki nehirler, kanallar ve sulama sistemleriyle müslümanların eline geçtiğinden bunların idaresi son derece önemliydi. Alimler bu konularda yöneticilere yol gösterecek temel prensipleri kaleme almışlardı. Örneğin Abbasiler döneminde adalet sisteminin başında bulunan meşhur alim Ebû Yusuf, devlet yönetiminde idarecilere yol göstermek amacıyla kaleme aldığı eseri *Kitâbü'l-Harac*'da nehirler, sulama kanalları, suyun kullanım hakkı gibi çeşitli meseleleri Hz. Peygamber'in uygulamalarını merkeze alarak değerlendirmiş, pek çok meselede temel ilkeleri belirlemiştir. Bu konularda insanların sorumluluklarını ve devletin görevlerini açıkça beyan etmiştir. Benzer amaçla kaleme alınan sonraki eserlerde de bu konuların işlendiği görülmektedir. Su kaynakları ve sulama sistemleriyle ilgili ilmi manada araştırılan ve devlet tarafından uygulamaya konulan başlıca prensiplerin verilmesi uygun görülmüştür.¹⁴

1) Büyük nehirlerde yolcuların ve amme menfaatinin korunması: Büyük nehirlerin kenarlarında veya içerisinde ortaya çıkan adalarda tarımsal üretim amacıyla yapılan yapılar herhangi bir şekilde gemiler ve yolcular için tehdit oluşturuyor hatta korkuya sebep oluyorsa derhal yıktırılmalı ve benzer çalışmalara asla müsaade edilmemeliydi. Ayrıca arazi sahibi bazı kimselerin kendi topraklarına su taşımak amacıyla büyük nehirlerden doğrudan açtıkları kanallar da gemilere zarar verebilirdi. Hatta rüzgârlı zamanlarda gemilerin bu bentlere sürüklenmesi gibi ihtimaller de göz önüne alınarak kaçak kanallara müsaade edilmemeliydi. Eğer herhangi bir kazaya sebebiyet verirlerse kanal sahipleri gemilerin ve yolcuların kaybını tazmin etmek zorundaydı. Bu hususların ilan edilmesi ve hatta bütün nehirlerin görevliler tarafından kontrol edilerek uygunsuz yapıların acilen yıktırılması elzemdi.

Büyük nehirler, akarsular ve hatta dereler gibi su kaynakları herkesin ortak malıydı. Asla birileri bunları veya bir kısmını sahiplenip insanların kullanımını engelleyemezdi. Hatta bu ortak su kaynaklarının kenarında bulunan birilerinin nehirlerden aldıkları suları yolculara kervanlara, onların hayvanlarına içme suyu olarak satmaları da doğru değildi. Herkesin bu ortak kaynaklara ulaşma hakkı temin edilmeliydi. Nehir kenarında mülk arazisi olan bir kimse, şayet başka bir yol yoksa insanların nehre ulaşmak için kendi arazisinden geçmelerini yasaklayamazdı.

¹⁴ Maddeler halinde özetlenen bu temel ilke ve uygulamalar için bk. Ebû Yusuf, *Kitâbu'l-Harâc*, 232-249; Yahyâ b. Adem, *Kitâbü'l-Harac*, s. 127-137; Mâverdî, *el-Ahkâmü's-Sultâniyye*, s. 231-241.



Büyük nehirlerin ve herkesin ortak malı kabul edilen doğal kaynakların temizlik, bakım ve benzeri işlerin bizzat devlet tarafından yapılması gerekli görülmüştü. Zira bunlar büyük toprak sahiplerinin veya çiftçilerin yaptığı özel kanallar değildi. Ayrıca onların gücünü aşan bir organizasyon ve bütçe gerektirmekteydi. Diğer taraftan bu icraatlar arazilerden vergiyi toplayan devletin sorumluluğu ve bekası açısından önemliydi.

2) Nehir ortasında veya kenarında sonradan ortaya çıkan araziler ile bataklıkların tarıma açılması: Fırat ve Dicle gibi nehirlerde suyun çekilmesi sonucu ortaya çıkan adalarda tarım yapılması meselesi ele alınmıştır. Burada tarım yapmak isteyen kimseler su tekrar çoğaldığında burayı yeniden ele geçirmesin diye setler yaparak tarım yaptıkları yeni arazilerini koruma altına almaktaydılar. Suların çekilmesiyle açılan bu araziler daha önce kimseye ait olmadığı için “mevât/ölü” arazi hükmünde olduğundan çeşitli faaliyetler ile tarımsal üretime geçen insanların burada hak sahipliği mümkündü. Ancak büyük nehirler üzerindeki bunun gibi faaliyetler devletin iznine tabi olmalıydı. Zira nehir içlerinde veya kıyı kesimlerinde ortaya çıkan adalarda yapılacak olan setler ve benzeri faaliyetler çeşitli açılardan başkalarına zarar verebilirdi. Örneğin aktif ulaşım güzergahı olarak kullanılan nehirlerde gemilere zarar vermesi mümkündü. Ayrıca yakın adalarda yapılacak olan çalışmaların komşu evleri zarara uğratması mümkündü. Bu nedenle herkesin ortak malı olan nehirlerde suların çekilmesiyle ortaya çıkan toprak üzerinde tarım yapmak ve sahiplik iddiasında bulunmak ancak idarenin iznine bağlıydı. Yönetim de başkalarının mağdur olmayacağından emin olmadan izin veremezdi.

Büyük nehirlerde ortaya çıkan bu adalara bazı kimselerin sadece kendi evine veya arazisine yakın olduğu iddiasıyla sahip çıkmasına izin verilemezdi. Sahiplik kazanmak için çeşitli emeklerle tarım arazisine çevirmek ve üretime geçtikten sonra vergisini de ödemek şarttı. Ancak komşu olan kimseler bu işleri yapmak koşuluyla araziye isterlerse komşuluk hakkı gereği onlara verilmesi daha uygundu. Şehirlerin uzağında bulunan adaları ihyâ edenlere ise müdahale edilmez onlar araziye işleyip vergisini verdikleri müddetçe toprak kendilerine aittir. Benzer şekilde nehirlerin kıyısındaki bazı arazileri veya bataklıkları çeşitli setlerle veya kanal sistemleriyle tarım arazisine çevirenler de mevât arazi hükmünde olan bu topraklarda yaptıkları ihyâ faaliyetlerinin karşılığını alırlardı.

İhya edilecek arazinin mevât olması şarttı. Yani herhangi bir şahsî veya tüzel kişiliğe ait iken sular altında kalan bir arazi sular çekildiğinde başkaları tarafından ihyâ bahanesiyle sahiplenilemezdi. Böyle yapanlardan alınıp eski sahibine verilmesi gerekli görülmüştü.

Suların çekilmesiyle ortaya çıkan araziye veya bir bataklığı birisi ihyâ ederken başkaları da gelip ortaklık iddia ederse duruma bakılmalıydı. Eğer ilk şahıs gerekli çalışmaları yaptıktan sonra diğeri



gelmişse hak iddia edemez ortak olamazdı. Ancak geldiğinde kendisi de çalışmalara destek olarak bölgeyi tarım arazisine çevirme işlerine katılmış ise ortaklık hakkı vardı.

3) Sulama sistemlerinin teşviki ve bakımı: Hz. Peygamber'in kuyular için belirlediği 40 zira genişliğin taşıp akmayan kanallar için uygun olacağı belirtilmiştir. Yani mevât bir araziye kuyu kazan veya kanal sistemi oluşturan kimse burada hak sahibiydi. Şayet sulama sistemi kurmuşsa kanal boyunca belirli mesafesindeki bir arazi üzerinde hak sahibi olurdu. Başka birisi bu sınırlar içerisinde hak iddia edemez kuyu kayamazdı.

Belirli bir güzergahta açılan kanalların belli aralıklarla temizlenmesi kanalın geçtiği bölgede arazisi olan ve bu suyu kullanan çiftçilere aitti. Her arazi sahibi kanalın kendi arazisi boyunca uzayan kısmının temizliğinden sorumluydu. Ancak gerek görülürse devlet kanalı temizletir ve kanaldan istifade eden arazi sahiplerine adil bir oranda bu masrafı paylaşırdı. Özel kanalın herhangi bir yerinin yıkılması durumunda ise sadece yıkıldığı kısımdaki tarla sahibinin değil istifade eden herkesin bu yükümlülüğün altına girmesi gerekirdi. Aksi halde yıkılan kanaldan kimsenin istifade etmesi mümkün olmazdı.

4) Sulama sistemleriyle ilgili şikayetlerin değerlendirilmesi: Nehirlerden açılan kanalların bazı ev sahiplerini rahatsız ettiği şeklinde şikayetler geldiğinde öncelikle bu kanalların ne zaman açıldığına bakılmalıydı. Eğer bunlar önceki dönemlerden kalan kadim sistemler ise onlara dokunulmazdı. Ancak valiler veya devlet adamları tarafından sonradan açılmışsa bu durumda da menfaatlerine bakılırdı. Eğer önemli bir menfaat söz konusu ise yine kapatılması doğru olmazdı. Fakat ev sahiplerine verdiği rahatsızlığa karşın bölgede ciddi bir faydası da yoksa kapatılması gerekirdi.

Özel kanal sahiplerinin izni olmadan başkalarının bu suyu tarımda kullanması mümkün değildi.

İhtiyaç fazlası suyun başkalarına sulama yapması için satışı da uygun görülmemekteydi. Nitekim Hz. Peygamber'in uyarıları nedeniyle sonraları büyük tarım arazilerine ve özel sulama kanallarına sahip olan sahâbenin ihtiyaç fazlası suyu satın almak isteyen komşularına ücretsiz olarak verdiği görülmektedir.

Nehirler herkesin istifadesine açıktı. Ancak buralarda açılacak olan özel kanalların ve sulama sistemlerinin idarenin iznine tabi olması gerekli görülmüştü. Birinin yaptığı çalışma diğerlerinin zararına olmadığı müddetçe devlet de bu işlere izin vermeliydi.

Kanal sahipleri sulama sistemlerini kontrol etmeli, bakımlarını yapmalıydı. Oluşacak taşkınlarla komşuların mağdur edilmemesi için gerekli tedbirleri almalıydı. Ancak böyle bir kaza durumunda komşuların zararını tazmin etmesi gerekli değildi.

Özel sulama sistemlerinin geçtiği komşulardan biri daha sonra kendi arazisinden kanalın geçmesini engelleyemez, kapatmaya kalkışamazdı.



Kanallardaki balıkların durumu dahi tartışılmış ve av hayvanı hükmünde olduğundan kimin arazisindeki kanalda olursa olsun balıkların yakalayana ait olduğu beyan edilmiştir.

5) İçme suyu hakkının önceliği ve dokunulmazlığı: Birileri tarafından şikâyet konusu olan kanallar herhangi bir köyün veya bazı insanları içme suyu kaynağı ise asla kapatılamazdı. Hatta birileri rahatsız oldukları gerekçesiyle bunu kapatır veya tahrip ederse şiddetle cezalandırılmalıydı. Çünkü içme suyu hayati bir öneme sahiptir ve asla menedilemez.

Bir yerleşim yerine veya bazı insanlara gelen içme suyunu başkaları sulama amacıyla kullandığı taktirde su sıkıntısı yaşanırsa derhal sulama yapanlar engellenmeli ve içme suyu tedariki garanti altına alınmalıydı.

Kanal sahipleri içme suyu olarak kullanmak isteyen kimseyi menedemezlerdi. Yani kendi özel mülkünde bulunan veya kendi emeğiyle çıkardığı kuyu, pınar gibi kaynaklar ile kendi yaptığı su bentleri gibi kaynaklardan insanların hatta hayvanların içme suyu ihtiyacının karşılanması asla engellenemezdi.

Bir kimsenin, başkalarına ait özel su kanalından, arkından izinsiz olarak kendi bahçesini sulaması suçtu. Ancak içme suyu olarak su çekilmesinde bir sakınca yoktur. Zira Hz. Peygamber kesin ifadeleriyle içme kaynağı olarak su insanların ortak malıdır, menedilemez. Hatta tarım arazilerinin, otlakların harap olması endişesiyle bile olsa başkalarının bu sudan içmesi engellenemez.

SONUÇ

İnsan için hayati bir değer taşıyan su aynı zamanda yerleşik hayatın, şehirleşmenin ve medeniyetin temelini oluşturmuştur. Bilhassa son yüzyıllara kadar su kaynakları açısından zengin, verimli topraklar büyük nüfuslara ev sahipliği yapmış ve medeniyetlerin gelişmesine katkı sağlamıştır. Dolayısıyla devletler için en önemli işlerden biri sahip oldukları arazilerdeki tarımsal üretimi sistemli bir şekilde geliştirmektir. Bu amaçla tarımsal su kaynaklarının sistemli bir şekilde kullanılmasını sağlayarak sulu tarım arazilerini genişletmek ve tarımsal üretimi arttırmak önemliydi.

Hz. Peygamber, Medine döneminde su kuyularının ve yağmurlardan sonra oluşan akıntıların kullanımıyla ilgili meselelerde sistemli çözümler getirmişti. Ayrıca kuyu kazılması ve böylece tarımsal üretimin artırılması amacıyla teşviklerde bulunmuştu. Zira her ne kadar Medine bir tarım şehri olsa da çöl ikliminin etkin olduğu Arap Yarımadası'nda maddi zorlukların yaşandığı ve hatta gıda tedarikinde sıkıntıların çekildiği bir şehirdi. Bu nedenle bütün tarım toplumlarında olduğu gibi bir yönetici olarak Hz. Peygamber de tarımsal su kaynaklarıyla ilgilenmiş ve tarımsal üretimin artırılmasını hedeflemişti.

Hz. Ebû Bekir ile başlayan halifeler döneminde ise gerçekleştirilen İslâm fetihleri sonucunda Mezopotamya ve Nil bölgesi gibi dünyanın en büyük nehirlerinin yer aldığı başlıca tarım merkezleri



müslümanların eline geçti. Bu andan itibaren müslüman yöneticiler bölge tarımını geliştirmek için çabalar sarfettiler ve gerekli durumlarda ayırdıkları büyük bütçelerle nehirlerin ve sulama sistemlerinin bakım ve ıslahıyla ilgilendiler. Bataklıkların kurutulmasıyla tarım arazilerinin genişletilmesinden eski sulama sistemlerinin tamirine ve yeni kanal sistemleriyle tarımsal su kaynaklarının daha verimli kullanılmasına kadar çeşitli çalışmalar hassasiyetle sürdürüldü. Bölge valileri bu işleri yakından takip ederek tarımsal üretimi ve bu üretimden alınan vergiler sayesinde devlet gelirlerini arttırmak için çalıştılar.

Büyük nehirler, akarsular, pınarlar ve hatta kuyu sularının adil, sistemli ve verimli bir şekilde kullanılabilmesi için alimler tarafından belirlenen temel ilkeler yöneticiler tarafından uygulandı. Bu konularda kimsenin başkalarını mağdur etmesine, haksız kazanç sağlamasına veya çeşitli bahanelerle toplumun refahını ve devletin hazinesini doğrudan ilgilendiren tarımsal üretimi zarara uğratmasına izin verilmemesi için tedbirler alındı.

Tarımsal su kaynaklarının verimli kullanılması amacıyla alınan tedbirlerin sahada uygulanması sayesinde İslâm hakimiyetine giren bu tarım merkezlerinden her yıl düzenli olarak toplanan vergiler çok yüksek rakamlara ulaşmaktaydı. Nitekim ilerleyen zamanda varlığını gösteren İslâm Medeniyetinin maddi kaynağını önemli ölçüde bu vergiler temin etmiş olmalıydı. Şayet su kaynaklarının yönetiminde ihmaller nedeniyle ciddi problemler yaşansaydı bir medeniyet inşasının aksine halkın geçimini sağlamak dahi mümkün olmazdı.



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ÖZET

Kırsal turizm, bir destinasyondaki tarım, hayvancılık, endemik bitki çeşitliliği gibi kırsal kaynaklara yönelik gerçekleştirilen turizm hareketlerinin genel adıdır. Kırsal turizm, özellikle denize kıyısı olmayan, deniz kum güneş turizminden elde edilen gelirlere faydalanamayan kırsal alanların, turizm gelirlerinden pay alabilmelerini sağlayan önemli bir alternatif turizm türüdür. Ayrıca, kırsal turizm, insanların geçimlerini kırsal kaynaklardan sağladığı bölgelerde kırsal kalkınmanın sağlanabilmesi açısından da oldukça önemlidir. Zira kırsal turizm faaliyetlerinin geliştirilmesi ile kırsal kaynakların pazarlanmasına katkı sunulabilmektedir. Kırsal turizm faaliyetleri aracılığıyla kırsal alanlarda yaşayan kişilerin tarım ve hayvancılık alanında sağlamış oldukları gelirlere ek olarak turizm gelirleri elde etmeleri için imkân oluşturulabilmektedir. Bu sayede kırsal alanlarda yaşayan nüfusun refah seviyesi yükseltilerek, ekonomik imkansızlıklar nedeniyle kırdan kente yapılan göçler önlenip, kırsal kalkınmaya katkı sağlanabilmektedir. Muş İli Türkiye'nin üçüncü büyük ovasına sahip, nüfusunun yarısından fazlasının kırsal alanlarda yaşamış olduğu ve kırsal turizme konu olabilecek birçok endemik bitki türünü barındıran önemli bir ilimizdir. Ayrıca, ilde kırsal alanlarda yaşanan imkansızlıklardan dolayı kırdan kente göç olayları da çok fazla yaşanmaktadır. Bu açıdan ilde kırsal kalkınmanın sağlanarak kırsal nüfusun refah seviyesinin yükseltilip, kırdan kente göçün önlenmesi için kırsal turizmin geliştirilmesi oldukça önemlidir. Bu nedenle bu çalışmada Muş İlinin kırsal turizm potansiyelini ortaya çıkarabilmek adına bir tur rotasının önerilmesi amaçlanmıştır. Bu amaç doğrultusunda Muş ilinde bulunan kırsal turizm kaynakları ve turizme konu olabilecek diğer çekicilik unsurları değerlendirilerek örnek bir tur rotası ve tur programı oluşturulmuştur. Oluşturulan bu tur rotası ve programı, ilde başta kırsal turizm olmak üzere turizme konu olabilecek çekiciliklerin bireysel seyahat planı yapan ziyaretçilere ve bölgeye yapılan paket turları düzenleyen organizatörlere tanıtılması açısından ışık tutabilecek niteliktedir.

Anahtar Kelimeler: Kırsal turizm, tur rotası, muş ili.



A RURAL TOURISM TOUR ROUTE RECOMMENDED TO MUŞ PROVINCE

ABSTRACT

Rural tourism is the general name of tourism activities carried out for rural resources such as agriculture, animal husbandry, endemic plant diversity in a destination. Rural tourism is an important alternative tourism type that enables rural areas that do not have a coastline and cannot benefit from the incomes obtained from sea-sand-sun. In addition, rural tourism is very important in terms of ensuring rural development in regions where people make their living from rural resources. Because, with the development of rural tourism activities, it can contribute to the marketing of rural resources. Through rural tourism activities, it is possible to create opportunities for people living in rural areas to obtain tourism income in addition to the income they have provided in the field of agriculture and animal husbandry. In this way, the welfare level of the population living in rural areas can be increased, and migration from rural to urban areas due to economic impossibilities can be prevented and rural development can be contributed. The province of Muş is an important province with Turkey's third largest plain, where more than half of its population lives in rural areas, and contains many endemic plant species that can be the subject of rural tourism. In addition, due to the impossibilities experienced in rural areas in the province, migration from rural to urban is also experienced a lot. In this respect, it is very important to develop rural tourism in order to increase the welfare level of the rural population by providing rural development in the province and to prevent migration from rural to urban areas. Therefore, in this study, it is aimed to propose a tour route in order to reveal the rural tourism potential of Muş Province. For this purpose, an exemplary tour route and tour program has been created by evaluating the rural tourism resources in Muş and other attractiveness factors that can be the subject of tourism. This tour route and program, which has been created, can shed light on the attractions that can be the subject of tourism, especially rural tourism, to the visitors who make individual travel plans and to the organizers who organize package tours to the region.

Keywords: Rural tourism, tour route, muş province.



1. GİRİŞ

Günümüzde değişmekte olan turizm anlayışı, insanları deniz-kum-güneş turizmi ile birlikte alternatif turizm türlerine yönlendirmeye başlamıştır. İnsanlar artık seyahat planlarını kültür, sanat, gastronomi spor, vb. alanlarda farklı deneyimler yaşamak üzere yapmaktadır. Bu alanların başlıcalarından birisi olan kırsal turizm de insanları turistik hareketlere yöneltmekte ve onlar için seyahat motivasyonu oluşturabilmektedir. Kırsal turizm, kırsal alanlardaki kaynaklar kullanılarak gerçekleştirilen turizm faaliyetlerine bu alanla ilgili motivasyona sahip ziyaretçilerin eğlenme, dinlenme, boş zamanlarını değerlendirme, şehir yaşamının stresli ortamından uzaklaşma vb. gibi çeşitli amaçlarla katıldığı bir alternatif turizm türü olarak kabul edilmektedir. Kırsal turizm, deniz-kum-güneş turizmi ile kıyaslandığında yılın on iki ayı boyunca sürdürülebilir ve kıyı kesiminde yer almayan illerin de ülke içerisinde oluşan turizm gelirlerinden pay alabilmelerini sağlayan önemli bir alternatif turizm türüdür. Bu nedenle kırsal turizm, özellikle kıyı kesiminde bulunmayan destinasyonların pazarlanması açısından son derece önemlidir.

Kültürel ve tarihi açıdan birçok önemli değeri barındıran, zengin bir gıda çeşitliliği ve mutfak kültürüne sahip, tarım ve hayvancılık faaliyetlerinin yoğun bir şekilde gerçekleştirildiği Muş İli de kırsal turizme yönelik faaliyetlerin geliştirilebileceği önemli bir destinasyon olarak görülmektedir. Geniş tarım arazilerine sahip Muş İli, nüfusunun büyük bir bölümünün geçimini tarım ve hayvancılık faaliyetlerinden elde edilen gelirlerle sürdürdüğü illerden birisidir. Ayrıca, Muş İli kırsal alanlarındaki teknoloji, araç-gereç, vb. gibi yetersizliklerden kaynaklanan sebeplerle kırdan kente göç olaylarının yoğun bir şekilde yaşandığı illerdendir. Muş İlinde kırsal turizmin geliştirilmesi sayesinde kırsal alanlarda yaşamakta olan nüfusun tarım ve hayvancılık faaliyetlerinden elde etmiş oldukları gelirlere ek olarak turizm faaliyetlerinden gelir elde edebilme imkânına kavuşacağı düşünülmektedir. Bu şekilde kırsal alanlarda yaşayan nüfusun istihdam problemleri yerinde çözülerek kırdan kente göçün azaltılabileceği ve tersine göç olaylarının başlayabileceği düşünülmektedir. Bu nedenle bu çalışmada muş ilinde kırsal turizmin geliştirilmesine katkı sunabilmek amacıyla bir kırsal turizm rota önerisi ve örnek tur programı hazırlanmıştır. Bu amaç doğrultusunda öncelikle kırsal kalkınma ve kırsal turizm ilişkisi incelenerek Muş İlinin kırsal turizm potansiyeli değerlendirilmiştir. Daha sonra ilde kırsal turizme konu olabilecek çekicilikler üzerinden bir kırsal turizm tur rotası önerisinde bulunulmuş ve 5 gece 6 günden oluşan örnek bir tur programı hazırlanmıştır.



2. KIRSAL KALKINMA VE KIRSAL TURİZM

Kırsal kalkınma; kırsal bölgelerde yaşayan kişilerin kültürel ve sosyo-ekonomik yapılarını değiştirebilecek derecede gelir, üretim ve refah seviyelerinin artırılması, kırsal alanlarda yaşanmakta olan dengesizliklerin ortadan kaldırılması, kentsel alanlarda mevcut olan toplumsal ve fiziksel alt yapının kırsal alanlarda da sağlanması, tarımsal üretimin daha verimli hale getirilmesi ile ilgili süreçleri, etkinlikleri ve örgütlenmeleri ifade etmektedir (Özdemir, 2012). Kırsal kalkınmanın temel amacı; kırsal alanlardaki mevcut kaynakların etkili bir şekilde kullanılmasıyla kırsal ile kent nüfusu arasındaki ekonomik ve sosyo-kültürel boyuttaki gelişmişlik farkını en aza indirmek, kırsal alanlarda yaşayan nüfusa yönelik istihdam olanaklarını arttırarak kırdan kente göçü önlemek ve kırsal alanlardaki nüfusun yaşam standartlarını yükseltmektir. Dünya genelinde gelişmekte olan ve gelişmiş ülkelerde, turistik arz kaynaklarının, kırsal turizme yönelik amaçlarla kullanılmasıyla başlayan kırsal yörelerin ekonomilerinin geliştirilmesine ilişkin faaliyetler giderek artmaktadır (Çeken vd, 2007). Başka bir ifade ile gelişmişlik seviyeleriyle orantılı bir şekilde ülkeler, kırsal turizme yönelik turistik unsurlarını değerlendirerek toplumsal refah seviyesini arttırmaya çalışmaktadırlar (Cengiz ve Akkuş, 2012)

Küçükaltan (1997) kırsal turizmi; kişilerin sürekli olarak ikamet ettikleri yerler dışında kalan kırsal alanları ziyaretleri, bu alanlarda tarım üreticilerinin üretmiş oldukları mal ve hizmetleri, yörenin doğal dokusuna uygun bir şekilde tasarlanmış mekânlarda talep ederek ve yörede para arttırma arzularını minimize ederek geçici konaklamalarından doğan olaylar ve ilişkilerin bütünü olarak ifade etmektedir. Başka bir tanımda ise kırsal turizm; kırsal faaliyetlerin yoğun olarak yaşandığı kırsal alanlarda gelişim gösteren, turistlerin bu faaliyetlere eğlenme, dinlenme, boş zamanlarını değerlendirme, yeni deneyimler yaşama, şehir hayatının stresli ortamından kısa süreli ayrılma amaçlarıyla katıldıkları alternatif turizm türü olarak belirtilmektedir (Kadanalı ve Yazgan, 2012).

Kırsal turizmin doğanın korunmasının yanı sıra, kırsal alanlarda yaşayan insanlara ek kazanç sağlama, kırsal kalkınmaya katkıda bulunma, doğal ve kültürel mirasın restore edilerek yaşatılmasına katkı sunma hususlarında çeşitli etkileri mevcuttur (Ahipaşaoğlu ve Çeltek, 2006). Ayrıca kırsal alanlarda gerçekleştirilen ekonomik faaliyetlerin kısıtlı olması nedeniyle kırsal turizm, doğada mevcut olan kaynakların ekonomik olarak etkin bir şekilde değerlendirilmesi aracılığıyla yöre halkının sosyo-ekonomik açıdan gelişmesine ve yörenin kalkınmasına katkı sağlayacaktır (Kızılaslan ve Ünal, 2014). Başka bir deyişle kırsal turizm aracılığıyla kırsal alanlarda yaşamını sürdüren kişilere kültürel etkileşim ve gelişimin yanı sıra ekonomik fayda da sağlanmaktadır. Kırsal alanlarda yaşamını sürdüren kişilerin tarımsal faaliyetlerde sağlamış oldukları gelirlere ek olarak kırsal turizm gelirleri oluşturularak kırsalda yaşamını sürdüren kişilerin gelirlerinde artış sağlanıp, bu kişilerin yaşam standartlarında bir yükselme gerçekleştirilmesi söz konusu olmaktadır (Torun, 2013).



Sonuç olarak kırsal alanlarda kırsal turizme yönelik faaliyetlerin geliştirilmesi sayesinde istihdam, kişisel gelir, ek gelir, refah seviyesi ve kamu gelirleri üzerinde olumlu anlamda bir değişim sağlanacağı ve kırdan kente göçün önüne geçilebileceği ve bu şekilde kırsal kalkınma sürecine ivme kazandırılabilceği düşünülmektedir. Kırsal turizmin geliştirilmesiyle kırsal alanlarda gerçekleştirilen turistik yatırımlarda artış sağlanmış olacak ve bu durum dolaylı olarak turizm sektörüne bağlı bir şekilde gelişim gösteren birçok sektörün (sanayi, inşaat, tarım, hizmet) gelişmesine katkı sağlayacaktır (Çeken vd., 2012). Günümüzde ayrıca insanların yaşadıkları stresli şehir hayatı ve yapay ortam, şehirlerde yaşayan kişilerin doğaya yönelerek kendilerini keşfetmeleri gerekliliğini doğurmuştur (Kesici 2012). Bu sebeple kırsal turizm hem kırsal alanların sosyo-ekonomik canlılıklarını koruyabilecek veya geliştirebilecek hem de turistlerin taleplerine cevap verebilecek nitelikteki önemli bir alternatif turizm türüdür (Yılmaz ve Gürol, 2012).

3. MUŞ İLİNİN KIRSAL TURİZM POTANSİYELİ

Muş ili, Doğu Anadolu Bölgesi'nin Yukarı Murat-Van Bölümü'nde bulunmaktadır. Yüz ölçümü yaklaşık 8.116 km²'dir (Sönmez, 2010: 45). Muş ilinin kuzeydoğusunda Patnos ve Tutak (Ağrı), doğusunda Ahlat, Adilcevaz ve Güroymak (Bitlis), kuzeyinde Karayazı, Hınıs, Tekman ve Karaçoban (Erzurum), güneyinde Kulp (Diyarbakır), Sason ve Mutki (Batman), Güroymak (Bitlis), batısında Karlıova, Solhan (Bingöl) yer almaktadır (Dölek, Avcı ve Harunoğulları, 2018: 1013). Muş ili tarihinin Urartular ile başladığı düşünülmektedir ancak kesin olarak ilk yerleşimlerin kimler tarafından gerçekleştirildiği konusunda net bir bilgi bulunmamaktadır (Muş Belediyesi, 2023). En kuvvetli söylentiler arasında şehrin Nuh peygamberin çocuklarından Yasif'in torunlarından olan Muşoğulları tarafından kurulmuş olduğudur. Bu konu hakkındaki bir diğer söylenti ise Muşkiler adlı bir grubun bölgeye gelerek ilk temellerini attığı yönündedir (San, 1982). İsminin kaynağı da bu belirsizlik içerisinde aydınlatılamamıştır ancak İbrani dilinde "sulak, verimli otlak" anlamına gelmektedir (Türkiye Kültür Portalı, 2023). Bu "sulak, verimli otlak" anlamı bölgenin coğrafik özellikleri göz önüne alındığında oldukça anlamlı bir hal almaktadır (Zülfikar, 1992).

Muş ili ekonomik yönden iyi gelişmemiştir ve halkın başlıca geçim kaynağı tarım ve hayvancılıktır (Gökmen vd., 2013). Muş ekonomisine önemli katkıları olan hayvancılık sektörü, genellikle meraya dayalı olarak yapılmaktadır (Şeker, Tasalı ve Güler, 2012: 10). Ağırlıklı olarak hayvancılık üzerine yoğunlaşmış olan bölge Türkiye'nin önemli hayvancılık merkezlerinden birisi haline gelmiştir. Bu sebeple et ve süt besinlerinin yoğun olarak kullanıldığı ve mutfağına da bu ürünlerin yansıdığı görülmektedir (Muslu ve Şensoy, 2020). Muş ili hayvancılık verilerine bakıldığında ise 325.067 adet büyükbaş hayvan, 1.084.591 adet küçükbaş hayvan, 300.908 adet tavuk, 72.615 adet hindi, 35.310 adet ördek, 94.036 adet kaz ve 53.006 kovan sayısına sahip olduğu görülmektedir. Bu verilere göre



Muş ili Türkiye’de büyükbaş hayvan sayısında 15, küçükbaş hayvan sayısında 12, manda sayısında 6, kaz sayısında 3, ördek sayısında 2 ve hindi sayısında 9. sırada yer almaktadır. İl 2019 yılında Türkiye’de süt üretiminde 393.071 ton ile 16. sırada ve 704 ton bal üretimi ile 35. sırada yer almıştır (TÜİK, 2019; Muş İl Tarım ve Orman Müdürlüğü, 2019). Ayrıca Muş ilinin ekolojik yapısı, doğal meyve ve bitki çeşitliliğinin fazla olması, organik arıcılık için oldukça uygun koşullar sağlamaktadır. Muş balı bölgede ünlü bir bal olmasına rağmen, tanıtım yetersizlikleri nedeniyle ülke genelinde yeteri kadar bilinmemektedir (Arslan, 2018, 81).

Muş ili, Türkiye'nin üçüncü büyük iç ovasına (Muş Ovası) ev sahipliği yapmaktadır. Bununla birlikte Malazgirt, Bulanık ve Liz ovaları da Muş ili sınırları içerisinde yer almaktadır (Arslan, 2018). İlde çeşitli büyüklüklerde ovalar yer almasına rağmen, nispi yükseltinin fazla olması (1500 m'nin üzerinde) ekonomik faaliyetlerin zor koşullar altında sürdürülmesine neden olmaktadır (Sönmez, 2010). Muş ilinde tarımsal faaliyetler yoğun olarak gerçekleşmektedir. Toplamda 2.577.555 dekar tarımsal arazisi bulunan ilde (çayır-mera, nadas alanı ve ormanlık alanlar hariç) bölge nüfusunun %56'sının bu alanda istihdam edildiği görülmektedir ve ağırlıklı olarak tarla bitkileri yetiştiriciliği ardından sebze yetiştiriciliği gerçekleştirilmektedir (Tarım ve Orman Bakanlığı, 2023). Muş ilinin tarım verilerine bakıldığında, 237.016 hektar toplam işlenen tarım alanına ve 578.736 bin TL tarımsal üretim değerine sahip olduğu görülmektedir. İlin başlıca tarım ürünlerini tahıllar, yem bitkileri, endüstri bitkileri, baklagiller, sebze ve meyve türleri oluşturmaktadır (TÜİK, 2019; Muş İl Tarım ve Orman Müdürlüğü, 2019). Ayrıca Muş'ta bağcılığın tarihi çok eskilere dayanmaktadır. Muş üzümü, ince kabuklu, sulu, şekerli ve hafifçe ekşimsidir. Bu üzüm türünün sinciri, danagözü, yazbeyazı, güzbeyazı ve kaşmer gibi çeşitleri ünlüdür. Bu üzümler Muş şehir merkezi yakınında, Haspet Kalesi'nin eteklerindeki Mongok Bağları'nda, İncebel ve Mehmetcan Bağları'nda da yetiştirilmektedir (DAKA, 2020).

Muş ilinin nüfusu 2022 yılı verilerine göre 399.202 kişidir (TÜİK, 2022). Muş il nüfusunun önemli bir kısmı kırsalda yaşadığı ve üretmiş oldukları doğal tarım ve hayvancılık ürünlerini doğal gıda olarak pazarlama imkânı bulamadıkları için ilde ekonomik refah seviyesi düşük olduğu bilinmektedir (Arslan, 2018, 81). Muş'ta nüfusun büyük bir bölümü kırsal bölge birimleri olarak nitelendirilen bucak köy ve mezralarda yaşamaktadır. Ancak toplam nüfusun önemli bir bölümünü oluşturan genç nüfus, ilde istihdam potansiyeli sınırlı olduğundan üretim faaliyetlerinde bulunamamaktadır. Bu durum Muş genelinde ekonomik ve sosyal gelişme ile kalkınmayı olumsuz etkileyen unsurlar arasında değerlendirilmektedir (Aykan, 2015). İlin turizm gelirleri Türkiye ortalamasının altındadır. İldeki turizm sektörünün mevcut durumuyla il ekonomisi üzerinde hissedilir bir etkisinden bahsetmek mümkün değildir. Ancak Muş ili, sahip olduğu doğal ve kültürel unsurlar bakımından geliştirilebilecek, turizm anlamında önemli bir potansiyele sahiptir (Dölek ve Şaroğlu, 2017, 2). Muş



ilinde kırsal kalkınmayı sağlamak, bölgeler arası gelişmişlik farklarını ortadan kaldırılmak ve istidam olanaklarına katkıda bulunmak amacıyla turizmden faydalanılabilir. Muş ilinin turizm pazarında yeterli düzeyde pay alabilmesi için bazı alternatif uygulamalara ihtiyaç bulunmaktadır (Şengel, 2020, 210). Bu noktada, Muş ilinde kırsal turizm ve buna bağlı olarak da gastronomi turizminin geliştirilmesi, ildeki tarım ve hayvancılık ürünlerinin daha iyi pazarlanabilmesini sağlayabilecek ve böylece ilin refah seviyesine katkı sunulabilecektir. Çünkü Muş ili sahip olduğu kırsal nüfusu ve kırsal turizme konu olabilecek çekicilik unsurları nedeniyle önemli bir kırsal turizm potansiyeline sahiptir (Türk ve Toprak, 2019, 190).

Türkiye’de dağlık alanlar, içlerinde barındırmış oldukları orman varlıkları, mera ve çayır alanlarına bağlı olarak gerçekleştirilen hayvancılık ve yaylacılık faaliyetleri, çeşitli tarımsal üretim ve madencilik gibi potansiyelleri nedeniyle geçmişten günümüze çeşitli şekillerde kullanılagelmiştir. Günümüzde ise dağlık alanlar geleneksel kullanım şekillerinden başka yeni bir turizm türü olan kırsal turizm ile ön plana çıkmaktadır (Bakırcı, 1995). Bu bağlamda Muş ilinin dağlık yapısı kırsal turizm açısından önemli bir çekicilik unsurudur. Bu açıdan il dağlık yapısı gereği kış sporları, dağcılık faaliyetleri, trekking gibi aktivitelerin yapılmasına imkân sunmaktadır. Yoğun kar yağışının yaşandığı ve karın nispeten yerde uzun süre kaldığı, topografyanın uygun olduğu yüksek dağlık bölgelere sahip olan il; dinlenme ve tatil yapma ayrıca kış sporlarını yapabilme bakımından uygun şartlara sahiptir (Ersungur ve Aslan, 2014).

Muş ilinde kırsal turizm açısından bir diğer çekicilik unsuru da endemik bitki türleridir. İl merkezinin hemen yanında bulunan Kızıl Ziyaret Tepesi (Kurtik Dağı) bahar aylarında türlü çiçekler ve lalelerle zengin bir çeşitliliğine ev sahipliği yapmaktadır (Aykan, 2015). Alıç (*crataegus monogyna*), çiriş otu (*asphodelus aestivus*), kenger (*gundelia tournefortii*), kuşkonmaz (*asparagus officinalis*), ışgın (*rheum ribes*), yemlik (*Tragopogon reticulatus*), kuşburnu (*Rosa canina*), kuzu kulağı (*Rumex acetosella*), ebe gümece (*Malva sylvestris*), Muş üzümü (*Vitis vinifera L.*), yabani erik (*Prunus kurdica*), lahana (*Brassica oleracea*) gibi Muş iline ait bitki türleri ilin önemli gastronomik değerleri olarak görülmektedir ve bu bitki türleri Muş coğrafyasının sahip olduğu iklimsel koşullara ihtiyaç duymaktadır (Eren ve Türk, 2023). Bu bitkilerin yiyecek-içecek kültürü açısından yörenin kırsal turizm potansiyeline katkı sağlayabileceği kabul edilmektedir. Çünkü kırsal turizme katılan turistlerin hem bu bitkilerin toplanma aşamasında farklı deneyimler yaşayabilecekleri hem de yöreye ait farklı lezzetleri tatma imkânı bulacakları düşünülmektedir. Ayrıca Muş ili bu tarz uygulamalar sayesinde turistlere yukarıda bahsedilen endemik bitki türlerinden toplama imkânı veren, kamp ve doğa yürüyüşleri yapmaya müsait kısa süreli turların düzenlenebileceği bir destinasyon haline dönüştürülebilecektir. Özellikle yörede doğal olarak yetişen 15 gün kadar kısa ömre sahip olan Nisan ayı sonları ile Mayıs



ayı başlarında çiçek açan Muş Lalesi (*Tulipa sintenisii* Baker) yöre halkı ve turistlerin önemli derecede ilgisini çekmekte, konuya ilişkin bir de festival düzenlenmektedir. İlki 2000 yılında düzenlenmiş olan lale festivali her sene 29-30 Nisan tarihlerinde tekrarlanmaktadır (Muş İl Kültür ve Turizm Müdürlüğü, 2018).

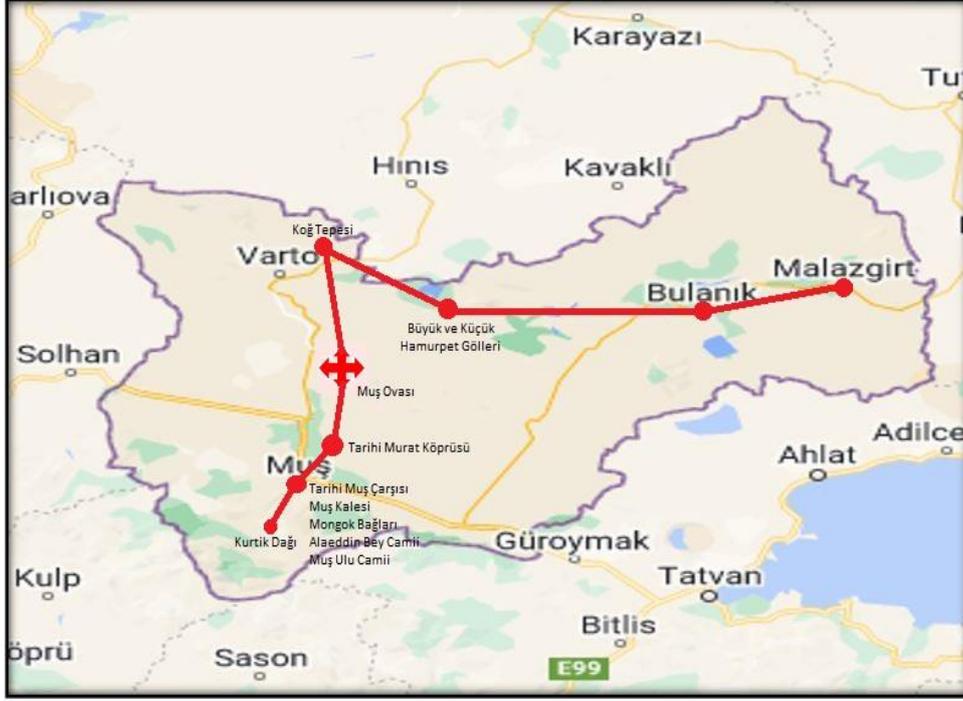
Tarım ve hayvancılıkla ilgili faaliyetler kırsal turizmin esas konusunu oluşturmaktadır. Kırsal turizme katılan turistler tarımsal faaliyetlere bizzat katılmakta ve tatillerini bu faaliyetler üzerine planlamaktadırlar. Bu bağlamda nüfusun büyük çoğunluğunun kırsal alanlarda yaşadığı, ekonomisinin daha çok tarım ve hayvancılığa dayandığı Muş ili için yapılacak olan yatırım ve teşviklerle birlikte kırsal turizmin il adına geliştirilmeye uygun bir alternatif turizm türü olduğu düşünülmektedir. Böylece kırsal turizmin geliştirilmesi ile tarım ve hayvancılık gelirlerine ek olarak yöre halkının ve genç nüfusun ekonomik refahını artıracak bir ek gelir sağlama imkânı oluşacaktır. Ayrıca kırsal turizm faaliyetlerinin geliştirilmesi ile yöre halkının istihdam problemi yerinde çözülecek, kırsal alanlardaki refah seviyesinin yükselmesine katkı sağlanarak kırdan kente göçün önüne de geçilebilecektir. (Türk ve Toprak, 2019, 190). Ayrıca il turizm açısından birçok değere ev sahipliği yapmaktadır. İlde bulunan başlıca turizm alanları Muş Kalesi, Malazgirt Kalesi, Muşet Kalesi, Hasbet Kalesi, Ulu Camii, Hacı Şeref Camii, Alaaddin Bey (Paşa) Camii, Esenlik Camii, Yünören Camii, Çengilli (Beyaz) Kilisesi, Arak Manastırı, Çanlı Kilise, Meryem Ana Kilisesi, Murat Nehri Köprüsü, Hatun Köprüsü, Kız Köprüsü, Mercimekkale Höyüğü, Yağcılar (Evrân) Höyüğü, Bostankale Höyüğü, Dolabaş Höyüğü, Kepenek Höyüğü'dür. Bunlara ek olarak ilde turizm alanı olarak birçok göl, ören yeri ve piknik alanı bulunmaktadır (Muş Kültür ve Turizm İl Müdürlüğü, 2023). Bu turistik çekiciliklerinde ilde kırsal turizmin geliştirilmesi adına destekleyici bir unsur olabileceği düşünülmektedir.

4. MUŞ İLİNE YÖNELİK KIRSAL TURİZM TUR ROTASI ÖNERİSİ

Turizm rotaları, bir ana temaya bağlı şekilde oluşturulan, birbirinden farklı bir dizi çekiciliği bir araya getiren ve ziyaretçilerin yapmış oldukları seyahatler nedeniyle bölgesel turizmi harekete geçirebilme potansiyeline sahip olan bir seyahat türüdür. Turizm rotaları, ürüne dayalı veya tematik rotalar olmak üzere iki başlık altında incelenebilir. Bir bölgenin imajının tematik yönüyle pazarlanabilmesi açısından tasarlanan rotalar, çeşitli yöreleri ve turistik çekicilikleri bir araya getiren rotalardır. Ürüne dayalı bir şekilde geliştirilen rotalar ise, yerelde geleneksel açıdan ön plana çıkan ürünlerin satışlarını artırabilmek amacıyla tasarlanmış turizm rotalarıdır. (Alkan, 2018). Oluşturulan her iki tür turizm rotasının da temel amacı, ziyaretçilerin bölgede vakit geçirebilmeleri ve harcama yapabilmeleri açısından her biri ayrı olarak yeterince çekici olmayan turistik aktivite ve değerleri birbirlerine bağlamaktır. Bu sayede oluşan sinerjik etki sayesinde daha güçlü bir turistik çekicilik meydana getirilerek, turizm merkezleri kolektif bir biçimde bir turizm destinasyonu olarak



konumlandırılabilir (Kervankıran ve Çuhadar, 2014). Bu bağlamda, bu araştırmada Muş İlinin kırsal turizm çekicilikleri üzerinden bir turizm rota önerisi oluşturulmuştur. Oluşturulan rota Görsel 1. de sunulmuştur.



Görsel 1. Muş Kırsal Turizm Tur Rotası Önerisi

Yukarıda önerilmiş olan kırsal turizm tur rotası doğrultusunda 5 gece 6 günden oluşan örnek bir tur programı hazırlanmış olup, oluşturulan tur programı Tablo 1. de sunulmuştur.



Tablo 1. Muş Kırsal Turizm Tur Programı Önerisi

TUR PROGRAMI	
1. GÜN;	10.00-10.45: Muş havalimanından transfer.
	10.45-12.45: Tarihi Murat Köprüsü gezisi ve Murat Nehri doğa yürüyüşü
	12.45-14.00: Tarihi Murat Köprüsü'ndeki tesislerde öğle yemeği.
	14.00-16.00: Muş ovası ve Muş Lalesi Gözlem Gezisi
	16.00-18.30: Muş lahanası tarım gezisi
	18.30-19.30: Otele dönüş ve istirahat
19.30-21.00: Akşam yemeği	
2. GÜN;	08.00-09.00: Muş çarşısında yöresel kahvaltı
	09.00-12.30: Kızıl Ziyaret Tepesi (Kurtik Dağı) endemik bitki toplama ve doğa yürüyüşü
	12.30-14.30: Toplanan endemik bitkilerle yemek yapma etkinliği ve öğle yemeği
	14.30-17.00: Muş Mongok Bağları gezisi
	17.00-20.00: Muş Seyir Tepesi'nde yöresel müzik dinletisi ve akşam yemeği
20.00: Otele dönüş ve istirahat	
3. GÜN;	08.00-09.00: Otelde yöresel kahvaltı
	09.00-12.30: Bulanık kazı yetiştirme ve işleme gezisi
	12.30-14.30: Bulanık kaz pişirme etkinliği ve öğlen yemeği
	14.30-18.30: Malazgirt Zafer Alanı gezisi ve serbest zaman
	18.30-20.00: Malazgirt'te akşam yemeği
20.00: Otele dönüş ve istirahat	
4. GÜN;	05.00-08.00: Koğ Tepesi gün doğumu seyir gezisi
	08.00-09.00: Yöresel kahvaltı
	09.00-12.00: Süt sağım ve peynir yapma etkinliği
	12.00-13.00: Öğlen Yemeği
	13.00-18.30: Büyük ve Küçük Hamurpet gölleri gezisi, doğa yürüyüşü ve balık tutma etkinliği
	18.30-20.00: Büyük ve Küçük Hamurpet göllerinden tutulan balıklarla Akşam yemeği
20.00: Otele dönüş ve istirahat	
5. GÜN;	08.00-09.30: Muş tarihi çarşısında yöresel kahvaltı
	09.30-12.30: Muş Kalesi ve tarihi kale mahallesi ziyareti.
	12.30-13.30: Öğlen Yemeği
	13.30-15.00: Alaeddin Bey Cami ve Muş Ulucami ziyareti.
	15.00-18.00: Muş tarihi çarşısı yöresel ürünler alışveriş gezisi
	18.00-19.00: Otele dönüş ve istirahat
19.00-21.00: Akşam yemeği	
6. GÜN;	09.00: Kahvaltı sonrası şehir merkezinde boş zaman
	12.00: Havalimanına geçiş



5. SONUÇ

Kırsal turizm, hayvancılık, tarım, yaylacılık ve dağcılık gibi faaliyetlerle kırsal kalkınmaya geniş kapsamda destek sunan unsurlardan birisidir. Kırsal turizmin geliştirilmesi sayesinde kırsal alanlarda yaşanmakta olan istihdam sorunlarının çözülmesine ve kırsal alanlardaki refah düzeyinin artırılmasına önemli ölçüde katkı sağlamak mümkündür. Bir yörede kırsal turizmin geliştirilebilmesi o yörede bulunan çekicilik unsurlarına bağlıdır. Kırsal turizm, hayvancılık ve tarıma yönelik faaliyetlerin yoğun bir şekilde gerçekleştirildiği kırsal alanlarda çiftçilerin asıl uğraşını oluşturan hayvancılık ve tarım faaliyetlerine ek olarak, yörenin barındığı diğer sosyo-kültürel ve doğal kaynakları, turizm amaçlı kullanarak kendilerine bir ek gelir sağlama olanağı tanımaktadır. Kırsal turizm ile ayrıca, kırsal alanlarda yaşamını sürdüren kişilere yerinde istihdam sağlama imkânı sunulmuş olacak ve bu sayede kırdan kente göçün önüne geçilebilecektir.

Muş ilinin kırsal turizm potansiyeli açısından önemli çekicilik unsurlarını barındırdığı görülmektedir. İlin dağlık yapısı, ildeki hayvancılık ve tarımla ilgili faaliyetler, yaylacılık ve ilde yetişen endemik bitki türleri bu unsurların başlıcalarındandır. Özellikle ildeki ekonomik gelişimin tarım ve hayvancılığa dayalı olması ve kırsal alanlarda yaşanan imkânsızlıklar ilde kırsal turizmin geliştirilmesi adına önemli sebeplerdendir. Kırsal turizmin geliştirilmesi sayesinde kırsal alanlarda yaşamını sürdüren kişilere yeni iş olanakları ve ek gelir sağlama imkânı sağlanabilecektir. Böylelikle yöredeki istihdam problemleri yerinde çözülmüş olacak, yörede yaşayan kişilerin ve özellikle genç nüfusun kazanacağı ek turizm gelirleri aracılığıyla yöre halkının refah seviyesinin yükseltilmesine katkı sağlanmış olacaktır. Bu bağlamda Muş ilinin kırsal turizm potansiyelinin geliştirilebilmesi adına bu çalışmada sunulmuş olan kırsal turizm tur rotası önerisi ve örnek tur programı oldukça önemlidir. Zira oluşturulan kırsal turizm tur rotası önerisi ve tur programı örneği kırsal turizme katılma motivasyonunda olan bireysel turistlere ve yöreye tur düzenleme niyetinde olan seyahat acentaları ve tur operatörlerine rehber olabilecek niteliktedir.



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EFFECTS OF DIETARY NUTRIENTS ON COLORECTAL CANCER: AN OVERVIEW

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ABSTRACT

Background: It's speculated that there is a positive correlation between what we eat and degenerative diseases. The human body absorbs a variety of vitamins, minerals, and antioxidants from whole meals that team together to safeguard our health. However, adequate research is needed to ascertain the dietary factors that can expose or reduce the risk of cancers of us being affected by cancers. In this study, an overview of colorectal cancer was given. It started with a brief description of cancer prevalence, estimated cases, and death. The anatomy of colorectal cancer, types, risk factors associated with colorectal cancer, and different kinds of literature including cohort, observational, prospective, retrospective, and case studies were explained in detail on how different nutritional factors influence colorectal cancer. **Method:** The current study used Mendeley referencing manager and collate related literatures from Scopus, Web of Science, PubMed, and Google Scholar. Global Cancer research data were obtained from World Cancer Research Fund International; Surveillance, Epidemiology, and End Result Program, and the American Cancer Society. Keywords used include “cancer and nutrition”, “colorectal cancer”, “food and cancer”, “dietary nutrients and colorectal cancer” **Conclusion:** Further actions are needed in finding ways and solutions for increased life expectancy.

Keywords: Nutrition, whole grains, dietary fiber, colorectal cancer, and polyphenols.



Background

The human body receives various nutrients from the foods we eat. These nutrients help in maintaining a fascinating healthy body and sound mind. Consuming various foods can lower the risk of disease and promote overall health [1].

The general incidence of cancer

In Nigeria, cancer claims more than 72,000 lives annually (roughly, 30924 for males and 40 647 for females). Given that there are 102,000 new instances of cancer each year, this number is expected to rise. According to estimates by the International Agency for Research on Cancer; in 2020, the incidence of breast cancer is (22.7%), uterine cervix cancer is 9.7%, prostate cancer is 12.3%, and colorectal cancer is 6%. While mortality rate from breast cancer is expected to be 20%, 17% for prostate, 13% for uterine cervix, and 12% for colorectal cancer. In general, Prostate cancer is the third most frequent type of cancer nowadays, causing cancer-related death in Nigeria, followed by liver cancer and breast cancer. Most parts of the world have seen an increase in cancer cases, but there are significant disparities between industrialized and developing nations like regarding cancer cases (figure 1).

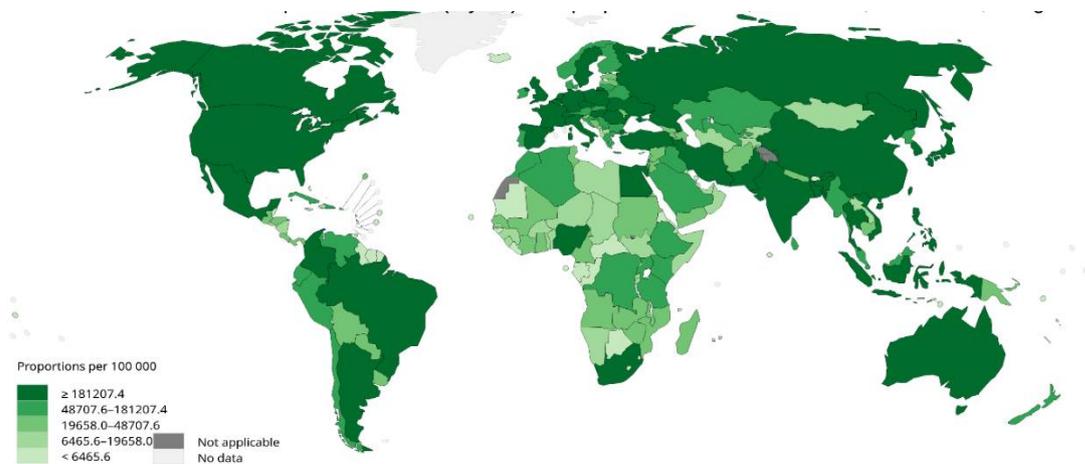


Figure 1 – Prevalence of cancers worldwide in 2020

There are high cases of cancer in developed countries than the developing countries. China is the leading of the board, followed by the US, India, and Japan. On the other hand, Niger, which has the lowest age-standardized cancer rate in the world at just 40.4 cases per 100,000 people, is closely followed by The Gambia and Nepal. It is important to note that these statistics only reflect malignancies that have been officially identified, not the total number of cases. Since many people in developing countries do not have access to high-quality medical treatment, their malignancies are probably going misdiagnosed, which reduces the number of cases., as depicted in figure 2 below.

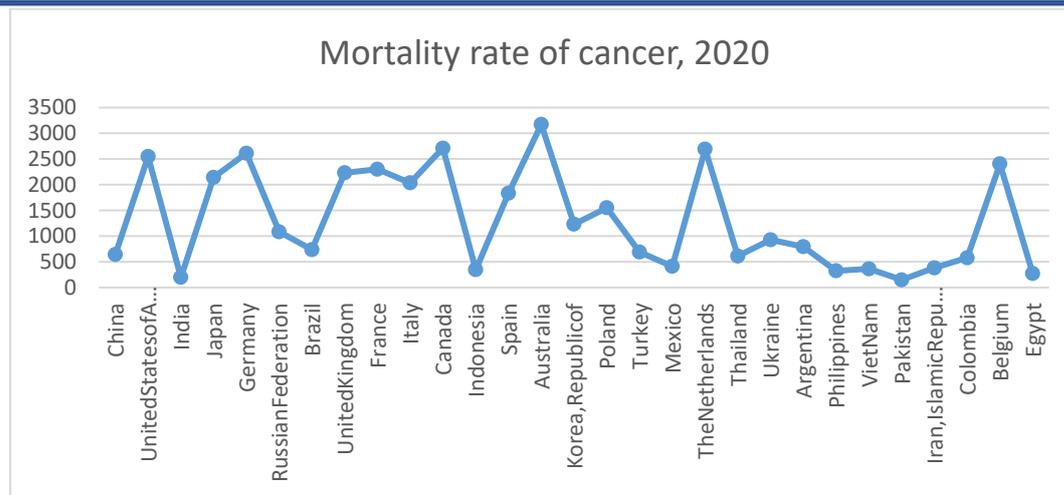


Figure 2 – Mortality rate of cancer in 2020

According to WHO/IARC, breast cancer incidence in Western Europe has surpassed 90 new cases per 100,000 women annually, compared to 30 per 100,000 in eastern Africa. Contrarily, the mortality rates from breast cancer are around 15 per 100,000 in Eastern Africa [2]. According to [3], in 2022, there was 268490 new cancer cases in the United States (table 1) for prostate with a death estimation of 34500 (figure 3).

Table 1 – Estimated cases of cancer in the United States

Estimated New Cases					
Males	Estimated New Cases	Percentage	Females	Estimated New Cases	Percentage
Prostate	268490	27%	Breast	287850	31%
Lung & bronchus	117910	12%	Lung & bronchus	118830	13%
Colon & rectum	80690	8%	Colon & rectum	70340	8%
Urinary bladder	61700	6%	Uterine corpus	65950	7%
Melanoma of the skin	57180	6%	Melanoma of the skin	42600	5%
Kidney & renal pelvis	50290	5%	Non-Hodgkin lymphoma	36350	4%
Non-Hodgkin lymphoma	44,120	4%	Thyroid	31940	3%
Oral cavity & pharynx	38700	4%	Pancreas	29240	3%
Leukemia	35810	4%	Kidney & renal pelvis	28710	3%
Pancreas	32970	3%	Leukemia	24840	3%
All Sites	983160	100%	All Sites	934870	100%



Additionally, these cancers have different death estimates. Colorectal cancer is estimated to be 343040 with 171920 death expectations [4].

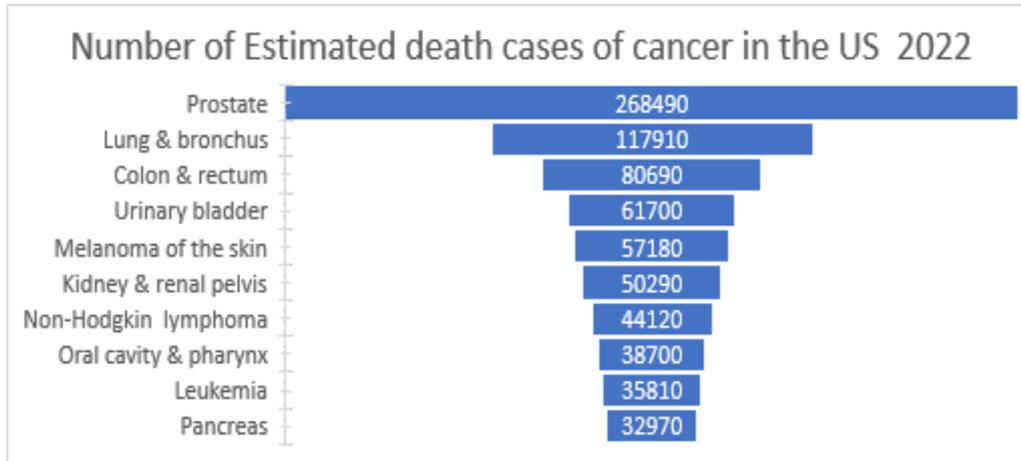


Figure 3 – Estimated death cases of cancer in the US in 2022

Colorectal cancer

A condition known as colorectal cancer is characterized by uncontrolled cell growth in the colon or rectum. It is also known as colon cancer. It affects the large intestine, or colon (Ref: What is colorectal cancer). The rectum serves as the conduit between the colon and the anus. The primary area of the large intestine where colorectal cancer typically first appears is the colon or the rectum. The third most diagnosed cancer for both men and women is colorectal cancer. The majority of these cancers start as polyps, which are growths on the colon or rectum's inner lining. After a given period of time, polyps can develop into cancer, but not all polyps do [5]. The type of polyp will determine whether it develops into cancer or not. There are two main types of polyps, which include:

1. Adenomatous polyps: these polyps grow on the mucous membrane that borders the large intestine and resemble glands (figure 3). They are also known as adenomas, and one of the following is often one of them: a tubular polyp that extends into the colon's lumen (space). These polyps are sometimes cancerous. Adenomas are considered a precancerous condition as a result.
2. Hyperplastic and inflammatory polyps: These polyps are more prevalent; however, they are typically not precancerous. An expansion of additional cells that extends from internal bodily tissues is known as a hyperplastic polyp. They develop in regions of the body where injured tissue has been restored, particularly along the digestive tract. In the lining of the big intestine, in the colon, are hyperplastic colorectal polyps (figure 4).

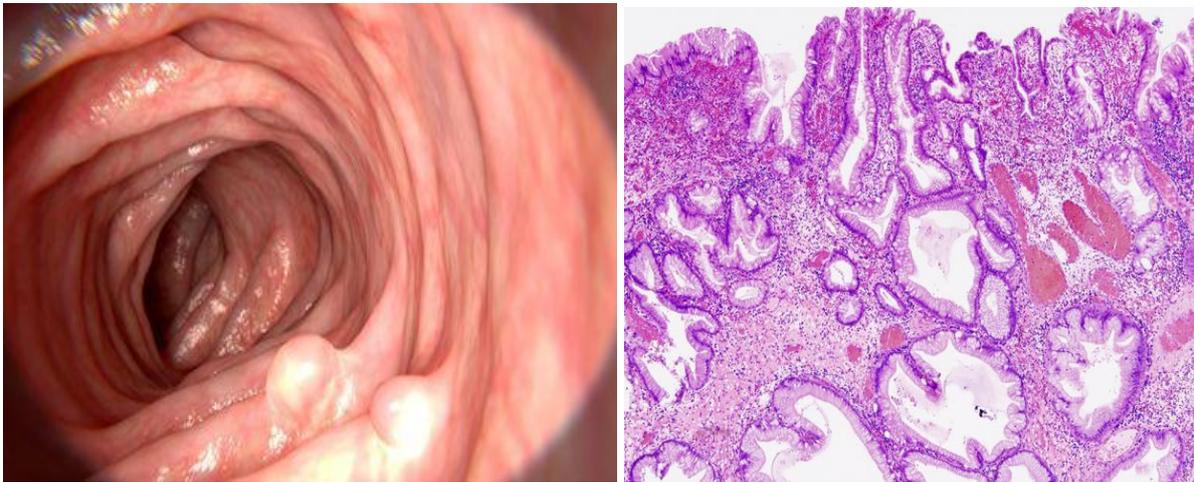


Figure 3 – Structure of Adenomatous polyps Adopted from [6] **Figure 7** –**Figure 4** –
Histopathologic image of hyperplastic polyp adapted from [7]

A region in a polyp or the lining of the colon or rectum with dysplasia, another precancerous disease, is where the cells appear aberrant (but not like true cancer cells). There are multiple layers to the wall of the colon and rectum. Colorectal cancer can spread through some or all of the other layers after beginning in the innermost layer (the mucosa). Cancerous cells can spread through the wall and develop into lymph or blood arteries (tiny channels that carry away waste and fluid). They can then proceed to neighbor lymph nodes or far-off regions of the body. The depth to which colorectal cancer penetrates the wall and if it has progressed outside the colon or rectum determine the stage (extent of dissemination) of the disease. In the world, colorectal cancer (CRC) is the second most common cancer diagnosed in women (614,000 new cases a year) and the third most common disease diagnosed in males (746,000 new cases annually). It is uncommon in persons under the age of 50, and as people get older, it becomes more prevalent. The prevalence of CRC varies significantly by area. Despite the fact that the advancement in technology is interesting to note that the incidence of CRC is 18% greater in developed countries than in lower-income areas. The incidence rate for men is 44.8 instances per 100,000 people, and for women, it is 32.2 cases per 100,000 people in the nations of Europe, North America, and Oceania. Western Africa, on the other hand, has the lowest rate, with 4.5 cases and 3.8 cases per 100,000 people, respectively, in men and women. This variation emphasizes the crucial involvement of environmental variables in the development of cancer in general and CRC in particular.



Aside from age, male sex, and inherited factors, which together account for 35% of CRC, food is the most significant risk factor [26]. Several epidemiological studies have been carried out especially considering the reports on CRC by the American Institute for Cancer Research (AICR) World Cancer Research Fund (WCRF), and these studies have presented new data and working hypotheses about diet-associated risk factors for CRC. Data from the WHO show that men and women in western countries have a high prevalence of colorectal cancer (CRC, [3]).

Effects of Nutrition and Cancer

Many supplements have claimed to provide all the vitamins and minerals needed by our body, while others assert that they can provide levels of micronutrients that are generally unattainable through diet alone. Unfortunately, research indicates that consuming real foods has more health advantages than “dietary components” found in supplements [8]. The body absorbs a variety of vitamins, minerals, and antioxidants from whole meals that team together to safeguard your health. However, research indicates that when a vitamin, fiber, or antioxidant is isolated into a supplement, it cannot be as well absorbed by your body as natural meals. While each person is unique, evidence largely demonstrates that supplements do not give cancer protection or aid cancer survivors who are concerned about recurrence [9].

It has long been believed that plant foods or their ingredients can prevent cancer. The most popular of the theories is that fruits and vegetables, or their constituent parts, may prevent cancer. It is also believed that fibre, which is abundant in whole grains, fruits, and vegetables, can fend off some types of cancer (Ref: Nutrition and cancers). According to the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) report from 1997, there is strong evidence that eating fruit and vegetables lowers the risk of developing cancers of the mouth and pharynx, esophagus, stomach, and lung. This conclusion was made primarily based on case-control studies [9].



Perceived Causes of colorectal cancer

In low- and lower-middle-income countries, cancer-causing infections like hepatitis and the human papillomavirus (HPV) account for about 30% of cases. According to a WHO report, one-third of cancer deaths are caused by tobacco use, high body mass index, alcohol use, low fruit and vegetable intake, and lack of physical activity [10]. Diet has drawn a lot of attention as one of the modifiable risk factors for CRC [11]; in fact, various dietary recommendations and patterns have been promoted to lower disease risk and prevent chronic diseases, including malignancies. Additionally, several scoring systems, including the Healthy Eating Index, Dietary Approaches to Stop Hypertension (DASH), and Mediterranean Style Dietary Pattern Score, have been employed to assess the population's adherence to those dietary recommendations.

The complicated etiology of malignancies, including CRC, has been linked to factors like sedentary lifestyles, alcohol consumption, body weight, smoking, nutrition, and family history. But among all cancers, colorectal cancer is most affected by dietary variables [11]. Strong evidence that whole grain consumption, foods high in dietary fiber dairy products, and calcium supplements (>200 mg/day) were protective against CRC and that red and processed meats, alcoholic beverages, excessive energy intake, and fast food were associated with a higher risk of CRC was noted in the Continuous Update Project by the World Cancer Research Fund and the American Institute for Cancer Research.

The risk of CRC may be decreased by eating foods high in vitamin C, fish, multivitamins, and vitamin D supplements, but it may be increased by eating a few non-starchy vegetables, a few fruits, and foods high in heme iron. Only colon cancer was found to be protected against by exercise. A recent systematic review and meta-analyses of observational studies [12] found 17 publications involving 54 different meta-analyses for whole grains and five for refined grains, and they reported significantly lower risks of both overall cancer and site-specific cancers in both “dose-response” and “highest vs lowest” whole grain intake analyses. Six studies specifically looked at CRC [13], and four of them contained dose-response information and claimed that consuming 90 g of whole grains per day could reduce CRC risk by 15–27%. On the other hand, 50–90 g/day of whole grains was linked to a 9–20% decreased risk of total cancer mortality, according to seven dose-response analyses. In these investigations, the weight of the food containing whole grains was used; 90 g (or three servings) provided roughly 48 g



of whole grains. [14] have explained this variation in how whole grain is calculated and used in earlier studies of this kind.

Dietary guidelines known as DASH are high in fresh produce, low in salt and added sugars, and moderate in low-fat dairy products. Although some studies have indicated a link between the DASH dietary pattern and a lower incidence of other chronic diseases, such as malignancies [15], it was initially developed for the management of high blood pressure [16]. Although whole grains, dairy products, and lower amounts of red meat, sodium, and excess sugar are some of the DASH dietary pattern's components that are linked to a decreased risk of CRC and CRA, this association has not been confirmed for all of these elements [17].

Risk factors of colorectal cancer

1. **Being overweight or obese:** have an increased chance of both getting and dying from colorectal cancer if an individual is overweight or obese (extremely overweight). Men and women who are overweight are at an increased risk of developing colon cancer, but the link seems to be more pronounced in men. Colorectal cancer has been associated with many lifestyle-related variables. In actuality, the associations between food, weight, and activity and the risk of colorectal cancer are among the strongest of any cancer.

In most industrialized nations, food and lifestyle changes have increased the prevalence of overweight and obesity. Increased mortality in CRC is linked to obesity, which is defined as a body mass index (BMI, kg/m²) greater than 30, and overweight, which is defined as a BMI between 25 and 29.9 kg/m² [18]. Compared to people with a BMI between 20 and 25 kg/m², individuals with a BMI > 30 have a 19% higher risk of CRC. There are some inconsistencies in the epidemiological data about the link between high-fat diets and an elevated risk of cancers [19]. After adopting a healthy dietary pattern that is low in fat and high in fibre, fruits, and vegetables, there has been no influence on the risk of CRC [20]. However, new dietary pattern analyses show that a “Western dietary pattern”—characterized by high consumption of red and/or processed meat, high-fat dairy products, fast food, refined grains, and sweet foods and beverages—increases the risk of CRC. A good healthy dietary system, which includes eating lots of fruits, vegetables, whole grain cereals, fish, white meats, and soy products, reduces the incidence of CRC [21]. Recent meta-analyses that looked at the impact of high-sugar, high-glycemic-load diets on the incidence of CRC did not find a strong relationship between the two [22].

Numerous biological processes are involved in the relationship between obesity and cancer, and several factors, including insulin, insulin-like growth factor (IGF)-1, insulin resistance,



sexual hormones (estrogens), pro-inflammatory cytokines (tumour necrosis factor-alpha (TNF), interleukine-6 (IL-6)), and C-reactive protein, may play a role (a marker of chronic vascular inflammation). A low or high increase in the chance of developing cancer depends on how well these factors are balanced and/or interact [23].

2. Physical inactivity: people who don't exercise regularly, the risk of having colorectal cancer is higher. Increased activity may reduce the risk of cancer in an individual. Regular, moderate exercise increases basal metabolism, enhances tissue oxygenation, improves metabolic capacity, and ultimately reduces body fat, insulin levels, insulin resistance, and the volume of adipose tissue. As a result, exercise lowers the risk of CRC. According to research, those who lead more physically active lifestyles had a 24 per cent lower risk of CRC than those who lead more sedentary lifestyles [24], and regular exercisers, regardless of BMI, reduce their risk of CRC by 40 per cent [25]. The risk of CRC is reduced by 11% with 30 minutes of moderate exercise each day. For overall health, current recommendations for adults call for 75 minutes per week of strong aerobic activity or at least 150 minutes per week of moderate aerobic activity [26]. Physical inactivity, on the other hand, is linked to latent or low-grade chronic inflammation as well as elevated levels of estrogen, androgen, and insulin.

3. Red and processed meat consumption: a diet high in processed meats (such as hot dogs and various luncheon types of meat) and red meats (like beef, hog, lamb, or liver) can increase the chance of developing colorectal cancer. The amount by which cooking meat at extremely high temperatures (such as frying, broiling, or grilling) produces chemicals that may increase the chance of developing cancer is unknown. Supplemental fibre has not been proven to reduce the risk of colorectal cancer, although it suggested that diets rich in fruits, vegetables, and whole grains have been related to a decreased risk [13].

Based on a large number of researches, CRC is the primary cancer form that has been linked to a high meat diet. A demographic change in dietary patterns, including an increase in red meat consumption and the risk of CRC, has been observed during the past three decades, according to epidemiological studies conducted in a variety of locations [27]. Different product intakes, such as total fresh meat intake, red or white meat consumption, processed meat intake (amount of additives), elaboration techniques (smoked, cured, salt, etc.), or associated dietary patterns (i.e., meats, fats, vegetables, and wine) can all be taken into account when analyzing this causal relationship. There have been several postulated action paths or mechanisms adopted from [23], which include:



- a) Increased consumption of meat and fat lead to generation of secondary bile acids increases along with a rise in insulin resistance, which helps to promote carcinogenesis.
- b) The production of heterocyclic aromatic amines (HAA) through high cooking temperatures and/or an increase in cooking time both promote HAA development.
- c) The creation of polycyclic aromatic hydrocarbons (PAHs) happens when organic material, such as coal, wood, etc., burns insufficiently.
- d) N-nitroso compounds (NOC) are formed in the meat by internal metabolic processes as a result of redox interactions between nitrogen oxides, nitrites, and nitrates and secondary amines, namely N-alkyl amines. This is when nitrate or nitrite is used as a preservative; the production of N-nitroso compounds is very crucial.
- e) Heme steel Heme iron, which is abundant in red meats and acts as a nitrosylation agent to generate NOC, promotes cell proliferation in the gastrointestinal mucosa via the lipid-peroxidation pathway.

Among the dietary variables that cause cancer, HAA, PAH, and N-nitrosamines are regarded as genotoxic compounds since they interact directly with DNA and result in point mutations, deletions, insertions, etc. These compounds' metabolic pathway, which starts in cytochrome P450, produces reactive metabolites that interact with DNA and start the CRC carcinogenesis process [28]. Consuming 50 g/day of processed meat or 100 g/day of red meat raises the risk of CRC by roughly 15-20%, according to a recent meta-analysis of cohort studies [29].

According to large-scale international epidemiological studies, those who consume up to 160 g of meat per day have a 35 per cent higher chance of developing CRC than those who consume less than 20 g. Concerning eating processed beef, this risk may increase to 49% with a daily intake of 25 g [22]. The risk of CRC increases in a non-linear fashion with intakes ranging from 20 g/day to 140 g/day, and then the increase stabilizes, according to studies analyzing risk elevation related to total meat intake (red and/or processed meat) [30]. The frequency of meat consumption also affects the rise in CRC risk. Rectal cancer (RC) and colorectal cancer (CRC) risk increase from 21 per cent to 37 per cent and 43 per cent, respectively, when intake exceeds once per day [31]. The ongoing generation of bile acids brought on by recurrent meat consumption can account for this.

It is important to note that some meat components, such as selenium, zinc, omega-3 fatty acids, vitamins B6, B12, and D, and folic acid, which are anticancer substances and necessary for human nutrition. But even with that, the epidemiological studies show strong correlation between meat consumption and an increased risk of CRC [30].



4. Smoking: long-term smokers are more likely than non-smokers to get colorectal cancer and pass away from it. Although smoking is an established risk factor for lung cancer, it is also connected to other malignancies, such as colorectal cancer.

5. Alcohol: colorectal cancer has been linked to excessive alcohol consumption. One possible health advantage of limiting alcohol consumption to a maximum of two drinks per day for men and one drink per day for women is a decreased risk of colorectal cancer. Alcohol consumption and the emergence of CRCs are related. The gut mucosa is not directly affected by ethanol in a carcinogenic way. Instead, acetaldehyde, the first substance created during the metabolism of ethanol, has mutagenic and carcinogenic activity, and it is because of this that it is essential in the development of CRC [46]. Alcohol use of 30 grams per day is linked to a 16 per cent rise in the risk of CRC, whereas consumption of 45 grams per day increases the risk by 41 per cent [33], indicating a dose-response connection where the higher the intake, the greater the risk increase. Men and this relationship are more strongly linked than women. Long-term alcohol use can decrease the absorption of group B vitamins (B1, B2, B12, and folic acid) [23].

6. Old age: although colorectal cancer can occur in younger persons, the risk rises significantly after the age of 50.

7. Family history (genetics): adenomatous polyps or colorectal cancer in the family history. Most persons who develop colorectal cancer have no history of the disease in their families. Even so, up to 1 in 5 persons who have colorectal cancer have relatives who have also been afflicted by the disease. A personal history of inflammatory bowel diseases, such as Crohn's disease or ulcerative colitis. About 5–10% of individuals with colorectal cancer have inherited gene flaws (mutations) that can result in family cancer syndromes and make them susceptible to the condition. Familial adenomatous polyposis (FAP) and Lynch syndrome (hereditary non-polyposis colorectal cancer, or HNPCC) are the most prevalent inherited syndromes linked to colorectal malignancies, but other, less frequent syndromes can also raise the risk of developing the disease.

Colorectal cancer risk reducing foods

1. Fruits and vegetables

Fruits and vegetables are beneficial because they include a variety of potentially protective compounds that influence several metabolic pathways [32]. Vitamin E, Epigallocatechin-3-gallate, diallyl trisulfide, selenium, calcium, vitamins E, D, C, and A, and folic acid have all been examined in several epidemiological studies about the risk of CRC. Folic acid (vitamin



B9) has been shown in numerous *in vitro* and *in vivo* studies to have a protective effect against CRC when physiological levels are maintained by diet content [5], but not when folic acid is supplemented (a consumption of 1000 g/day increases the risk of neoplasms) [32]. On the other hand, *in vitro* studies show that low folic acid levels support the invasion of malignant cells into the colon [33]. According to a meta-analysis by Lopez *et al.* of prospective trials with a sizable participant pool (756,217) and a longer follow-up period (6–20 years), eating fruit and vegetables is mildly but not significantly linked with a 9 per cent reduction in the risk of CRC [34]. There is currently discussion regarding the potential advantages of fruits and vegetables in specific colorectal tract anatomical regions. Accordingly, the analysis of 470,000 European individuals revealed a 14% reduction in the risk of CRC and a 24% reduction in the risk of colon cancer [35].

2. Phenolic compounds

A reduction in several chronic, cardiovascular, and cancer disorders is linked to regular ingestion of polyphenols through fruits, vegetables, and specific plants [36]. These substances alter some metabolic processes, including cytochrome P450 and signal pathways regulated by MAP kinases, PI3 kinases, IGF-1, NF-B, and ROS, implicated in both healthy and unhealthy cell activity, in addition to their direct antioxidant action [37].

3. Fibre

Consuming fruits, vegetables, and whole grain cereals can give human bodies the amount of fibre they require. The recommended daily consumption ranges from 21 to 38 g. The preventive effects of fibre are primarily linked to CRC. Studies have shown a reduction in cancer risk of up to 25% for intakes between 33.1 and 12.6 g/day or a reduction of 17% for three intakes per day. The epidemiological research that is now available is inconclusive, and the evidence for CRC is insufficient [38]. The proposed modes of action for fibre effects on colorectal cancer are depicted in figure 7 as outlined by [38]. These actions collectively may explain the advantages of fibre in terms of not only cancer but also diabetes or inflammatory bowel illnesses [39].

Innovative methods for examining the link between fibre intake and CRC have been put forth, taking into account dietary patterns and particular factors such as the cereal's shell, the degree of food processing, the impact on the immune system, or the microbiome's composition in the colon [40]. The host's gut microbiota performs or supplements additional metabolic tasks that have an impact on immunity or metabolism. The gut ecosystem's makeup appears to be influenced by the type of diet or its alterations. By triggering an inflammatory state,



biotransforming dietary pro-carcinogens, and producing genotoxins, the microbiome may play a role in carcinogenesis. An imbalance between “toxic” metabolites like secondary biliary acids (deoxycholic acid), nitro compounds, and sulfhydic acid (characteristic of diets high in fat and red/processed meat) and “protective” metabolites like short-chain fatty acids (butyric acid, propionic acid, etc.) or folic acid (that are characteristic of diets high in fibre, fruits, and vegetables) may affect the risk of CRC [41].

5. Calcium and milk and dairy products

Whole milk has a high calcium content as well as other crucial minerals. Since both substances inhibit cell proliferation and cause differentiation and death in gut cells, calcium actions are mostly dependent on vitamin D levels and are intimately related to them [42]. Men who consume nonfermented milk on average at 525 grams per day have a 26% lower risk of developing colon cancer, according to a novel meta-analysis that included 15 prospective studies and 900,000 participants [43]. The analysis looked at the relationship between different types of dairy foods (cheese, fermented milk, and nonfermented milk) and the development of CRC (highest intake category). Intake of cheese or fermented milk had no protective impact on CRC, and there was no correlation between consumption of nonfermented milk and rectal cancer in males or colon or rectal cancer in women [44]. Various lactose concentrations reach the digestive system and function as prebiotics (40 g of cheese has 0.1 g of lactose compared to 250 mL of nonfermented milk’s 11–15 g). The interaction of hormones, such as estrogens, may change the potential effects of calcium and vitamin D on CRC risk, according to epidemiological evidence, which is inconsistent [45].

6. Grains

Grains aid in cancer prevention. Consuming a range of cereals, grain products, legumes, roots, and tubers each day will help to prevent cancer. Whole-grain foods are less processed. They are better overall. Good foods to eat include oats, brown rice, corn, rye, kidney beans, and lentils. Diets rich in refined carbohydrates and sugar may raise the risk of bowel and stomach cancer [47]. The results of a study of the Palestinian population indicate that higher fibre intake showed an inverse relationship with colorectal cancer (CRC) risk across intake quartiles, even after controlling for confounding clinical, behavioural, and demographic characteristics. After controlling for age and sex, there was a significant connection between increased fibre intake and lower CRC risk; however, the associations weakened after controlling for behavioural and clinical confounding variables [48]. According to the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) 2018 study, daily eating 90 g of whole grains



reduces the risk of CRC by a significant 17 per cent [9] and getting at least 400 g of fibre and 30 g of fibre from dietary sources daily also lowers the risk [49].

A systematic review and meta-analysis study included 21 primary observational studies and discovered that a high fibre intake was associated with a 30% lower risk of colorectal adenoma and that there was a marginally significant negative linear correlation between the amount of fibre and colorectal adenoma risk [50]. There was an inverse relationship between whole-grain intake and CRC incidence, but not between fibre intake and CRC incidence, according to another large cohort study (NIH-AARP Diet and Health Study), which followed up 478,994 US adults for 16 years [51]. Additionally, fibre from grains was linked to a decreased risk of CRC but not fibre from other sources.

It is hypothesized that fibres lower the incidence of CRC thanks to many advantageous gastrointestinal mechanisms. These include short-chain fatty acids (SCFA), which have anti-proliferative properties and can increase the growth of the gastrointestinal microbiota [52], lowering bile reabsorption, improving faecal carcinogens excretion by binding to them, and increasing the gastrointestinal microbiota. The anti-carcinogenic nutrients vitamin E, selenium, copper, zinc, lignin, phytoestrogens, and phenolic compounds are abundant in whole grains [53]. Another mechanism is that fibre delays gastric emptying, slowing down glucose absorption and plasma insulin levels. This improves insulin sensitivity and regulates hormones that stimulate postprandial insulin release, improve glucose tolerance, and delay gastric emptying, all of which work together to reduce obesity, a significant risk factor for CRC [47]. A prospective cohort study by the European Prospective Investigation into Cancer and Nutrition (EPIC) enrolled over 500,000 participants from 10 different European nations to investigate the relationships between FV and fibre consumption and the risk of cancer [54]. According to the study's findings, there was a significant inverse relationship between total fruit and vegetable (FV) intake and CRC risk of 14% and 17%, respectively. In terms of fibre type, the EPIC study also found a significant inverse relationship between cereal fibre consumption and CRC risk of 13% but no correlation with intakes of fruit or vegetable fibre. Similar findings were reached by a recent meta-analysis of 10 prospective trials, which found that the relationship between vegetable and fruit fibres and the risk of colorectal cancer did not follow a linear dose-response curve [55].

METHOD

Scopus, Google Scholar, and PubMed Central (PMC)-NCBI searches of the scientific literature were conducted to discover human studies published up to January 2023 that were written in



English. The search criteria included the following words or phrases: diet, colorectal cancer, epidemiology, risk factors, and way of life. Using Mendeley's reference manager, articles from various sources were gathered and organized.

CONCLUSION

Currently, the demand for foods with more health advantages is on the increase with the increase of the socioeconomic and population demographic trends. Governments, physicians, researchers, and the agriculture and food industries have all been prompted to find ways to better manage these changes as a result of an increase in life expectancy, which has resulted in an increase in the elderly population and their desire for a better quality of life as well as an increase in health care costs. The focus now is on finding those functional foods that have the potential to enhance health, lower the risk of chronic diseases, and postpone the onset of serious illnesses like cardiovascular disease (CVD), cancer, and osteoporosis.



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ÖZET

Bitki uçucu yağları, bitki, gıda ve insan patojeni birçok mikroorganizma türlerine karşı kimyasallara alternatif mücadele yöntemi olarak kullanım potansiyeline sahiptir. Bu çalışmada dokuz farklı *Origanum* (*Origanum minutiflorum*, *O. onites*, *O. vulgare*, *O. syriacum*, *O. majorana*) ve adaçayı (*Salvia officinalis*, *S. aramiensis*, *S. tomentosa* ve *S. triloba*) türlerine ait bitkilerden uçucu yağlar elde edilmiştir. Uçucu yağların antibakteriyel etkinliği tohum kökenli bitki patojeni (karpuz fide yanıklığı ve meyve leke hastalık etmeni *Acidovorax citrulli*) ve fırsatçı yumuşak çürüklük bakteriyel etmenlere (*Bacillus pumilus* ve *Pseudomonas putida*) karşı araştırılmıştır. Uçucu yağların antibakteriyel etkinlikleri agar disk difüzyon yöntemi kullanılarak belirlenmiştir. Antibakteriyel etkinlik farklı düzeylerde disk (5 mm) çevresinde engellenme bölgelerinin oluşturulmasıyla açıkça ifade edilmiştir. Çalışmalarda kullanılan tüm bitki uçucu yağların test edilen bakteriyel hastalık etmenlerine karşı 5,33-40,33 mm çapında değişen engelleme bölgesi oluşturmak suretiyle antibakteriyel etkinliğe sahip olduğu belirlenmiştir. Uçucu yağlar tarafından oluşturulan ortalama engelleme zon çapı değerleri göz önüne alındığında, uçucu yağlara en duyarlı bakteri izolatu ortalama 21,56 mm zon çapı ile *B. pumilus* olurken, bu izolatu 17,96 mm zon çapı ile *A. citrulli* ve 13,22 mm zon çapı ile *P. putida* izolatları izlemiştir. Test edilen uçucu yağlar arasında en yüksek antibakteriyel etkinlik 40,33 mm engelleme zon çapıyla *Origanum onites* uçucu yağı tarafından *B. pumilus* izolatına karşı gösterilmiş olup, en düşük etkinlik ise 5,33 mm engelleme zon çapıyla *Salvia* spp. ait uçucu yağlar tarafından *P. putida* izolatına karşı kayıt edilmiştir. Elde edilen ön sonuçlar *Origanum* spp. ait bitki uçucu yağlarının tohum kökenli bitki patojeni bakteriyel hastalık etmenlerine karşı tohum dezenfektanı olarak uygulanma potansiyeline sahip olduğunu önermektedir.

Anahtar Kelimeler: Antibakteriyel, *acidovorax citrulli*, *origanum*, *salvia*, uçucu yağ



ANTIBACTERIAL ACTIVITIES OF PLANT ESSENTIAL OILS AGAINST BACTERIAL DISEASE AGENTS OF WATERMELON

ABSTRACT

Plant essential oils have potential for use in alternative control strategies against wide range of plant, food and human pathogenic microorganisms. Essential oils were extracted from nine different oregano (*Origanum minutiflorum*, *O. onites*, *O. vulgare*, *O. syriacum*, *O. majorana*) and sage plant species (*Salvia officinalis*, *S. aramiensis*, *S. tomentosa* and *S. triloba*). The antibacterial activities of essential oils were investigated against seed-borne plant pathogen (*Acidovorax citrulli*, causal agent of bacterial seedling blight and fruit blotch of watermelon) and two opportunistic spoilage bacterial agents (soft rot disease agents *Bacillus pumilus* and *Pseudomonas putida*). Antibacterial activities of the essential oils were determined by using agar disk diffusion. Different degrees of antibacterial activities, as displayed by causing inhibition zones around the filter disc (5 mm), were clearly observed. All plant essential oils used in the studies have antibacterial activity against the tested bacterial disease agents by causing inhibition zones of 5.33-40.33 mm in diameter. Considering the average inhibition zone diameter caused by the essential oils, *B. pumilus* was the most sensitive bacterial isolate with a zone diameter of 21.56 mm, followed by *A. citrulli* with a zone diameter of 17.96 mm and *P. putida* with a zone diameter of 13.22 mm, respectively. Among the essential oils tested, the highest antibacterial activity was displayed by *Origanum onites* essential oil against *B. pumilus* isolate with an inhibition zone diameter of 40.33 mm, and the lowest activity was recorded against *P. putida* isolate by the essential oils of *Salvia* spp. with a 5.33 mm inhibition zone diameter. Preliminary results obtained suggest that plant essential oils of *Origanum* spp. have potential to be applied as a seed disinfectant against seed-borne plant pathogenic bacterial disease agents.

Keywords: Antibacterial, *acidovorax citrulli*, *origanum*, *salvia*, essential oil



1. GİRİŞ

Farklı bakteriyel hastalık etmenlerinin neden olduğu hastalıklar, dünya genelinde önemli bitki türleri üzerinde ekonomik kayıplara yol açmaktadır. Birçok meyve ve sebzeye nakliye ve depolama sırasında %30-40'a ulaşan ve hatta bazı gelişmekte olan ülkelerde daha yüksek oranda kayıplara neden olarak büyük zararlar oluşturmaktadır. Farklı bakteri türlerinin neden olduğu başlıca hastalıklar, yumuşak çürüklük, solgunluk, ur ve aşırı büyümeler, yaprak lekeleri, yanıklıklar ve kanserlerdir (Clafin, 2001). Bu hastalık etmenlerinden *Acidovorax citrulli*, kavun, hıyar, kabak ve karpuz gibi Cucurbitaceae familyasında yer alan ürünlerde bakteriyel meyve lekesine ve fide yanıklığına neden olan patojen bir bakteri türüdür. Enfekteli tohumlar, çimlenmeden sonraki 6-10 gün içinde fidelerde bakteriyel meyve lekesi belirtilerine yol açmaktadır (Burdman ve Walcott, 2012). Belirtiler, yaprak ve meyve yüzeylerinde, meyve kabuklarında delikler oluşturacak şekilde giderek genişleyen koyu kahverengi lekeler şeklinde olmaktadır (Hopkins ve Thompson, 2002). *A. citrulli*'nin neden olduğu ilk ciddi bakteriyel meyve lekesi salgını, 1988'de Mariana Adaları'ndaki bir karpuz çiftliğinde meydana gelmiştir. 1990'ların ortalarında *A. citrulli*, ABD'nin çeşitli eyaletlerindeki (Florida, Georgia, Indiana, South Carolina ve Texas) karpuz tarlalarında tespit edilmiş olup geniş alanlarda çok önemli ekonomik hasarlara neden olduğu bildirilmiştir (Burdman ve Walcott, 2012).

Fırsatçı yumuşak çürüklük bakteriyel etmenlerden *Pseudomonas putida*, biyokontrol ajanı olarak doğada çok fazla bulunmaktadır. Bununla birlikte bakterinin bazı izolatları yoncada (*Medicago sativa* L.) çürüklük benzeri lezyonlara, şeftali (*Prunus persica* L.), kayısı (*Prunus armeniaca* L.), erik (*Prunus cerasifera* Ehrh.) ve elma (*Malus domestica* Borkh) meyvelerinde iç çürüklüğe, domateste (*Lycopersicon esculentum* Mill) iç renk değişimine ve patateste yumuşak çürüklüğe (*Solanum tuberosum* L.) neden olmaktadır (Pandey ve ark., 2012). Fırsatçı yumuşak çürüklük bakteriyel etmenlerden *Bacillus pumilus* ise *Pectobacterium carotovorum* subsp. *carotovorum*, *Dickeya solani*, *Ralstonia solanacearum*, *Enterobacter cloacae* ile birlikte patateslerde karabacak ve yumuşak çürüklük hastalığına neden olarak patates tarlalarını tamamen yok edebildiği, hasat sonrası patateslerde kahverengi çürüklüklere neden olabilmektedir (Bauer ve ark., 1966).

Bitki bakteriyel hastalıklarının kontrolünde genellikle bakır bazlı sentetik pestisitler ve antibiyotiklerin (streptomycin gibi) kullanımı tercih edilmektedir. Bakır bileşiklerinin kullanımı bakterilerin çoğalmasını önlemekte fakat her zaman bakteriyel hastalıkların yeterli kontrolünü sağlayamamaktadır (Nguyen ve ark., 2018). Bitki patojeni bakterilere karşı bakır



bileşiklerinin ve antibiyotiklerin sık kullanımı, kullanılan kimyasallara karşı dirençli bakteri popülasyonunun gelişmesine de yol açmaktadır (Duman ve Soylu, 2019). Pestisitlerin sık kullanımının yüksek maliyeti, pestisitlerin/antibiyotiğe dirençli bakteriyel izolatların geliştirilmesi, Türkiye de dahil Avrupa ülkelerinde bakteriyel patojenlere karşı antibiyotik kullanımına ilişkin resmi kısıtlamalar ve çevre duyarlılığına yönelik kamu ilgisi, çevre dostu yöntemler bulma ihtiyacını artırmaktadır. Bitki kaynaklı doğal bakterisitler ve bunların bitki bakteriyel hastalıklarını kontrol etmek için tarımdaki olası uygulamalarına odaklanan araştırmalar son zamanlarda yoğunlaşmıştır. Çok çeşitli aromatik bitki türlerinden elde edilen uçucu yağların, ekstraktların ve bunların ana bileşenlerinin antimikrobiyal etkileri, bakteri, fungus ve virüsler dahil olmak üzere kapsamlı mikroorganizmalara karşı araştırılmıştır (Burt, 2004; Bakkali ve ark., 2008).

Uçucu yağ içeren en önemli bitkiler genellikle Lamiaceae, Apiaceae, Lauraceae gibi belirli bitki familyaları içinde yer almaktadır. Lamiaceae familyası lavanta, keklik otu, kekik, nane, adaçayı ve mercan köşkü gibi çok çeşitli aromatik bitki ve çalı gruplarını içermektedir (Nieto, 2017; Mamadaliyeva ve ark., 2017). Uçucu yağlar, bitkilerin çiçeklerinden, yapraklarından, gövdelerinden ve dallarından ekstrakte edilen oldukça fazla uçucu bileşikler içeren sıvılardır (Amorati ve ark., 2013). Uçucu yağlardaki terpenler gibi fenolik bileşiklerin *in vitro* koşullarda mikroorganizmaları engellediği bilinmektedir (Bassolé ve Juliani, 2012). Uçucu yağlar, sıvı veya buhar fazında uygulanabilmekte olup buhar fazında, uçucu yağlar bitki yüzey alanının daha fazlasına ulaşarak daha belirgin antibakteriyel etki göstermektedir (Al Yousef, 2014). Uçucu yağların sıvı halden ziyade buhar halinde daha güçlü antimikrobiyal aktiviteye sahip olduğu bildirilmiştir (Delaquis ve ark., 2002; Fisher ve Phillips, 2009). Uçucu yağların buharla işlenmesi nedeniyle bitki patojenlerini çevre dostu bir şekilde kontrol etmek için mevcut tohum dekontaminasyon yöntemlerine iyi bir alternatif olabilme potansiyeli bulunmaktadır. Bu çalışmada, farklı Lamiaceae (*Origanum minutiflorum*, *O. onites*, *O. vulgare*, *O. syriacum*, *O. majorana*, *Salvia officinalis*, *S. aramiensis*, *S. tomentosa* ve *S. triloba*) türlerine ait uçucu yağlarının tohum kökenli bitki patojeni (karpuz fide yanıklığı ve meyve leke hastalık etmeni *Acidovorax citrulli*) ve fırsatçı yumuşak çürüklük bakteriyel etmenlere (*Bacillus pumilus* ve *Pseudomonas putida*) karşı antibakteriyel etkinlikleri araştırılmıştır.



2. MATERYAL VE METOD

2.1. BAKTERİYEL HASTALIK ETMENLERİNİN İZOLASYONU VE TANILANMASI

Bakteriyel hastalık etmenleri; *Acidovorax citrulli*, *Bacillus pumilus* ve *Pseudomonas putida* Adana ilinden HMKÜ Ziraat Fakültesi Bitki Koruma Bölümü'ne gönderilmiş şüpheli karpuz meyvesinin kabuk ve iç dokularından izole edilmiştir. Bakteri izolatları, MALDI-TOF (Bruker Daltonics GmbH, Bremen, Germany) analizi ile tanımlanmıştır (Aktan ve Soylu, 2020). Tüm izolatlar King B ortamında 4°C'de muhafaza edilmiştir. Bakteri süspansiyonları, stok kültürlerden bir öze dolusu hücrenin 26°C'de 24 saat inkübe edilmiş 10 mL'lik Nutrient Broth şişelerine aktarılmasıyla hazırlanmıştır. Kültürler, konsantrasyonu 0.12 OD₆₄₀ olacak şekilde seyreltme yoluyla 10⁸ cfu ml⁻¹'e ayarlamak için broth ile seyreltilmiştir (Bozkurt ve ark., 2020). Bu süspansiyonlar antibakteriyel etkinlik çalışmalarında kullanılmıştır.

2.2. UÇUCU YAĞLARIN ANTİBAKTERİYEL ETKİLERİNİN BELİRLENMESİ

Çalışmada kullanılan uçucu yağlar, Hatay Mustafa Kemal Üniversitesi Ziraat Fakültesi Bitki Koruma Bölümü Fitopatoloji Laboratuvarı stoklarından temin edilmiştir. Her bir uçucu yağın *in vitro* koşullarda antibakteriyel etkisi petri kapları içerisinde disk difüzyon tekniği kullanılarak belirlenmiştir. İçerisinde King B ortamı bulunan petri kaplarının yüzeyine, daha önce açıklandığı gibi hazırlanan 200 µl bakteri süspansiyonu yayılmıştır. Petri yüzeylerine steril filtre kağıdı diskleri (6 mm çapında) yerleştirilmiş, üzerlerine 5 µl miktarında uçucu yağları eklendikten sonra petri kapları steril parafilm ile kapatılarak 25°C'de 48 saat inkübasyona bırakılmıştır. Negatif kontrol petrilerinde steril distile su eklenmiş diskler kullanılmıştır. Uçucu yağların antibakteriyel etkisi, diskin etrafında gözlenen engelleme bölge (inhibisyon zonu) çaplarının ölçülmesi suretiyle değerlendirilmiştir.

2.3. İSTATİSTİK ANALİZ

In vitro antibakteriyel etkinlik denemeleri, her bir uçucu yağ/bakteri türü için en az üç tekerrürlü olarak yapılmış, deneme iki farklı zamanda tekrarlanmıştır. Denemelerde elde edilen değerlere SPSS istatistik programı (SPSS Statistics 17.0) kullanılarak tek yönlü varyans analizi yapılmış ve uygulamalar arasındaki farklılık Duncan Çoklu Karşılaştırma Testi (P≤0.05) ile analiz edilmiştir.

3. SONUÇLAR VE TARTIŞMA

Her bir bitki türünden elde edilen uçucu yağların antibakteriyel etkileri, disk difüzyon tekniği kullanılarak belirlenmiş ve bu uçucu yağların bakteriyel hastalık etmenlerine karşı engelleme



bölgelerinin çapları ölçülerek Çizelge 1’de verilmiştir. Farklı bitki türlerinin uçucu yağları, istatistiki olarak önemli ölçüde değişen seviyelerde antibakteriyel etki göstermiştir.

Origanum türlerine ait bitki uçucu yağlarının antibakteriyel etkilerinin, *Salvia* türlerine ait bitkilerin uçucu yağlarından daha etkili olduğu belirlenmiştir. Engelleme zon çapı değerlerine göre, *Origanum* türlerine ait bitki uçucu yağlarına karşı en hassas bakteri türü *B. pumilus* olarak belirlenmiş olup, *Salvia* türlerine ait bitki uçucu yağlarına karşı ise en dayanıklı bakteri türünün *P. putida* olduğu belirlenmiştir. Genel olarak *O. minutiflorum*, *O. onites*, *O. vulgare*, *O. syriacum* bitkilerinin uçucu yağları test edilen bakteri türlerinin tümüne karşı en yüksek düzeyde antibakteriyel etki göstermiştir (Çizelge 1).

Yapılan *in vitro* çalışmalarda *B. pumilus*’e karşı en yüksek antibakteriyel etkinlik, *O. onites* (40,33 mm), *O. syriacum* (36,67 mm) ve *O. vulgare* (32,33 mm) tarafından gösterilmiştir. En düşük antibakteriyel etkinlik ise *O. majorana* (10,33 mm) ve *S. aramiensis* (10,33 mm) tarafından gösterilmiştir. *A. citrulli*’ye karşı en yüksek antibakteriyel etkinlik, *Origanum onites* (22,67 mm) tarafından gösterilmiş olup, bunu sırasıyla *O. syriacum* (22,00 mm) ve *O. minutiflorum* (20,67 mm) takip etmiştir. En düşük antibakteriyel etkinlik ise *O. majorana* (10,00 mm) tarafından gösterilmiştir. Çalışmada uçucu yağlara dirençli olarak tespit edilen *P. putida*’ya karşı en yüksek engelleme zonu, *B. pumilus* hastalık etmeninde olduğu gibi *O. onites* (25,33 mm) tarafından oluşturulmuş olup en düşük engelleme oranına sahip olan uçucu yağların 5,33 mm zon çapları ile *Salvia* (*S. officinalis*, *S. aramiensis*, *S. tomentosa*, *S. triloba*) türlerine ait uçucu yağlar olduğu belirlenmiştir (Çizelge 1).

Çizelge 1. Bitki uçucu yağlarının bakteriyel meyve lekesi, fide yanıklığı ve yumuşak çürüklük oluşturan hastalık etmenleri *Acidovorax citrulli*, *Bacillus pumilus* ve *Pseudomonas putida* gelişimi üzerine olan antibakteriyel etkinlikleri^a

Bitki uçucu yağları	Bakteri türleri ve engelleme zonları (mm)		
	<i>Acidovorax citrulli</i>	<i>Bacillus pumilus</i>	<i>Pseudomonas putida</i>
<i>Origanum onites</i>	22,67aE	40,33cE	25,33bE
<i>Origanum syriacum</i>	22,00aDE	36,67bD	22,33aD
<i>Origanum minutiflorum</i>	20,67aCD	29,33bB	20,33aC
<i>Origanum vulgare</i>	19,67aC	32,33cC	22,33bD
<i>Origanum majorana</i>	10,00bA	10,33bA	7,33aB
<i>Salvia officinalis</i>	15,67cB	11,67bA	5,33aA
<i>Salvia aramiensis</i>	19,00cC	10,33bA	5,33aA
<i>Salvia tomentosa</i>	15,67cB	11,33bA	5,33aA
<i>Salvia triloba</i>	16,33cB	11,67bA	5,33aA

^aElde edilen değerler 3 farklı petride gelişen bakteri zon çapı (mm) değerlerinin ortalamasıdır.



Aynı sütun içinde yer alan ortalama değerlerin yanındaki benzer küçük harfler veya satır içerisinde yer alan ortalama değerlerin yanındaki benzer büyük harfler uygulamalar arasındaki farkın istatistiksel olarak önemli olmadığını gösterir (Duncan's Multiple Range Test, $P \leq 0.05$). Yapılan istatistiksel analizler sonucunda, elde edilen sonuçlara göre aynı bakteri türüne karşı test edilen bitki uçucu yağları arasında antibakteriyel etkinlik istatistiksel olarak önemli farklılık gösterirken, aynı uçucu yağın gösterdiği antibakteriyel etkinliğin test edildikleri bakteri türlerine bağlı olarak da önemli farklılık göstermiştir.

Bu çalışmanın bulguları, bitki uçucu yağlarının bakteriyel meyve lekesi ve fide yanıklığı, ve yumuşak çürüklük hastalık etmenlerine karşı antibakteriyel bileşik olarak kullanılma potansiyeline sahip olduklarını ortaya koymaktadır. Uçucu yağların antibakteriyel etkileri temel olarak insan ve gıdalarda sorun olan mikroorganizmalara karşı araştırılmıştır. Bununla birlikte, literatürde fitopatogenik bakterilere karşı bitki özleri ve uçucu yağlarla ilgili kısıtlı sayıda çalışma bulunmaktadır.

Bu araştırmanın sonuçları *Origanum* ve *Salvia* bitki türlerine ait uçucu yağların bakteriyel meyve lekesi, fide yanıklığı ve yumuşak çürüklük oluşturan bakteriyel hastalık etmenlerine karşı antibakteriyel etki gösterme potansiyeline sahip olduğunu göstermektedir. Bu çalışmada kullanılan *Origanum* bitki türlerine ait uçucu yağların carvacrol and thymol içerdiği (Kara ve ark., 2022) ve *Salvia* bitki türlerine ait uçucu yağların ise cineole, camphor, β -pinene ve α -terpineol içerdiği (Kara ve ark., 2021) daha önceden yapılmış çalışmalarla belirlenmiştir.

Tıbbi ve aromatik bitkilerin uçucu yağlarının, antimikrobiyal ve antioksidan aktivitelere sahip fenolikler, nitrojen bileşikler, vitaminler, terpenoidler ve diğer bazı endojen metabolitler gibi çok çeşitli bileşikler içerdiği bilinmektedir (Burt, 2004; Bakkali ve ark., 2008). Farklı bitki türlerinden (*Thymbra spicata*, *Thymus serpyllum*, *Origanum majorana*, *Mentha spicata*, *Lavandula stoechas*, *Melissa officinalis*, *Rosmarinus officinalis* ve *Ocimum basilicum*) elde edilen uçucu yağların bakteriyel meyve lekesi ve fide yanıklığına neden olan *Acidovorax avenae* subsp. *citrulli*'ye karşı antibakteriyel etkinliği araştırılmıştır (Mengulluoglu ve Soylu, 2012). Bununla birlikte farklı bitki türlerinden elde edilen uçucu yağların (*Chenopodium ambrosioides*, *Citrus aurantium*, *Clausena pentaphylla*, *Hyptis suaveolens*, *Lippia alba*, *Mentha arvensis*, *Ocimum sanctum* ve *Vitex negundo*) yumuşak çürüklüğe neden olan *P. putida*'ya karşı antibakteriyel etkinliği araştırılmıştır (Pandey ve ark., 2012). Fakat yumuşak çürüklük hastalığı etmeni olan *B. pumilus*'e karşı yapılmış çalışma bulunmamaktadır. Bu kapsamdan değerlendirildiğinde, çalışmamız *B. pumilus*'e karşı çalışmada kullanılan uçucu yağlarının etkinliklerinin değerlendirilmesine yönelik ilk çalışma niteliğindedir.



Bakteriyel hastalık etmenlerinden *Pseudomonas syringae* pv. *syringae* (Schollenberger ve ark., 2018; Moghaddam ve ark., 2014), *Xanthomonas arboricola* pv. *corylina* (Schollenberger ve ark., 2018), *Ralstonia solanacearum*, *Pseudomonas syringae* pv. *lachrymans*, *Pseudomonas tolaasii*, *Xanthomonas oryzae* pv. *oryzae*, *Xanthomonas citri*, *Brenneria nigrifluens*, *Pantoea stewartii* subsp. *indologenes*, *Agrobacterium vitis*, *Rhodococcus fascians* (Moghaddam ve ark., 2014), *Erwinia carotovora* var. *carotovora* (Basim ve ark., 2000; Badawy ve Abdelgaleil, 2014), *Erwinia chrysanthemi* (Mohan ve ark., 2011), *Clavibacter michiganensis* subsp. *michiganensis* (Iacobellis ve ark., 2005; Soylu ve ark., 2009), *Erwinia amylovora*, *Pseudomonas viridiflava*, *Xanthomonas axonopodis* pv. *vesicatoria* (Basim ve ark., 2000) ve *Pseudomonas syringae* pv. *tomato* (Soylu ve ark., 2009)'ya karşı farklı bitkilerden elde edilen uçucu yağların antibakteriyel etkinlikleri belirlenmiştir.

Yumuşak çürüklük hastalık etmeni olan *Erwinia herbicola* ve *Pseudomonas putida*'ya karşı 53 adet bitki uçucu yağının antibakteriyel etkinliği araştırılmıştır (Pandey ve ark., 2012). Uçucu yağların tümü bakteriyel hastalık etmenlerine karşı çok az etkinlik gösterirken, *Cleome gynandra* ve *Cyperus brevifolius* yağları *Erwinia herbicola*'ya, *Leonotis*, *Leonurus* ve *Melia* yağları *Pseudomonas putida*'ya karşı herhangi bir engelleme etkinliği göstermemiştir. Patojen olan iki bakteri türünün gelişmesini tamamen engelleyip en başarılı sonuçları elde eden uçucu yağlar; *Chenopodium*, *Citrus aurantium*, *Clausena*, *Hyptis*, *Lippia*, *Mentha*, *Ocimum sanctum* ve *Vitex* olarak belirlenmiştir. *Citrus aurantifolia* yalnızca *E. herbicola*'nın gelişimini tamamen engellemiştir. Diğer yağlar arasında, *Acorus calamus*, *Anisomeles indica*, *Clerodendrum inermae*, *C. viscosum* ve *Curcuma zedoaria*, 14,0-25,8 mm arasında değişen bir engelleme zonu bölgesi oluşturarak her iki test bakterisine karşı antibiyotiklerden daha etkili olduğu bildirilmiştir (Pandey ve ark., 2012). Farklı bitki türlerinden elde edilen uçucu yağlar, *Acidovorax avenae* subsp. *citrulli*'ye karşı değişen seviyelerde antibakteriyel aktivite göstermiş ancak bitki türüne bağlı olarak mikrobiyal duyarlılıkta önemli farklılıklar göstermiştir. *Thymbra spicata*'dan elde edilen uçucu yağlar, bakteriyel etmene karşı 20,7 mm'lik engelleme zonu oluşturarak en yüksek engelleme aktivitesini göstermiştir. *Thymbra serpyllum*, *Origanum majorana*, *Mentha officinalis*, *Mentha spicata*, *Salvia officinalis*, *Rosmarinus officinalis*, *Origanum basilicum* ve *Lavandula stoechas*'tan elde edilen uçucu yağların neden olduğu engelleme zonları 6,7-13,0 mm arasında değişiklik göstermiştir (Mengulluoglu ve Soylu, 2012).

Lamiaceae familyasına ait bitkilerin uçucu yağları, belirgin insektisidal, herbisidal ve antimikrobiyal etkinliği olup bilinen fenolik bileşikler açısından zengindir (Kordali ve ark.,



2008; Jovanka ve ark., 2011; Mamadalieva ve ark., 2017; Kaya ve ark., 2018; Kachur ve Suntres, 2020). Esansiyel yağlardan olan kekik ve ana bileşenlerinin, bazı fungal ve bakteriyel hastalık etmenlerinin hızlı hücre parçalanmasını tetiklediği bildirilmiştir (da Silva ve ark, 2019; Kachur ve Suntres, 2020; Liu ve ark., 2019; Churklam ve ark., 2020).

Sonuç olarak, bu çalışmada kullanılan bakteriyel hastalık etmenlerine karşı dayanıklı bitki çeşidinin olmaması dikkate alındığında, karpuz fide yanıklığı ve meyve leke hastalık etmeni (*Acidovorax citrulli*) ve yumuşak çürüklük (*Pseudomonas putida* ve *Bacillus pumilus*) hastalık etmenlerine karşı bitki uçucu yağlarının antibakteriyel olarak kullanılması ilgi çekicidir. Bu çalışmanın bulguları özellikle kekik (*Origanum spp.*) ve adaçayı (*Salvia spp.*) gibi şifalı bitkilerden elde edilen uçucu yağların *Acidovorax citrulli*, *Pseudomonas putida* ve *Bacillus pumilus* hastalık etmenlerinin neden olduğu hastalıklara karşı antibakteriyel etkinlik göstererek kullanılabilme potansiyeline sahip olduğunu göstermiştir. Bununla birlikte, uçucu yağların *in vivo* koşullarda antibakteriyel etkileri ve ekonomik maliyeti hakkında bilgi elde etmek için gelecekte daha detaylı çalışmaların yapılması gerekmektedir.



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**PERCEPTION OF LECTURERS TOWARDS INFORMATION AND TECHNOLOGY
IN IMPROVING THE QUALITY OF TEACHING AND LEARNING IN FEDERAL
UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA**

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ABSTRACT

The use of ICT in teaching-learning process is a relatively new phenomenon and it has been an educational research focus for effective integration of this technology into classroom practices. This study was aimed at investigating the perception of lecturers towards information and media technology in improving the quality of teaching and learning in Federal University of Technology Minna and a Survey design was employed. The population of the study was 133 lecturers' in the Federal University of Technology Minna, Niger state. The sampling technique used was the Yaro Yamani Formula to arrive at the sample size of fifty (50) lecturers' that were randomly selected. The major instrument of the study used for data collection was a well titled and structured questionnaire titled "Lecturers perception on the use of information and media technology questionnaire" (LPIMQ) which was used to gather the data which was analyzed using mean, standard deviation, frequency count and percentages. The instrument was validated and its reliability coefficient established was 0.82 which was correlated using cronbach alpha formula. The study hence showed that lecturers in federal university of technology Minna are used to ICT and make use of them in improving the quality of teaching and learning. It was recommended that investments of the college on lecturers' training programs for instructional technologies and support services of instructional technologies should be prioritized to integrate ICT into teaching-learning process and avenues should be created for lecturers not having ICT tools to have and start using them.

Keywords: ICT, Nigeria, education



INTRODUCTION

Information technology is described as the gathering, processing, storing or retrieval of information. A more general term, ICT emphasizes the role of communication in modern information technology, in the transmission or transfer of the information from place to place and over a distance. According to Otamiri (2014), ICT is a term used to describe a range of hardware equipment (personal computer, scanners, digital camera), computer software (database programs, multi-media programs) and the telecommunication infrastructure (phones, faxes, videoconferencing equipment and web cameras) that allow us to access, retrieve, store, organize, manipulate, present, send material and communicate locally and globally through digital media. Generally, ICT is used to encompass all forms of telecommunication networks, including telephone, radio, and television. However, the driving power of ICT is obviously the internet, a world-wide computer network built on telecommunication media, and which is usually the focus of discussions on ICT. According to Nwokocha and Onwuchekwa (2014), the internet has emerged as a major driving force of this dynamic development of information and communication technologies, which has impacted positively in virtually every sector.

Quality guarantee in the education system is a concept consisting of lot of activities that are designed to improve the quality of input, process and output of the educational system (Emmanuel, *et al.*, 2015). Quality guarantee in the education system involves the process of observing, weighing and evaluating all aspects of the education activities and communicating the outcome to all concerned with a view of improving the products of the education system. Quality guarantee addresses some vital issues in education which enhance the quality of delivery. Ololube, (2012) notes quality assurance in education as all proactive measures adopted by a country to ensure that the system standard remain high enough to produce results set for it. Thus, quality standard in education is the bench mark that should guide the performance of the education system. Quality assurance in education is in fact a process of continuous improvement in the quality of teaching and learning activities. The Federal Ministry of Education (FME, 2014) remarked that quality standard in the education system are goals or targets to which learners, teachers, staff and school administration aspires to attain. Quality guarantee in the education system is therefore a multi-dimensional concepts involving the various functions and activities of the education system which includes teaching research, staffing, students, buildings, facilities and equipment, service to the community and academic



environment. It is ensuring that at least the provision of the minimum academic standard is attained and sustained.

However, today in Nigeria, there exists general disenchantment in the quality of the education system as well as in the quality of education output. Similarly, Njoku, (2016) noted that quantitatively, the Nigerian Education scene is quite impressive but qualitatively deficient. Therefore, this research intends to investigate the role of ICT as a change agent for quality education in Federal University of Technology, Minna. The challenges confronting our educational system in tertiary institution centers on quality achievement of education delivery, almost everything connected with education in tertiary institution is in minimal supply. Quality teachers are in short supply, quality buildings, quality equipment, quality electricity supply, quality laboratories, good experimental farms/fields and other resources input that can lead to quality education are inadequately provided. Today, there exists general distrust in the quality of the education system as well as education output. The quality of education is the prime factor that determines the worth, value and significance of the system to both the recipients and the society at large. Thus, Iheonunekwu, *et al.*, (2013) noted that, the promises of information and communication technologies (ICTs) have driven E-learning in transforming education delivery and thereby advancing knowledge and the economy.

The knowledge, economy for example sets a new scene for education and new challenges and prospects for education is a pre-requisite of the knowledge based economy and the production and use of new knowledge both require a more educated population and workforce (Stephenson, 2011). ICTs are very powerful tool for diffusing knowledge and information which is fundamental aspects of the education process. In that capacity, ICTs play a pedagogic role that could in principle compliment the traditional practices of the education sector (Udo, 2011). Undoubtedly, e-learning powered by ICT use in tertiary institutions could help to expand and widen access to Federal University of Technology, Minna and learning, improve the quality of education as well reduce its cost. This means that effective ICT use in tertiary institutions in Nigeria could help to spur positive results in improving the overall learning (and teaching) experiences as well as in up-lifting the quality of the system. Therefore, the research seeks to investigate the role of ICT as a change agent for quality education in Federal University of Technology, Minna.



Statement of the problem

The use of ICT in teaching requires competencies on part of the teacher and has indeed made the profession more challenging experience and retains knowledge for a longer time. According to the UNDP (2011) statistics, almost 80% of the teachers in developing countries feel that they are not prepared to use the technology. The integration of information and communication technologies into curriculum is a crucial process in ensuring the quality of education (Vandervert, *et al.*, 2013). However, the presence of technology alone will not stimulate significant changes in a school. Teachers are an important ingredient in the implementation of ICT in education. Without the involvement of teachers, most students may not take advantage of all the available potential benefits of ICT on their own. Teachers need to actively participate in using ICT.

Okoli (2012), notes that quantitatively, the Nigerian Education scene is quite impressive but qualitative deficient. There exist general disenchantment and general distrust in the quality of the education system as well as in the quality of education output. Stephenson (2011), stated that ICT can play a very prominent role in diffusing knowledge and information which is fundamental aspects of the education process towards quality attainments. In this capacity, ICT plays a pedagogic role that could in principle complement the traditional practices of the education sector. Therefore, since the tendency of using ICT in teaching and learning strongly depends on the attitudes of the teachers, this study aims to investigate teachers' perception towards ICT integration in teaching-learning process in Federal University of Technology, Minna. This was based on the assumption that effective and successful use of ICT is helpful to motivate the students in teaching-learning process and enhance quality of education.

Purpose of the Study

The aim of the study is to find out the perception of lecturers towards Information and Communication Technology in improving the quality of teaching and learning in federal university of Technology Minna, Niger State. The specific objectives are to:

1. determine the demographic characteristics of lecturers in Federal University of Technology, Minna,
2. determine the response of lecturers to ICT usage in Federal University of Technology, Minna,
3. To determine perception of lecturers towards use of ICT in Federal University of Technology, Minna.



Research questions

To fulfill the objectives of this study, the researcher set up the following research questions.

1. What are the demographic characteristics of lecturers in Federal University of Technology, Minna?
2. What are the responses to usage of available ICT tools in Federal University of Technology, Minna?
3. What is the perception of lecturers towards use of ICT in Federal University of Technology, Minna?

METHODOLOGY

The researcher used descriptive research survey design in building up this project work. The target population of this study was the entire lecturers' population of FUT or comprehensive items, since the researcher was interested in getting information on the study on the appraisal of the role of ICT as a change agent for quality in teaching and learning in the federal university of technology Minna. 133 lecturers from different departments. The sample size for this study comprises of 50 respondents randomly selected. Due to large size of the target population, the researcher used the Yaro Yamane formula to arrive at the sample population of the study.

The major research instrument used was the questionnaires to analyze data. The research questionnaire was titled: Lecturers perception on the use of Information and media questionnaire (LPIMQ) which consist of three sections "A, B & C". Each question had its responses coded by assigning codes of responses for each item. Section A contains questions on the demographic characteristics. The responses were categorized into themes based on research questions and objectives. Data such as gender, age, academic qualification and professional experience were analyzed using descriptive statistics; while Likert scale was used to determine the perception of lecturers on the use of ICT. A four-point Likert-type scale (i.e. 4=Strongly Agree, 3=Agree, 2=Disagree and 1=Strongly Disagree) was used to rate their level of agreement on 9 research questions/statements to investigate perception of teachers on ICT usage. The lecturers were administered with the questionnaires to fill, with or without disclosing their identities. The questionnaire was designed to obtain concise and vital information from the respondents. The primary data contained information extracted from the questionnaires in which the respondents were required to give specific answer to a question by ticking in front of an appropriate answers.

The questionnaire used as the research instrument was subjected to its validation, so as to make sure the instrument represents the content of the study and accurately measures what is intended



(i.e. its primary objective). This research instrument (questionnaire) adopted was adequately checked and validated by the experts in the field of research in the department of science education and educational technology in the faculty of technology education. Their contributions and corrections were effected into the final draft of the research instrument utilized.

The research used qualitative and quantitative research methods Three mean groups were established based on Vandervert, *et al.*, (2013), with the mean for the perception of teachers about ICT usage ranging from 2.8 and below, to demonstrate as disagreement. The mean for the perception of teachers about ICT usage ranged between 3.2 and above, to demonstrate strong agreement.

RESULTS

Demographic characteristics of respondents

Gender

Figure 1.1 show that majority of the respondents accounting for 70% of the total respondents were male while 30% of the respondents were female. This implies that majority of the lecturers were male.

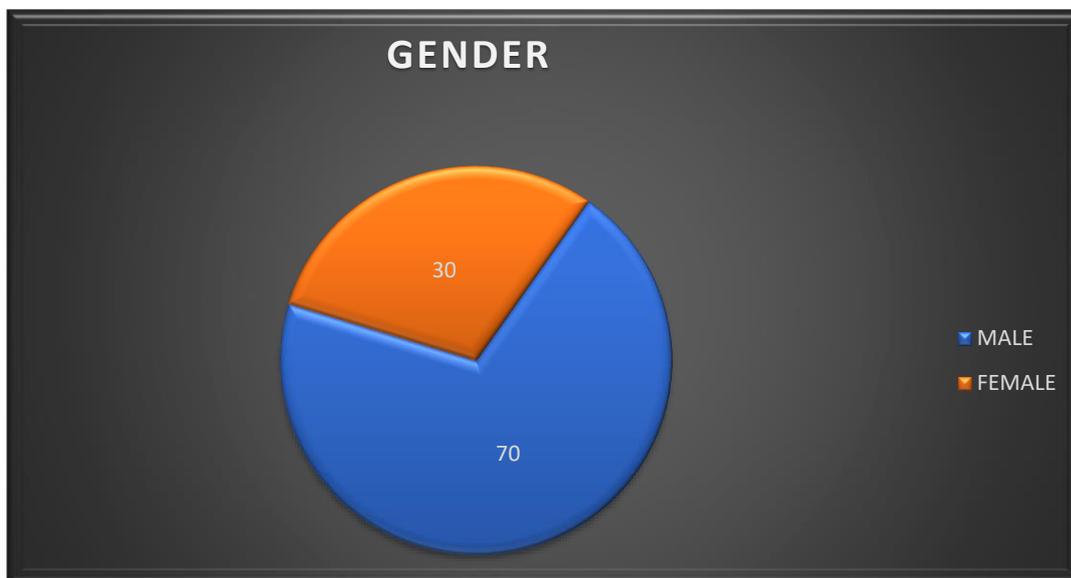


Figure 1: Distribution of respondents according to Gender

Figure 1 show the age of the respondents. The mean age of the respondents was 43 years. Majority (52%) of the respondents were within the age range of 41 – 50 years and 30% of the respondents were within the age range of 31 -40 years and 6% were above 50 years.

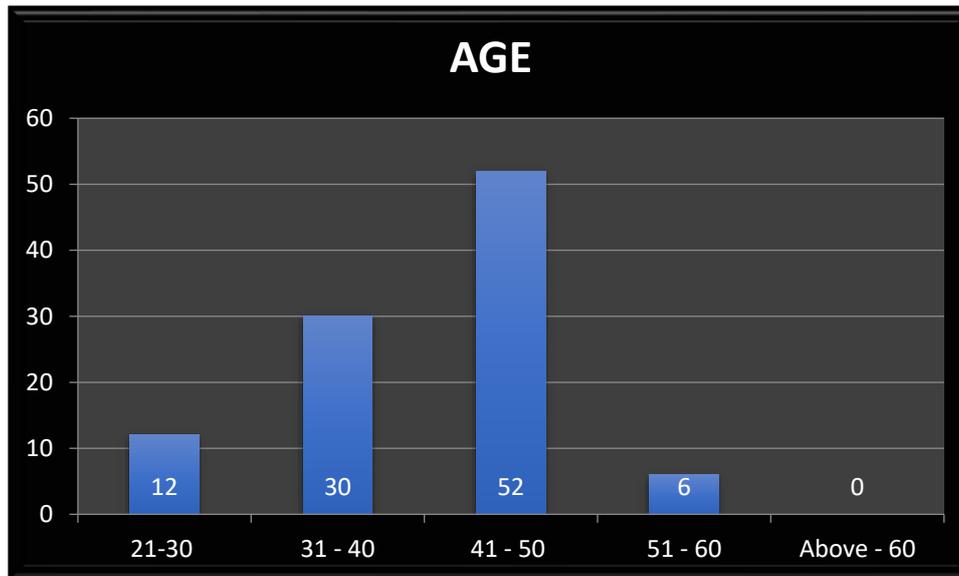


Figure 2: Distribution of respondents according to ranks

Positions held by respondents

Table 2: reveal that majority of the respondents were Lecturer I-Senior lecturers (50%), followed by Lecturer II and below (30%) and Asst. Prof.-Professors accounting for 20% of the total respondents.

Ranks held by respondents	Frequency	Percentage
Lecturer II and below	15	30
Lecturer I-Senior lecturers	25	50
Assoc. Prof. - Professor	10	20
Total	50	100

Source: Filed survey, 2019

Years of experience in using ICT

Figure 3 show that majority (46%) of the respondents have been using ICT for more than 15 years while 32% of the respondents have been using ICT for between 11 to 15 years, 14% have been using ICT for within 6 to 10 years and only 8% have used ICT for within 1 to 5 years. This indicates that the lecturers use ICT tool frequently which attributes to ease of their teaching and preparing of lecture notes.



Figure 3: Distribution of respondents according to years of experience in using ICT

Lecturers response to ICT usage

Table 4. revealed that majority of the lecturers use one ICT tool or the other. This implies that the lecturers were used to ICT tools and regularly use them. This show that ICT tool are used in improving teaching and learning.

Table 4: Distribution of respondents according to response to ICT usage

Lecturers response to ICT usage	Frequently	Sometimes	Never
Projector	17	5	0
Computer	45	2	0
Learning management system	9	9	30
Website interactive tool	7	2	34
Intranet/web	36	7	0
Grade records software	12	5	0
Television/ video conferencing	3	0	38
Public address (PA) system	23	4	4
Mobile Phones	25	11	0

Source: Field survey, 2019

Table 4 above reveal that majority of the ICT used were computer, internet/web facilities, Mobile phones, Public address systems, Overhead projector and Grade records software. The result revealed that majority of the respondents (90%) used computers, 72% used internet/web, 50% used telephone, 46% used public address system, 24% used grade record software and 14% used website interactive tool and 6% used television/video conferencing. This implies that lecturers used ICT tools and are conversant with the importance of using ICT to improve teaching and learning in Federal University of Technology, Minna.



Table 5: Distribution of respondents according to Perception of lecturers towards use of ICT showing mean and standard deviation of respondents on the use of ICT

S/N	Lecturers perception towards the use of ICT	SA	A	D	SD	X	Sd	Remark
1.	Critical thinking skills in students can be improved by use of computer	32	18	0	0	3.64	0.23	ACCEPT
2.	ICT can enhance students' effective participation and feedback to lecturers	24	28	0	0	3.60	0.28	ACCEPT
3.	ICT can enhance students' collaboration	23	26	1	0	3.44	0.29	ACCEPT
4.	ICT can enhance teacher and student interaction	30	19	1	0	3.58	0.37	ACCEPT
5.	Internet offers a wide range of opportunities and variety of resources to lecturers for content improvement/modification.	38	10	2	0	3.72	0.28	ACCEPT
6.	Higher institutions should replace the traditional teaching aids by new ICT tools to improve teaching and learning	36	12	1	1	3.36	0.38	ACCEPT
7.	The use of ICT enhances individual practice for attainment of mastery	33	15	2	0	3.62	0.32	ACCEPT
8.	Preparation of course materials, assignment, handouts etc is made easy by the use of instructional technologies	39	9	1	1	3.72	0.36	ACCEPT
9.	Integrating ICT in academic activities improves the performance of students	28	22	0	0	3.56	0.25	ACCEPT

Grand Mean = 3.58

The findings reveal that 32 and 18 of the respondent strongly agreed and agreed respectively with a mean score of 3.64 and a standard deviation of 0.23 reflecting a low variability that Critical thinking skills in students can be improved by use of computer while none of the respondent disagreed to this statement also 24 and 28 of the total respondent strongly agreed and agreed that ICT can enhance students 'effective participation and feedback to lecturers with a mean score of 3.60 and a standard of 0.28 reflecting low variability . It was also observed that 23 and 26 of the respondents strongly agreed and agreed that ICT can enhance students collaboration with a mean score of 3.44 and a standard deviation of 0.29 reflecting low variability, it was also visible from the findings that 38 respondent strongly agreed and 10 agreed that ICT can enhance teacher and student interaction while 2 disagreed to this statement with a mean of 3.58 and standard deviation of 0.37 reflecting a high variability, it was also observed that 36 and 12 of the respondent strongly agreed and agreed respectively that Internet offers a wide range of opportunities and variety of resources to lecturers for content improvement/modification while 1 equally disagrees and strongly disagree to this statement with a mean score of 3.36 and a standard deviation of 0.38 reflecting more variability. Also 33



and 15 strongly agreed and agreed respectively that Higher institutions should replace the traditional teaching aids by new ICT tools to improve teaching and learning while only 2 disagreed to this statement with a mean score of 3.62 and standard deviation of 0.32 reflecting more variability .in addition 39 and 9 of the respondent strongly agreed and agreed that The use of ICT enhances individual practice for attainment of mastery but 1 of the respondents strongly disagreed and disagreed to this statement with a mean of 3.72 and a standard deviation of 0.36 reflecting more variability .

Furthermore, 28 and 22 of the respondent strongly agreed and agreed that Preparation of course materials, assignment, handouts etc. is made easy by the use of instructional technologies. Integrating ICT in academic activities improves the performance of students with a mean score of 3.56 and a standard deviation of 3.25 reflecting low variability. And the grand mean reflecting that respondents agrees with the use of ICT

DISCUSSION

The table above further revealed that the lecturers agreed that the use of ICT for instructional purposes is important rather than printed materials, ICT can enhance students effective participation, effectiveness and feedback to lecturers; ICT enhances students collaboration, ICT enhances teacher-student interaction, internet offers a wide range of opportunities and variety of resources to teachers for content improvement/modification, the use of ICT enhances individual practice for attainment of mastery, integrating ICT in academics improves performance of students, usage of instructional technologies makes it easier to prepare course materials (assignments, handouts, etc.); internet can offer opportunities to teachers for obtaining learning resources to improve content; ICT tends to increase students learning motivations and ICT can enhance students' participation and feedback to teachers as a tool. This implies that ICT was viewed as important in improving the quality of teaching.

CONCLUSION

This study reveals that the lecturers are used to ICT tools and use them in improving the quality of teaching and learning which shows that lecturers in federal university of technology Minna have a positive perception on the use of ICT in improving classroom teaching and learning activities/quality of education.

RECOMMENDATIONS

1. Investments of the college on lecturers training programs for instructional technologies and support services of instructional technologies should be prioritized to integrate ICT into teaching-learning process,



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2. Avenues should be created for lecturers not having ICT tools to have and start using them,
 3. It is important to motivate and reward lecturers to use ICT in instructional activities,
 4. Technology should be incorporated during curriculum design in order to apply it easily and the University should also give attention in creating comfortable environment which motivates to use this technology.



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TÜRKİYE TARIM SEKTÖRÜNDE DİJİTAL DÖNÜŞÜM

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ÖZET

Dijital dönüşüm, hedef bir sektörde son teknoloji ürünlerinin kullanımı ile üretim ve çalışma biçiminin değiştirilmesi sürecidir. Teknolojide görülen hızlı gelişmeler sayesinde günümüzde tüm sektörlerde olduğu gibi sosyal ve kültürel yaşantılarımızda ve algılarımızda da köklü değişimlerden geçmekteyiz. Covid pandemisinin de etkisiyle çalışma ve okul hayatlarımız dahil pek çok alanda dijital dönüşüm hız kazanmıştır. Tarım sektörü de bu dönüşümden kaçınılmaz olarak bir ölçüde etkilenmektedir. Ancak ülkemizde tarımsal üretim gittikçe yaşlanan çiftçi nüfus tarafından, parçalı ve küçük ölçekli işletmeler üzerinde gerçekleştirildiği için dijitalleşme oldukça dar bir alanda sınırlı kalmaktadır. Bu nedenle, üretim ve pazarlama süreçlerini güncel teknoloji ile donatan küresel rakipler karşısında tarım sektörünün rekabet gücünün olumsuz etkilenmesi kaçınılmazdır. Yeterli gıda arzının temin edilmesi her ülkenin en önemli konularından birisini oluşturmaktadır. Günümüzde dünya giderek şiddetlenen bir gıda arz tehdidi ile karşı karşıyadır. BM'nin son rakamlarına göre 79 ülkede 350 milyon insan acil gıda kriziyle karşı karşıyadır ve 900 milyon kadar insan da kıtlık seviyesinde beslenebilmektedir. Bu sayılar her geçen yıl artmaktadır ve yakın zamanda iklim kaynaklı gıda ve su krizi sebebiyle kitlesel göçlerin görülmesi beklenmektedir. Ülkemizde de iklim değişikliği kaynaklı ekstrem olayların görülme sıklığı giderek artmaktadır ve bu nedenle her yıl tarımsal üretimde önemli kayıplar meydana gelmektedir. Ülkemiz tarımının sahip olduğu pek çok sorun teknoloji kullanımı ile çözülebilecek niteliktedir. Tarım ürünlerinde görülen ilaç kalıntıları, tedarik zincirinde görülen kayıplar, üreticilerin karlılığını düşüren komisyoncu ve aracılar, tarım işçisi bulma sorunu gibi pek çok problem teknoloji ile aşılabılır. Blok zincir, nesnelerin interneti, yapay zeka, otonom robotlar, dron uygulamaları ve e-ticaret gibi teknolojinin getirdiği çözümler belirli ölçüde ülkemizde uygulama alanı bulmuş durumdadır. Çalışmada, Türkiye tarımının mevcut durumu ve teknoloji kullanımı önündeki temel problemler belirlenmiş, dünyadan iyi uygulama örnekleri verilerek çözüm önerileri getirilmeye çalışılmıştır.

Anahtar Kelimeler: Tarım, dijitalleşme, tarım 4.0, smart agriculture



DIGITAL TRANSFORMATION IN AGRICULTURE SECTOR OF TÜRKİYE

ABSTRACT

Digital transformation is the use of latest technology products in a sector to change the way of operation. Thanks to the rapid developments in technology, we are going through radical changes in our social and cultural lives and perceptions. With the impact of the Covid pandemic, digital transformation has accelerated in many areas, including business and education. The agricultural sector has been inevitably affected by this transformation to some extent. However, since agricultural production in Türkiye is carried out by the aging farmer population, on fragmented and small-scale enterprises, digitalization remains confined to a small application domain in agriculture. As developed countries equip their agriculture sector with latest technologies, which will adversely affect developing countries competitiveness. Ensuring adequate food supply is one of the most important issues for every country. Today, the world is faced with an increasing food supply threat. According to the latest figures of the UN, 350 million people in 79 countries are facing an acute food crisis and as many as 900 million people can only survive on famine-like conditions. These numbers are increasing every year and mass migrations are expected in the near future due to the climate-related food and water crisis. The incidence of extreme events caused by climate change is increasing in Türkiye as well, and therefore, significant losses occur in agricultural production every year. Many problems of Turkish agriculture sector can be solved with the use of technology. Such problems as pesticide residues in agricultural products, losses in the supply chain, brokers and intermediaries that reduce the profitability of producers, and the lack of agricultural workers can be overcome with technology. Solutions brought by technology such as blockchain, internet of things, artificial intelligence, autonomous robots, drone applications and e-commerce are used in Türkiye to a certain extent. This paper investigates the current status of agriculture sector in Türkiye in terms of digital transformation, establishes problems faced by the stakeholders and put forward policy recommendations based on the good practices in the world.

Keywords: Agriculture, digitalization, agriculture 4.0, smart agriculture



1. Introduction

Digitalization is commonly mistaken with digitization, which sound similar but actually are two different words. Digitization is defined as the process of converting any analog information into computer readable digital bits. On the other hand, digitalization has a broader meaning and it is the use of digital technologies to change a business model in order to attain higher revenue. Digitalization has a profound process effect on organization which is called digital transformation.

The world population is expected to exceed 8.5 billion by 2030 and 10 billion by 2050 (UN, 2019). 30% of world population lived in urban areas in 1950, however, this figure has reached 55% in 2018 and is expected to exceed 68% by 2050. The need for food has been steadily increasing and will continue to increase in the future with the growing global and urban population. Climate change is another important factor that poses serious threats to agriculture. Precipitation regime is showing more tropical characteristics and extreme weather events like heavy rainfall, floods, storms and tornadoes have been observed in every coming year. Therefore, climate change will reduce water resources, cause certain problems in agriculture production, and possibly change the range of products and negatively affects the quality and quantity of the foods. The future poses serious challenges for adequate food delivery. These challenges can be shortly grouped under 4 main sections, which are climate change, demographics, food waste and decreasing natural resources. The advancing digital technologies could be the solution for a more productive, effective, sustainable and inclusive food production. Technologies such as Blockchain, Internet of Things, Augmented and Virtual Reality, Artificial Intelligence enable innovative applications and are rapidly altering all sectors, which are all categorized as Industry 4.0 revolution.

2. Overview of Agriculture in Türkiye

Agriculture sector has always been of critical importance for Türkiye. Agriculture sector accounts for about 7% of national GDP and 20% of total employment. Agricultural lands are about 50% of the total land area. However, the size of agricultural enterprises are about 5-6ha and 70% of farmers have less than 5 ha. The primary agricultural products of Türkiye are wheat (20,5 million tons/ year), sugar beet (23,0 million tons/year), tomatoes (13,2 million tons/year), barley (8,3 million tons/year), and corn (6,5 million tons/year). Animal productions is as important as plant production in Türkiye. Türkiye has over 1.3 million cattle farms, however, over 60% of farms are small sized family enterprises with less than 5 cattle. There are about 3.6



million beef cattle and 6 million dairy cows in Türkiye. Sheep is mainly raised for meat production with over 21 million head, while goat is raised for meat (4.5 million head) and milk (5 million head). Türkiye imports half of the feed ingredients (soybean, seed, corn, additives and sunflower) every year, which increases vulnerability of agriculture sector to foreign currency shocks. The mean age of Turkish farmers is 54 years and it is getting older, while the mean age of Turkish population is 28 years. Younger people have been migrating to urban areas for better opportunities for education, employment and quality of life.

3. Digital Technologies and Agriculture

Technologies that enable digitalization continue their rapid evolution. Therefore, digitalization is not a simple topic of adopting more technologies. It is to create new opportunities through innovative thinking. Digitalization can be integrated into every step of production chain, from cultivating, harvesting to transporting, marketing and even consumer experience after purchase. In this way, effective decisions can be taken faster and the whole process of production supply can be monitored, which will create additional value, increase food safety and optimize resource management. There are currently various technological fields that can be incorporated into different parts of food supply chain. The most important of these technologies are summarized below.



Figure 1. Smart farming examples

Internet of Things (IoT)

IoT is a term used to define equipping devices with sensors and internet. One equipped, users can monitor and command devices through using their personal computers, cellphones or any device connected to internet. In agriculture, automation systems with internet connection are used for a wide range of purposes such as irrigation, fertilization, pest control, spraying, climate conditioning, feeding etc. Farmers can monitor their farms remotely, they can see and manage air condition in greenhouses, control their herds in ban. There are more opportunities that can increase the productivity and quality with reduction in cost.



Intelligent Systems - Cyber-Physical Systems (CPS)

CPS or intelligent systems are monitoring and controlling systems based on computer algorithms combining physical and software components. They can be seen as larger systems that uses IoT sensors to control communication, movement and presence of physical systems like robots. Such integrated far management systems are used to monitor certain parameters and take correct action in accordance, thus losses can be reduced with early action.

Artificial Intelligence (AI)

Artificial intelligence is the technological simulation of human intelligence by machines. It is the statistical inference and learning process of computers through large datasets. It comprises data gathering, processing, learning, taking decision and making calculations. It is relatively less used in Agriculture but its application has been steadily increasing. AI can bring solutions to human labor intensive tasks in Agriculture.

Robotics and Autonomous System

Equipped with sensors, robots can sense their environment and act accordingly. Robots can work manually or autonomously without human intervention depending on their design requirements and elaboration. They are employed in agriculture especially for insecticide spraying, crop harvesting, mowing or similar tasks. Autonomous tractors and harvester machines are among autonomous robotic systems as well.



Figure 2. Autonomous robots used in greenhouses

Big Data

Big Data comprises huge volumes of data that are beyond the capacity of conventional computer systems and requires the server implants of big companies. Big Data means more than data itself and signifies the whole system of constantly collecting storing, analyzing, interpreting and reporting results. This makes it possible to take right decisions and strategies, gain competitiveness through decreasing risks and costs.

Drone



Drones are manually controlled or autonomous flying robots. They are classified by ICAO depending on the autonomous structure of the vehicle. They are widely used in many different areas for various purposes. They have a wide range of applications in agriculture including seed planting, disease and weed detection, crop monitoring and harvest detection etc. Some of its variants incorporate tanks for spraying pests.



Figure 3. Drones of different sizes and types used in agriculture

Blockchain

Blockchain is a database distributed among multiple users. It is best known for its role in cryptocurrency development in that it provides a secure and decentralized record of transactions. It guarantees trust and transparency without the need for a third party service. With the use of IoT, all phases of food supply chain can be publicly stored in blockchain. It can mainly be used in agriculture for food safety, traceability and quality insurance to create a credible system for all parties.

4. Discussion

The technologies continue to evolve and bring about new opportunities for the agriculture sector. Uncertainty is the underlying cause for many problems shown in every step of the food chain. With the help of emerging technologies and digitalization of agriculture, many things will become more predictable, which will enable faster and effective decision-making processes.

There have been encouraging developments in Türkiye in the recent decades. Türkiye ranked 5th out of 150 countries for 3G and 4G coverage and network performance. Large investments have been made in infrastructure to increase accessibility. Another important development has been seen in the e-business field. A digital marketplace has been established for farmers, named DITAP. The aim is to meet buyers and sellers without the need for intermediaries and thus increase the profit of farmers and decrease the price for consumers. However, the application is not widespread among older producers.



Many research findings have indicated that lack of capital in agriculture is the main obstacle for digitalization. The second most important obstacle is the aging producers who are not open to alteration in their habits and have difficulty in learning how to use new technologies.

Several startup companies have been founded to develop new technology products for agriculture. IoT based automatization, drone based pesticide sprayer and monitoring applications gained attention in this respect. However, these applications are limited in use. Considering the average size of agriculture land and enterprise, it is quite expensive for a farmer to adopt the new technologies alone. Presidential Digital Transformation Office supervises all digital transformation programs in agriculture and other sectors. They work to develop national digital solutions and raise awareness among stakeholders, provide recommendations to both public and private sectors and prepare national technology strategies and policies. The Ministry of Agriculture and Forestry is the main investor and buyer for digital technologies in agriculture. With the support of public owned electronics companies in Türkiye like ASELSAN, the Ministry develops and supports a number of national projects including Autonomous Tractor Steering, Farm Management Systems, UAV Image Processing in Agriculture, Precision Farming Applications, Wheat Loss Monitoring Systems and Intelligent Systems for Monitoring Sheep and Goat Breeding etc. Moreover, Türkiye has many skilled workforce in digital sector, but many of them are based in large city centers and interested in other sectors. Agriculture is still to be explored by digital workforce.

5. Conclusion

Despite the advantages of using digital technologies, stakeholders in agriculture sector do not invest in this field. The main reasons are the high initial investment requirement and lack of knowledge. The small sized and fragmented structure of agricultural lands and enterprises make it difficult to adopt innovative applications. The deteriorating effects of climate change, water shortages and soil pollution are other limiting factors for making investments in new fields. The agriculture sectors of advanced countries have been undergoing digital transformation and the gap is further enlarging between those and developing countries. It will be impossible to compete with these countries even for the domestic market in the near future. When the individual investments are not possible, government's responsibility increases for directing, managing and making investments in agriculture. Investments in digitalization becomes logical with over 10 decare fields. The small sized enterprises in agriculture should be encouraged to use co-owned technology in order to minimize the cost . Türkiye has skilled workforce in digital field, however, most of them are located in large city centers. Government policy should be



developed to attract their attention to agriculture sector. Another problem is the aging population in rural areas. Many agriculture fields are not cultivated by their owners, and some are left uncultivated. The policies should be developed to provide the unemployed agriculture engineers with arable lands through renting or profit sharing methods with land owners. This will increase the adaptability to new digital technologies as well. There are important opportunities for many young people in the rural areas and agriculture sector. For the elder population, continuous training programs should be kept open for the use of technologies in rural areas.



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EXPRESSING GENES OF SUNFLOWER (*Helianthus annuus* L.): A REVIEW

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ABSTRACT

Sunflower is one of the most important oil crops which is valuable for its high content of unsaturated fatty acids, vitamin E and phytosterols. The genome sequence of this species is unknown and the information regarding the huge quantity of expressed sequence tags (ESTs) from *Helianthus* spp., available in public databases, has not yet been well explored.

Here reader may find a review of molecular mechanisms underlying the sunflower plant's response to biotic and abiotic stress factors and oil and tocopherols.

Keywords: Genes, expression, sunflower, *Helianthus annuus* L., biotechnology



1. Introduction

Energy security and pollution are becoming critical issues in the context of climate change and the circular economy, calling for sustainable resources. *Asteraceae* species, commonly referred as the aster, daisy, composite, or sunflower family, are among the largest flowering plants with 23,000 species belonging to 1600 genera (Nguyen et al., 2021). Sunflower (*Helianthus annuus* L.) is one of the world's most important oil crops and sunflower oil is esteemed for its high content of unsaturated fatty acids together with the occurrence of relatively high amounts of vitamin E and phytosterols. Reports on other secondary metabolites are rare, but recently identified bioactive sesquiterpene lactones in non-germinated sunflower seeds suggested their existence in sunflower oil (Spring, 2021). Sunflower is an important oilseed crop native to South America and currently cultivated throughout the world. Generally, the sunflower is considered important based on its nutritional and medicinal value. Due to its beneficial health effects, sunflower has been recognized as functional foods or nutraceutical, although not yet fully harnessed. Sunflower contains mineral elements and phytochemicals such as dietary fiber, manganese, vitamins, tocopherols, phytosterols, triterpene glycosides, α -tocopherol, glutathione reductase, flavonoids, phenolic acids, carotenoids, peptides, chlorogenic acid, caffeic acid, alkaloids, tannins, and saponins; and these compounds contribute to their functional and nutraceutical development. The extract from sunflower is known to be a potential source of antimicrobial, anti-inflammatory, antitumor, and antioxidants agents that protect human cells against harmful reactive oxygen molecules and pathogenic microorganisms. Also, the pharmacological survey on sunflower had revealed its curative power to different kinds of diseases (Adeleke & Babalola, 2020).

The sunflower belongs to the *Asteraceae* family, whose members represent ten percent of the flowering plants. The genome sequence of this species is unknown and the information regarding the huge quantity of expressed sequence tags (ESTs) from *Helianthus* spp., available in public databases, has not yet been well explored. Transcription factors (TFs) are key proteins regulating many signal transduction pathways (Giacomelli et al., 2010). The mechanisms by which natural populations generate adaptive genetic variation are not well understood. Some studies propose that microsatellites can function as drivers of adaptive variation (Ranathunge et al., 2018).



2. Oil, Tocopherols and tricarboxylates

Biochemical and fluorescence microscopic imaging approach has been adopted to investigate the accumulation of oil bodies at specific stages of seed development in *Helianthus annuus* L. cv. Morden by Kaushik et al., (2010). Seed filling in sunflower is marked with a rapid accumulation of proteins and lipids upto 30 DAA, after which protein accumulation declines whereas lipids continue to accumulate. Earliest signs of lipid accumulation are evident as early as during globular stage of embryo development. Spatially, a developing seed exhibits enhanced lipid deposition in peripheral cells. Oil body biogenesis is observed as early as 10 DAA, as is evident from the fluorescence microscopic detection of Nile red-positive entities in the protoplasts. To begin with, expression of one of the oleosin (the principal oil body membrane proteins) isoforms (16 kDa), is slower than the other two (17.5 and 20 kDa). Fatty acid composition of oil body lipids is quite similar to that of total seed lipids. An enhanced accumulation of linoleic acid is evident during later stages of seed filling. The proportion of major saturated fatty acids, palmitic (16:0) and stearic (18:0), however, do not alter much during the later phases of seed development.

Membrane-bound fatty acid desaturase (FAD) gene family plays crucial roles in regulation of fatty acid (FA) compositions in plants. Role of FAD family in relation to stress tolerance in sunflower was studied by Li et al., (2021). They identified 40 putative FAD genes in *H. annuus* (HaFAD), which were unevenly distributed across 13 of the total 17 chromosomes. Phylogenetic analysis indicated that HaFAD genes were divided into four subfamilies, as supported by highly conserved gene structures and motifs. Collinearity analysis showed that tandem duplication events played a crucial role in the expansion of HaFAD gene family. In addition, tissue-specific expression showed that 32 HaFAD genes were widely expressed in various tissues or organs of sunflower. Some specific up-regulated genes such as HaFAD3.2, HaADS8, HaFAD2.1, and HaADS9 would be the potential candidate genes for the sunflower tolerance breeding.

Sunflower occupies the fourth position among oilseed crops the around the world. Eceriferum (CER) is an important gene family that plays critical role in very-long-chain fatty acids elongation and biosynthesis of epicuticular waxes under both biotic and abiotic stress conditions. Ahmad et al., (2021) identified thirty-seven unevenly distributed CER genes in the sunflower genome. Expression analysis showed that genes CER10 and CER60 were upregulated in sunflower during drought conditions, indicating that these genes are activated



during drought stress. Expression of wax biosynthesis genes CER10 and CER60 was upregulated when the plants were subjected to drought stress.

Tocopherols are natural antioxidants with both in vivo (vitamin E) and in vitro activity. Sunflower seeds contain predominantly alpha-tocopherol (>90% of total tocopherols), with maximum vitamin E effect but lower in vitro antioxidant action than other tocopherol forms such as gamma-tocopherol. Sunflower germplasm with stable high levels of gamma-tocopherol (>85%) has been developed. The trait is controlled by recessive alleles at a single locus Tph2 underlying a gamma-tocopherol methyltransferase (gamma-TMT). Additionally, unstable expression of increased gamma-tocopherol content in the range from 5 to 85% has been reported (García-Moreno et al., 2012).

Fumarase (fumarate hydratase; EC 4.2.1.2) interconverts malate and fumarate and participates in the tricarboxylic acid cycle. Fumarase (EC 4.2.1.2) is encoded in sunflower (*Helianthus annuus* L.) by two genes (FUM1 and FUM2) expressing correspondingly the mitochondrial and the cytosolic form. Both forms have been purified from sunflower cotyledons and characterized. Three quarters of fumarase activity is located in the mitochondrial and one quarter in the cytosolic fraction. The cytosolic form has lower pH optimum than the mitochondrial form, it possesses higher affinity to malate, activated by Mn²⁺ and less efficiently by Mg²⁺ while the mitochondrial form is activated only by Mg²⁺. It is proposed that the mitochondrial form is involved in the respiratory processes linked to the tricarboxylic acid cycle and the cytosolic form participates in the utilization of succinate produced in the glyoxylate cycle providing the flux to gluconeogenesis in germinating sunflower seeds (Eprintsev et al., 2018).

3. Abiotic stress factors

Sunflower is one of the principal oil seed crops affected by the salinity stress, which limits the oil content and crop yield of sunflower plants. The acclimatization of plants to abiotic stresses such as salinity tolerance is mainly mediated by the vacuolar Na⁺/H⁺ antiporters (NHX) by tagging Na⁺ into vacuoles from the cytosol (Mushke et al., 2019). Salinity results in significant reduction in sunflower seedling growth and excessive generation of reactive oxygen species (ROS) (Arora & Bhatla, 2017).

Salt stress adversely affects plants by causing osmotic and ionic imbalance. Cellular osmotic adjustment occurs by modulation of water fluxes. Polyamines (PAs) are often advocated to be involved in osmoregulation during stressful conditions, and thus, they serve as potential “osmolytes.” Aquaporins (AQPs), the water-transporting channels, are expected to play crucial roles in osmoregulation (Tailor & Bhatla, 2021).



Gene expression pattern of two important regulatory proteins, salt overly sensitive 2 (SOS2) and plasma membrane protein 3-1 (PMP3-1), involved in ion homeostasis, was analyzed in two salinity-contrasting sunflower (*Helianthus annuus* L.) lines, Hysun-38 (salt tolerant) and S-278 (moderately salt tolerant). Both tolerant and moderately tolerant lines showed a gradual increase in SOS2 expression in sunflower root tissues. Leaf tissues showed the gradually increasing pattern of SOS2 expression in tolerant plants as compared to that for moderately tolerant ones that showed a relatively lower level of expression for this gene. The highest level of PMP 3-1 expression was found in the roots of tolerant sunflower line at 6 and 12 h postsalinity treatment. The moderately tolerant line showed higher expression of PMP3-1 at 12 and 24 h after salt treatment. Overall, the expression of genes for both the regulator proteins varied significantly in the two sunflower lines differing in salinity tolerance (Saadia et al., 2013).

Although sunflower is categorized as a medium drought-sensitive crop, in a changing climate scenario and/or with the onset of early droughts, the crop may be affected by water stress (Escalante et al., 2020).

Valine-glutamine (VQ) genes play important roles in plant growth, development and responses to biotic and abiotic stresses. Total 20 VQ genes were identified and classified into seven groups (I-VII) that are distributed among 11 chromosomes within the sunflower genome in the study of Ma et al., (2021). Based on phylogenetic analyses, HaVQ genes that clustered within the same branches shared similar motifs and structures. Most HaVQ genes exhibited tissue-specific expression patterns suggesting putative roles in plant drought and salt stress responses, with several HaVQ proteins predicted to interact with HaWRKY proteins.

Membrane-bound fatty acid desaturase (FAD) gene family plays crucial roles in regulation of fatty acid (FA) compositions in plants. Li et al., (2021) identified 40 putative FAD genes in *H. annuus* (HaFAD), which were unevenly distributed across 13 of the total 17 chromosomes. Phylogenetic analysis indicated that HaFAD genes were divided into four subfamilies, as supported by highly conserved gene structures and motifs. Collinearity analysis showed that tandem duplication events played a crucial role in the expansion of HaFAD gene family. In addition, tissue-specific expression showed that 32 HaFAD genes were widely expressed in various tissues or organs of sunflower. Results revealed significant expression changes of HaFAD genes in response to abiotic (cadmium, drought) and biotic (*Orobanche cumana*) stresses, suggesting their important functions in response to different stresses. Specific up-regulated genes such as HaFAD3.2, HaADS8, HaFAD2.1, and HaADS9 would be the potential candidate genes for the sunflower tolerance breeding.



Sunflower is a promising plant species for phytoextraction of excess soil phosphorus (P) because of its superior P accumulating characteristics. Several of the up-regulated genes identified by Padmanabhan & Sahi, (2011) under high P-treatment that might be involved in P-accumulation and tolerance in this plant. A total of 89 non-redundant expressed sequence tags (ESTs) were identified as high P-responsive genes and they were classified into 6 functional groups.

4. Biotic stress factors

The necrotrophic pathogen *Sclerotinia sclerotiorum* is a causal agent of rot diseases in sunflower and is described as one of the most damaging pathogens of cultivated sunflower. Resistance to this pathogen is found in some genotypes of wild sunflower in particular characterised by significantly reduced lesion lengths in capitulum, stems and leaves. Muellenborn et al., (2011) characterised transcriptomic alterations during interaction of host and pathogen in lesion-surrounding areas of the leaf using differential display RT-PCR and to compare molecular responses between a resistant and a susceptible genotype. Leaves were examined during the first stages of pathogenesis (dpi 2, 3 and 4) after inoculation with *S. sclerotiorum*. The expression profile revealed that a response measured by the number of significant differentially expressed transcripts differed between the resistant and susceptible genotype in timing. Nine differentially expressed transcripts were successfully sequenced of which two transcripts originated from the mRNA population of the pathogen, two transcripts were derived from the susceptible cultivar of *Helianthus annuus* and five transcripts were isolated from the resistant genotype of *Helianthus maximiliani*.

Systemic infections are commonly associated with changes in host metabolism and gene expression. Sunflower chlorotic mottle virus (SuCMoV) causes systemic infection with sugar increase, photoinhibition and increase in antioxidant enzyme activities before chlorotic symptom appearance in sunflower leaves. Rodriguez et al., (2012) determined if chlorotic symptom development induced by SuCMoV infection is accompanied by changes in different redox-related metabolites and transcripts. A positive correlation between chlorotic symptom and number of viral copies was also observed. Changes in hydrogen peroxide, glutathione, pyridine nucleotides and ATP content were observed. The expression of some of the genes analyzed was also strongly affected by SuCMoV infection. Specifically, down-regulation of both chloroplast-encoded genes and chloroplast-targeted genes: *psbA*, *rbcS*, *Cu/Zn sod*, *Fe sod*, phosphoglycolate phosphatase, *psbO*, *psaH* and *fnr* was present, whereas the expression of cytoplasmic-targeted genes, *apx1*, and *Cu/Zn sod* was up-regulated.



Verticillium dahliae is a pathogen causing vascular wilts in a broad range of plant species. The production of cell wall degrading enzymes (CWDE) is one of the pathogenicity factors contributing to this disease. The expression of eight CWDE genes was estimated in 15 *V. dahliae* isolates. Correlation tests revealed a clear association between the pathogenicity and gene expression of pectinase, cutinase, 1,4- β glucosidase, and SNF protein kinase. In contrast, xylanase and endoglucanase G1 correlated negatively with pathogenicity (Gharbi et al., 2015).



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BAL ARILARINDA DEFORME KANAT VİRUS VE AKUT ARI FELCİ VİRUS ENFEKSİYONLARININ MOLEKÜLER TEŞHİSİ

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ÖZET

Arıcılık tarihin en eski mesleklerinden birisidir. Toprağa bağlı olmayıp, topraksız veya yeterli toprağı olmayan aileler için alternatif geçim kaynaklarından biri olması bunun en önemli nedenlerindedir. Bal arılarından elde edilen arı sütü, bal ve polen gibi yüksek besin içerikli ürünler beslenme, sağlık ve sanayi açısından da çok kıymetlidir. Bu durum oluşturduğu katma değer ile aile ve ülke ekonomisine katkı sağlar. Ayrıca arıların tozlaşmaya katkısı, tarımsal üretim ve çiçekli bitkilerin çeşitliliği için kritik önemi bulunmaktadır. Bal arılarının tabiata ve canlı varlığına olan bu denli katkısından dolayı bunların hastalıklarının teşhisi ve patojenleri ile mücadele oldukça önemlidir. Bu kapsamda bal arılarının hastalık yapıcı mikroorganizmaları arasında yer alan viruslar ergin arı ve yavru ölümlerine yol açarak koloni sönmelerine neden olan başlıca etkenler arasında yer almaktadırlar. Viral etkenlere bağlı oluşan yüksek mortalite oranları bu patojenlerin bal arılarının refahını ve sağlığını ciddi boyutta tehdit ettiğini göstermektedir. Bu çalışmada, Burdur bölgesinde bulunan arıcılık işletmelerindeki bal arılarında akut arı felci virus (ABPV) ve deforme kanat virus (DWV) enfeksiyonlarının varlığı virolojik olarak araştırılmıştır. Araştırmada Burdur yöresinde bulunan 25 arıcılık işletmesinden yapılan örneklemeler ile değişik arı ırklarından 50 ergin bal arısı örneği toplandı. Alınan bal arısı örnekleri reverz transkriptaz polimeraz zincir reaksiyon (RT-PCR) yöntemi ile analiz edildi ve deforme kanat virus, akut arı felci virus enfeksiyonlarının prevalansı sırasıyla %78 ve %66 oranlarında tespit edildi. Araştırmanın yapıldığı arı kolonilerinde belirlenen pozitifliğin ikili enfeksiyon oranları ve ırklara göre dağılımı ortaya konuldu. Sonuç olarak, ülkemizde arı kolonilerinde önemli koloni kayıplarına sebep olan söz konusu iki arı virusunun epidemiyolojik durumları belirlendi ve bu hastalıkların kontrolü amacıyla önlemlerin alınması gerektiği kanaatine varıldı.

Anahtar Kelimeler: Akut arı felci virus, bal arısı, deforme kanat virus, rt pcr



MOLECULAR DIAGNOSIS OF DEFORMED WING VIRUS AND ACUTE BEE PARALYSIS VIRUS INFECTIONS IN HONEY BEES

ABSTRACT

Beekeeping is one of the oldest professions in history. One of the most important reasons is that beekeeping is one of the alternative livelihoods for families who are not dependent on the land and don't have enough or any land. Products obtained from honey bees with high nutritional content such as royal jelly, honey and pollen are also very valuable in terms of nutrition, health and industry. This situation contributes to the family and country's economy with the added value it creates. Furthermore, the contribution of bees to pollination is vital for agricultural production and the diversity of flowery plants. Due to the contribution of honey bees to the nature and to life, it is crucial to diagnose their diseases and challenge with their pathogens. Thence, viruses, which are disease-causing microorganisms in honey bees are among the main factors that cause colony extinction by causing adult bee and brood deaths. High mortality rates due to viral agents indicate that these pathogens seriously threaten the welfare and health conditions of the honey bees. In this study, the presence of acute bee paralysis virus (ABPV) and deformed wing virus (DWV) infections in honey bees were investigated virologically in beekeeping enterprises around Burdur region. In the research, 50 adult honey bee samples from different breeds were collected from 25 beekeeping enterprises in Burdur region. The honey bee samples analyzed with reverse transcriptase polymerase chain reaction (RT PCR) and the prevalence of deformed wing virus and acute bee paralysis virus infections were determined as 78% and 66% respectively. The dual infection rates and the distribution by race of the determined positivity in the bee colonies were revealed. As a result, the epidemiological conditions of these two bee viruses that cause significant losses in bee colonies in our country were determined and it was concluded that measures should be taken to control those diseases.

Keywords: Acute bee paralysis virus, honey bee, deformed wing virus, rt pcr



1. GİRİŞ

Dünyada arılar tozlaşmanın aktarılması ile bitkisel üretime/çeşitliliğe ve tarıma yarar sağlamakta bu özelliği ile de ekosistemde dengeyi oluşturmaktadırlar. Bu kapsamda ülkemizin ekolojik çeşitliliği ve zengin bitki florası arıcılık için ideal bir ortam yaratmaktadır. Bu çeşitlilik sayesinde de ülkemiz dünyada arıcılık faaliyetlerinde ön plana çıkmaktadır.

Akut arı felci virusu, klinik belirti görülmeyen enfekte ergin arılardan arı sütü ile gelişmekte olan larvalara veya varroa parazitleri tarafından pupalara ve larvalara iletilmektedir (Moore ve ark., 2015) Etken *Dicistroviridae* ailesinin (De Miranda ve ark., 2010) *Aparavirus* cinsi içerisinde yer alan kübik simetrik, zarfsız yapıda tek iplikçikli RNA (ssRNA) virusudur. Felçli arıların beyin, baş ve hipofarengeal bezlerinde yoğun olarak akut arı felci virusu bulunabilir. Doğal koşullarda virus, enfekte ergin arıların ağız salgılarıyla saçılır ve genç arılara beslenme yolu ile bulaşır. Ayrıca klinik belirti gösteren arılarda dışkılarıyla da virus saçılmaktadır. Bal arısı kolonilerinde çokça görülen bu etken arı kolonilerinin ani çökmesine neden olabilir ve parazitik akar olan *Varroa destructor* tarafından da bulaştırılır (Bakonyi ve ark., 2002). Bu virus ergin ve yavru arılar arasında bulunan varroa enfestasyonu ile hızlı bir şekilde yayılabilir. Hem varroa akarı ile enfeste olmuş hem de enfeksiyonu gelişmiş kolonilerde arı ölümleri oldukça fazladır. Ayrıca bu etken ile deforme kanat virusunun miks enfeksiyonlar oluşturduğu da belirlenmiştir (Shumkova ve ark., 2018).

Deforme kanat virusu, tek iplikçikli pozitif polariteli, çapı 30 nm olan kübik simetrik RNA taşıyan bir patojendir ve yapısındaki viral nükleik asit yaklaşık 10,1 kb uzunluğundadır (Lanzi ve ark., 2006; Maramorosch ve Shatkin, 2007). Deforme kanat virusu, *Iflaviridae* ailesinin *Iflavirus* cinsinde yer almaktadır. Iflaviruslar, viral genomunda tek bir ORF bölgesi taşımalarıyla dicistroviruslardan ayrılırlar (Valles ve ark., 2017). Enfekte arı kolonilerinde klinik semptomların oluşması genellikle varroa parazitinin bulunmasıyla alakalıdır. Deforme kanat virusu bal arılarında kısalmış abdomenler, arı deformitesi, ağırlık azalması, kusurlu uzantılar (buruşmuş/körelmiş kanatlar) olası yaşam süresinde bir azalma ve sonuç olarak düzensiz yavru oluşumu ve azalan arı sayıları ile koloni kayıplarına neden olabilir (DeJong ve ark., 1982; Shimanuki ve ark., 1994).

Bal arısı popülasyonu dünyada ve ülkemizde önemli sayıda olmasına karşın arı viruslarıyla ilgili sınırlı veriler bulunmaktadır. Bu çalışmada Burdur yöresinde önemli koloni kayıplarına sebep olan deforme kanat virusu (DWV) ve akut arı felci virusu (ABPV) etkenlerinin, reverz



transkriptaz-polimeraz zincir reaksiyon (RT-PCR) tekniği kullanılarak varlığının, yaygınlığının ve kolonilerdeki dağılım oranlarının belirlenmesi amaçlanmıştır.

2.MATERYAL VE YÖNTEM

Bu araştırmada, viral arı enfeksiyonlarından DWV ve ABPV hastalıklarının tespiti amacıyla Nisan-Eylül 2022 tarihleri arasında Burdur yöresinden örnekleme yapıldı. Çalışma için 1 örnekleme 15-20 arı olacak şekilde 25 kovanlıktan 50 örnekleme yapılarak ergin arı örnekleri soğuk zincir altında laboratuvara getirildi. Toplanan bal arısı örnekleri; 9 adet Karniyol Irkı, 4 adet Suriye Irkı, 18 adet Muğla Irkı, 10 adet İtalyan Irkı, 3 adet Ege Irkı, 2 adet Karpat Irkı ve 4 adet de Belfast Irkıdan oluşmaktaydı. Hem saha hem de laboratuvar çalışmalarında bal arıları, varroa paraziti yönünden de kontrollere tabii tutuldu.

Numunelerin Ekstraksiyonu

Her bir numune 15-20 adet erişkin arı olacak şekilde gruplandırıldı. Numuneler steril bir havanda 6 ml phosphate buffer saline ile homojenize edilip, falkon tüplere aktararak 4500 rpm'de 20 dakika santrifüj edildi. Daha sonra virus genomunun tespiti için RNA ekstraksiyon protokolü uygulandı. Ependorf içerisine alınan 250µl ön işlem görmüş örneklerin süpernatantına 750µl trizol (Hibrogen) aktarıldı. RNA faz ayırımı için numunelerin üzerine 200 µl kloroform (K51568145931) eklendi. 4°C'de 12000 g'de 15 dakika santrifüjlendikten sonra, üst aquatik fazdan temiz ependorf tüplerine süpernatantlar alındı. RNA presipitesi için 500µl isopropanol (Lot#STBH 9873) ilave edildi. Numuneler 10 dakika oda ısısında inkübasyona bırakıldı ve 4°C'de 12000 g'de 10 dakika santrifüj edildi ve süpernatant döküldü. Yıkama işlemi için 1000µl %75'lik etanol ilave edilerek vortekslendi ve 4°C'de 7500 g'de 5dk santrifüj edildi ve bu işlem bir kez daha tekrarlandı. Numunelerin süpernatantı döküldükten sonra blok ısıtıcıda kurumaya bırakıldı. Kurutma işleminden sonra 45µl RNAaz içermeyen su ilave edildi ve 56°C'de 13 dk blok ısıtıcıda inkübe edildi. Örnekler tekrar kullanılıncaya kadar -20°C'de saklanıldı.

RT-PCR Yöntemi

Toplanan numunelerde viral nükleik asit varlığının araştırılması amacıyla Reverz Transkriptaz-Polimeraz Zincir Reaksiyon (RT-PCR) yöntemi kullanıldı. Öncelikle Grisp, Xpert One step RT-PCR Kit (GK 64.0100 Portugal) prosedürüne uygun olarak reaksiyon miksi hazırlandı. Deforme kanat virus ve akut arı felci virus nükleik asitlerinin reverz transkriptaz PCR yöntemi ile tespiti için, primer setleri Sguazza ve ark. (2013) göre seçildi. Deforme kanat virus için, forward primer DWV-F TGGTCAATTACAAGCTACTTGG 269 bp/reverse primer DWV-R TAGTTGGACCAGTAGCACTCAT kullanıldı. Akut arı felci virus için, forward primer AIV-



F GGTGCCCTATTTAGGGTGAGGA 460 bp/reverse primer ABPV-R
ACTACAGAAGGCAATGTCCAAGA tercih edildi. PCR reaksiyon koşulları cDNA 45°C'de
15 dk, 95°C'de 3 dk ilk denatürasyon, (denatürasyon 95 °C'de 10 sn, 35 siklus 56 °C annealing,
15 sn için 72 °C'de uzatma) ve son uzatma 72 °C'de 1 dk olarak uygulandı.

3.BULGULAR

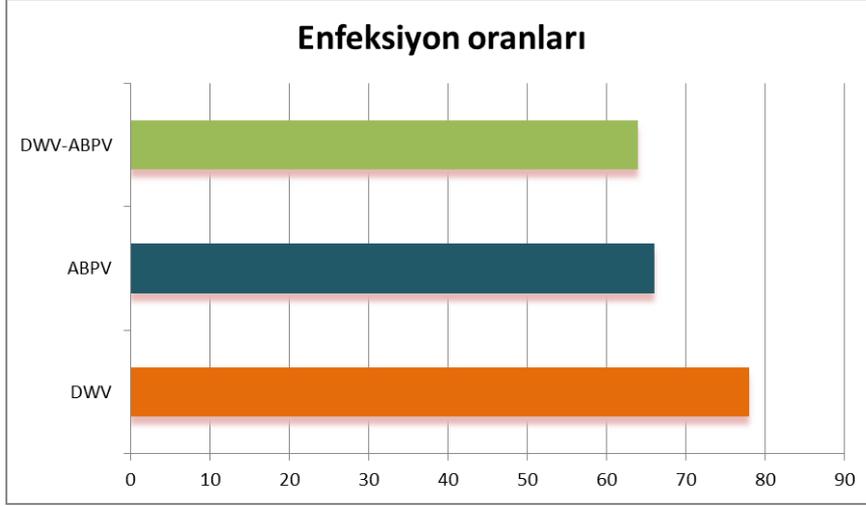
Bu çalışmada 25 işletmeden alınan 50 örneğin 39'u (%78) DWV, 33'ü (%66) ise ABPV nükleik
asidi yönünden pozitif bulundu (Tablo 1). Araştırmanın sonucuna bakıldığında Burdur ilinde
söz konusu viral etkenlerin bal arılarını enfekte ettiği ve bölgede yetiştiriciliği yapılan arı
kolonilerinde ABPV ve DWV'nin yüksek prevalans oranlarında olduğu belirlendi.

Araştırma verilerinin arı ırklarına göre dağılımına bakıldığında; DWV pozitif 39 adet örneğin;
5'i Karniyol, 4'ü Suriye, 16'sı Muğla, 8'i İtalyan, 1'i Ege ekotipi, 2'si Karpat ve 3'ü de Belfast
arı ırkında dağılımı görülmüştür. ABPV pozitif 33 adet örneğin ise 6'sı Karniyol, 1'i Suriye,
16'sı Muğla, 5'i İtalyan, 1'i Ege ekotipi, 2'si Karpat ve 2'si de Belfast arı ırkında olduğu
belirlendi (Tablo 1).

Tablo 1. Arı ırklarına göre Deforme kanat virusun ve Akut arı felci virusun prevalans dağılımı

Arı ırkı	Numune	ABPV		DWV		DWV/ABPV	
		(+)	%	(+)	%	(+)	%
Karniyol	9	6	66,66	5	55,55	5	55,55
Suriye	4	1	25	4	100	1	25
Muğla	18	16	88,88	16	88,88	16	88,88
İtalyan	10	5	50	8	80	5	50
Ege	3	1	33,33	1	33,33	1	33,33
Karpat	2	2	100	2	100	2	100
Belfast	4	2	50	3	75	2	50
Toplam	50	33	66	39	78	32	64

Ayrıca DWV ve ABPV yönünden pozitif sonuçlar değerlendirilerek, kolonilerde görülen ikili
enfeksiyon oranları belirlendi. Pozitif bal arısı örneklerinin 32'si (%64) iki virusa (DWV-
ABPV) karşı pozitif olarak belirlendi (Şekil 1).



Şekil 1. Kontrol edilen arı kolonilerinde tekli ve ikili enfeksiyon oranı

4. TARTIŞMA VE SONUÇ

Günümüzde arıcılık, dünyada ve ülkemizde yapılan en yaygın tarımsal faaliyetlerden birisidir. Yüksek besin içerikli bal arısı ürünleri (arı sütü, bal ve polen gibi) beslenme, sağlık ve sanayi açısından önemli bir kaynak oluşturmaktadır. Bunun yanında ekosistemin devamlılığı açısından arılar kritik öneme sahip olup, arıların sağlıklarını korumak ve hastalıkları ile mücadele etmek oldukça önem arz etmektedir. Özellikle arı kovanlarında sebebi açıklanamayan koloni sönmelerinin önüne geçilmesi veya bal arısı kayıplarının en aza indirilmesi dünyamızın geleceği ve devamı için şarttır.

Dünyada deforme kanat virus enfeksiyonuna bakıldığında, arı kolonilerinde kayıpların yaşandığı Ürdün'de RT-PCR yöntemi kullanılarak yapılan bir araştırmada, bu kolonilerde deforme kanat virusun pozitifliği yüksek oranda belirlenmiştir (Haddad ve ark., 2008). Güney Brezilya'da *Apis mellifera* arılarında tanımlanan altı virusun varlığı değerlendirilmiş ve bunlardan %3 ABPV ve %1 DWV pozitif olarak rapor edilmiştir (Chagas ve ark., 2022). Almanya'da yapılan bir araştırmada, o bölgede endemik olan bir varroa akar türü tarafından istila edilen tüm alman arıları ile o ana kadar varroanın henüz bildirilmediği İsveç'ten getirilen isveç arıları karşılaştırılmıştır. Alman arılarında DWV nükleik asit %100 pozitif oran gösterirken, isveç arılarının ise %40'ına yakınında DWV pozitifliği rapor edilmiştir. Aynı çalışmada enfeksiyon etkeni bal arıların sadece toraks ve karın bölgelerinde değil, aynı zamanda baş bölgesinde de görüldüğü tespit edilmiştir (Yue ve Genersch, 2005). Bal arılarında yapılan başka bir araştırmada Arjantin'de bulunan bal arıları kolonilerin %35'inde DWV



pozitifliği rapor edilmiştir. Ayrıca aynı araştırmada bal arıların yaklaşık %25'inde ikili ve üçlü viral enfeksiyon varlığı bildirilmiştir (Molineri ve ark., 2017). Bulgaristan'da yapılan bir araştırmada ise bal arısı kolonilerinde deforme kanat virusunun prevalansının daha az oranda olduğu belirlenmiştir (Shumkova ve ark., 2018).

Ülkemizde de DWV ile alakalı birçok araştırma yapılmıştır. Erzincan ilinde kasım ayında yapılan bir çalışmada bal arısı örneklerinde (12/6) DWV varlığı rapor edilmiştir (Güller ve ark., 2021). Van'da yapılan bir çalışmada arı kolonilerinde DWV enfeksiyonu %69,23 oranında, bu arı kolonilerinde varroa akarının prevalansının da aynı şekilde yüksek oranda olduğu belirlenmiştir (Karapınar ve ark., 2018). Çağırğan, (2018) Ege Bölgesinde yapmış olduğu bir çalışmada arı işletmelerinde multipleks RT-PCR yöntemiyle DWV oranını %25,2 olarak tespit etmiş ve ayrıca bazı işletmelerde DWV enfeksiyon semptomlarını gösteren veya yüksek koloni çöküşünün olduğu popülasyonlarda diğer viral etkenlerin prevalanslarının daha yüksek oranda olduğu bildirilmiştir. Doğu'da Hakkari ilinden toplanılan bal arı numunelerinde ise RT-PCR yöntemi kullanılarak yapılan çalışmada, 90 arı işletmesinde DWV prevalansını %23,3 oranında olduğu tespit edilmiştir (Rüstemoğlu, 2015). Ülkemizde deforme kanat virus filogenetik analizi ile alakalı yapılan çalışmada bölgesel suşlarla birbirleri ile yüksek yakınlıklar gösterdikleri tespit edilmiştir (Çağırğan ve ark., 2020).

Bu çalışmada 25 arı işletmesinden toplanılan 50 örneğin 39 tanesinde (%78) DWV tespit edilmiştir. Bu oran ülkemizde yapılan diğer çalışmalar ile paralellik göstermekte hatta bazı çalışmalardan ise daha yüksek oranda olduğu görülmektedir. Bunun sebebinin ise bölge konumunun gezginci arıcılar için geçiş noktası oluşu ve etkenin varroa akarı ile bulaştığı düşünüldüğünde örnek alınan işletmelerdeki bal arılarında görülen varroa enfestasyonunun yaygınlığından kaynaklandığı değerlendirilmiştir.

Araştırmamızdaki diğer bir viral etken olan ABPV ile alakalı dünya da yapılan çalışmalarda; İran'da Ghorani ve ark. (2022) dört önemli arıcılık ilinde RT-PCR yöntemi ile yaptıkları taramada 89 arı kovanında ABPV varlığını rapor etmişlerdir. Avrupa'da yapılan çalışmalara bakıldığında daha yüksek oranlarda (%29-%58) ABPV pozitifliği belirlenmiş ve arı koloni kayıplarının önemli sebeplerinden biri olarak görülmüştür (Baker ve Schroeder, 2008; Gajger ve ark., 2014; Nielsen ve ark., 2008; Tentcheva ve ark., 2004). Güney Amerika'da yapılan çalışmalarda Şili'de ABPV varlığı %2, Uruguay'da ise %9 oranında tespit edilmiştir (Antúnez ve ark., 2006; Rodríguez ve ark., 2014).

Ülkemizde ABPV enfeksiyonu ile ilgili yapılan araştırmalarda etkenin varlığı farklı prevalanslarda olduğu belirlenmiştir. İlk kez akut arı felci virus varlığını (%2,2), Rüstemoğlu,



(2015) ülkemizin Doğu bölgesinden (Hakkari) alınan arı örneklerinden raporlamıştır. Ege Bölgesinde bulunan arı kolonilerinde yapılan çalışmada ise ABPV prevalansı %3,6 oranında olduğu tespit edilmiştir (Çağırğan, 2018). Türkiye’de akut arı felci virus filogenetik analizi ile alakalı yapılan araştırmada bölgesel suşlarla birbirleri ile yüksek yakınlıklar gösterdikleri rapor edilmiştir (Çağırğan ve ark., 2020).

Bu çalışmada ABPV’nin prevalansı %66 (50/33) oranında pozitiflik belirlendi. Ülkemizdeki diğer araştırmalarla kıyaslandığında çalışmamızda bu virusun oranının yüksek olmasının nedeni olarak kovan içinde yoğun arı barındırılması, varroa akarının kovanlarda fazla olmasının enfeksiyöz etkenlerin yayılmasını arttırdığı kanaatine varılmıştır.

Sonuç olarak, Burdur yöresindeki bal arılarında bu enfeksiyöz virusların oldukça yaygın oranda varlığının ortaya konulduğu bu çalışmanın verilerine bakıldığında, bu hastalıkların Burdur ilinde arı kovanlarındaki koloni çökmelerinin bir sebebi olabileceği düşünüldü. Viral enfeksiyonların etkenlerine karşı dirençli arı ırklarının belirlenmesi, arıların besleme/barındırma koşullarının iyileştirilmesi, kovan içi hijyen kurallarına uyulması bu enfeksiyonlarla mücadelede önemli bir yer tutmaktadır. Ayrıca arı viral ve paraziter etkenlerinin, tarama/mücadele programlarının birlikte yürütülmesinin ve daha geniş çaplı araştırmaların yapılmasının yararlı olacağı düşünülmektedir.



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KEDİLERDE FELINE CORONAVIRUS ENFEKSİYONUNUN SEROLOJİK OLARAK ARAŞTIRILMASI

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ÖZET

Feline coronavirus (FCoV) enfeksiyonları evcil ve vahşi kedilerde yüksek morbiditeye sahiptir. Oro-fekal yolla bulaştığından dolayı özellikle birden çok kedi bulunan evlerde ve sokak kedilerinde seroprevalans oranı %90'lara kadar ulaşabilmektedir. Coronavirus ile enfekte kedilerin büyük bir çoğunluğu hastalığı basit semptomatik bulgularla ya da hiçbir semptom meydana getirmeden atlınsa da FCoV'nin mutasyonu sonucu meydana gelen Feline enfeksiyöz peritonitis (FIP) enfeksiyonunun varlığında ortaya çıkan yüksek mortalite oranları, bu viral etkenlerin hayvan sağlığını ve refahını ciddi boyutta tehdit ettiğini göz önüne sermektedir. FCoV'un teşhisinde birden çok parametrenin bir araya getirilerek değerlendirilmesi önem arz etse de, kesin teşhisi için laboratuvar testleri ana kriter olmaktadır. Çalışmamız kapsamında feline coronavirusa karşı aşılınmamış, farklı ırk ve cinsiyette feline enteric coronavirus (FECV) veya FIP'e özgü klinik bulgular gösteren ya da herhangi bir klinik semptom göstermeyen sahipli durumdaki 40 kediden kaolinli tüplere kan örnekleri alınmıştır. Toplanan kan numuneleri santrifüj işleminden sonra ayrılan serum örneklerinde FCoV'ye yönelik spesifik antikorların varlığı Indirect Enzyme Linked Immunosorbent Assay (ELISA) ve antikor (Ab) Rapid test yöntemleri ile araştırılmıştır. Analizlerin sonucunda 40 kedi kan serumunun ELISA yöntemi ile %55'i (22/40) ve Rapid test yöntemi ile de %20'si (8/40) pozitif olarak belirlenmiştir. ELISA ve Rapid test yöntemleri sonucunda ortaya çıkan seropozitiflik oranlarının istatistiksel olarak karşılaştırılması ile oranlar arasındaki farklılığın anlamlı ($P \leq 0,001$) olduğu tespit edilmiştir ($\chi^2=10,453$; $P=0,001$). Araştırma sonucunda FCoV enfeksiyonunun sahipli ev kedileri arasında varlığı/yaygınlığı serolojik olarak ortaya konulmuştur. Ayrıca FCoV enfeksiyonunun teşhisinde ELISA yönteminin Ab Rapid test yöntemine kıyasla daha duyarlı ve güvenilir sonuçlar verdiği tespit edilmiştir. Sahipli ve sahipsiz kedilerde FCoV enfeksiyonunun yaygınlığının ortaya koyulması ve hayvan sağlığının korunması için daha geniş çaplı çalışmaların yapılmasının yararlı olacağı kanaatine varılmıştır.

Anahtar Kelimeler: Ab Hızlı Test, Antikor, ELISA, Feline Coronavirus



SEROLOGICAL INVESTIGATION OF FELINE CORONAVIRUS INFECTION IN CATS

ABSTRACT

Feline coronavirus (FCoV) infections exhibit with high morbidity in domestic and wild felines. Due to oro-fecal transmission, the seroprevalence rate can reach up to 90%, especially in houses with more than one cat and in stray cats. Although the majority of cats infected with Coronavirus survive the disease with mild or no symptoms, Feline infectious peritonitis (FIP) infections caused by the mutation of FCoV, occurs with high mortality rates thus severely threatens animal health and welfare. Although it is important to collect and evaluate multiple parameters in the diagnosis of FCoV, laboratory tests are the main criteria for its definitive diagnosis. Within the scope of our study, blood samples were taken in kaolin tubes from 40 non-vaccinated cats of different breeds and gender, showing clinical signs specific to feline enteric coronavirus (FECV) or FIP, or not showing any clinical symptoms at all. The presence of specific antibodies against FCoV in serum samples separated after centrifugation of collected blood samples was investigated by Indirect Enzyme Linked Immunosorbent Assay (ELISA) and antibody (Ab) Rapid test methods. As a result of the analysis, 55% (22/40) of 40 cat blood serums were determined as positive by ELISA method and 20% (8/40) by Rapid test method. Statistical comparison of the seropositivity rates resulting from ELISA and Rapid test methods revealed that the difference between the rates was significant ($P \leq 0.001$) ($\chi^2 = 10.453$; $P = 0.001$). As a result of the research, the presence/prevalence of FCoV infection among owned house cats was demonstrated serologically. In addition, it has been determined that the ELISA method gives more sensitive and reliable results compared to the Ab Rapid test method in the diagnosis of FCoV infection. It was concluded that it would be beneficial to carry out larger studies to reveal the prevalence of FCoV infection in owned and stray cats and to protect animal health.

Keywords: Antibody, antibody rapid test, elisa, feline coronavirus, rapid test



1. GİRİŞ

Feline Coronavirus (FCoV) kedilerde çok sık rastlanan ve özellikle çok kedili ortamlarda yaşayan kedilerin %90'nın enfekte olduğu bir hastalık etkenidir. Uluslararası Virus Taksonomi Komitesi (ICTV)'nin güncel raporuna göre FCoV; *Nicoviridae* takımı içerisindeki *Coronaviridae* familyasına ait *Orthocoronavirinae* alt familyasındaki *Alphacoronavirus* cinsinin *Tegavirus* alt cinsinde bulunan Alphacoronavirus 1 türü içerisinde sınıflandırılmaktadır (ICTV, 2022). Coronaviruslar zarflı, tek sarmallı ve pozitif polariteli RNA'ya sahip pleomorfik yapıda patojen etkenlerdir. Virion çapları ise pleomorfik yapıları sebebiyle 60-160 nm arasında değişim gösterir (Frank F., 1999). Coronaviruslar isimlerini bir tacı andıran yüzey çıkıntularından yani peplomerlerinden almışlardır (Sykes, 2022). Yarasalar, kümes hayvanları, domuzlar, gelincikler ve ayrıca çiftlik hayvanları, vahşi ve evcil hayvan türleri farklı coronavirus türleri ile enfekte olabilmektedir (Amer, 2018; Cavanagh, 2007; Haake ve ark., 2020; Williams ve ark., 2000).

Coronaviruslar evcil kedilerde ilk olarak 1960'lı yıllarda Benaduce tarafından Nepal'de tespit edilmiş ve 1963'de Holzworth tarafından 'bazı önemli kedi hastalıkları' olarak tanımlanmıştır. Ardından 1971 yılında Hardy ve arkadaşları tarafından hastalığın etkeni virus benzeri partikül olarak değerlendirilerek elektron mikroskobu ile gösterilmiştir. FCoV serolojik yanıtlara dayalı olarak iki serotipe ayrılmaktadır. FCoV I serotipi doğal enfeksiyonun kaynağı (Kummrow ve ark., 2005) ve saha enfeksiyonlarında dominant tip iken, FCoV II'nin serotip I ile Canine Coronavirus arasındaki rekombinasyondan köken aldığı düşünülmektedir (Herrewegh ve ark., 1998). FCoV patobiyolojisine göre ise iki biyotipe ayrılmaktadır. Genellikle hafif klinik tablo ya da subklinik sindirim semptomlarına neden olan biyotip feline enteric coronavirus (FECV)'dur (Leibowitz ve ark., 2011). Diğer biyotip ise FECV'nin *in vivo* mutasyon teorisine yönelik spontan mutasyonlarından meydana gelen feline infectious peritonitis virustur (FIPV) ve bu etken kedilerde sistemik feline infectious peritonitis hastalığına neden olmaktadır.

Oro-fekal yolla kediler arasında hızlı bir şekilde bulaşabilen FeCV her yaşta kediyi enfekte edebilme kapasitesine sahiptir ve anneden alınan maternal antikorların etkisini kaybettiği andan itibaren (6-9 haftalık kedilerde) hastalık oluşturabilmektedir (Pedersen, 1976). FeCV doğrudan intestinal epitelyumu hedef alır ve bu bölgedeki epitel hücrelere yerleşir (Sabshin ve ark., 2012). Yapılan çalışmalar FeCV enfekte kedilerin hayatları boyunca, senede en az bir kez virusu saçmaya devam ettiğini, genellikle bu dönemlerin 1-3 ay kadar sürebileceğini ortaya koymuştur (Foley ve ark., 1997; Harpold ve ark., 1999; Herrewegh ve ark., 1997).



FeCV'un bulaşıcılığının aksine patojenitesi oldukça düşük seviyededir. Enfekte kedilerde önemli klinik bulgular ortaya çıkarmadığı rapor edilmiştir (Sabshin ve ark., 2012). Enterik formunda ciddi bir klinik semptomaya ya da hastalığa sebep olmayan FeCV'nin asıl önemi mutasyona uğradığında ortaya çıkmaktadır. Mutant viruslar intestinal epitele olan ilgilerini kaybederek monositler ile makrofajlara affinite kazanmaktadır. Mutasyon lenf dokuda, sekum ya da kolon epitelinde gerçekleşebilmektedir (Vennema ve ark., 1998). Bu aşamadan sonra mutant viruslar iki farklı formda hastalığa neden olarak enfekte kediler için tehlikeli bir hal almaktadır. Bu formlardan ilki ıslak, efüziv ya da non-parenkimatöz FIP olarak adlandırılan ve diffuz bir peritonit ile karakterize olan formdur. Diğeri ise kuru, non-efüziv ya da parenkimatöz FIP olarak adlandırılan ve zaman zaman nörolojik bulgular ile ön plana çıkan formudur. Efüziv form yetişkin kedilerde de görülebilmeye karşın yavru kediler arasında daha yaygındır. Hastalıkta tipik olarak ortaya çıkan efüzyon, efüziv enfekte kedilerin %75'inde abdomende, %10 ile %15'inde toraksta, kalanında ise karışık olarak vücut boşluklarında görülebilmektedir. Efüzyon spesifik hastalığın sebep olduğu vaskulit sebebiyle ortaya çıkmaktadır. FIP enfeksiyonu bulunan kedilerin dörtte birinin non-efüziv form olduğu bildirilmektedir ancak non-efüziv formun subklinik olarak da şekillenebiliyor olması nedeniyle bu oranın daha yüksek olabileceği değerlendirilmektedir (Riemer ve ark., 2016).

İnsanlarda patojenitesi bilinen üç coronavirus tipinin (MERS-CoV, SARS-CoV ve SARS-CoV 2) de yarası coronaviruslarından kaynaklanması, SARS-CoV ve MERS-CoV enfeksiyonlarında misk kedilerinin ve develerin insanlara enfeksiyon aktarımında geçiş görevi görmesi gibi etkenler göz önünde bulundurulduğunda, hayvanların coronaviruslar için rezervuar görevi görebileceği ve insanlarda tekrarlayan enfeksiyonlara neden olabileceği düşünülmektedir (Ye ve ark., 2020). Bu nedenle gelecekteki salgınların önüne geçebilmek adına, hayvanlardaki coronavirus enfeksiyonlarının kontrol altına alınma yollarının araştırılması ve tespit edilmesi önemli bir yer tutmaktadır. Ayrıca hayvanlarda meydana gelen coronavirus enfeksiyonları maddi ve manevi kayıplara neden olmasından dolayı da göz ardı edilmemesi gereken hastalıklar arasında yer almaktadır (Prince ve ark., 2021).

Bu çalışmada farklı ırk, yaş ve cinsiyette bulunan sahipli kedilerde feline coronavirus enfeksiyonunun serolojik olarak varlığının/yaygınlığının tespiti amaçlanmıştır. Ayrıca söz konusu enfeksiyona yönelik spesifik antikor varlığını belirlemek amacıyla kullanılan ELISA ve hızlı test yöntemlerinin duyarlılıklarının karşılaştırılması da hedeflenmiştir.



2. GEREÇ ve YÖNTEM

Örneklenen Hayvanlar

Araştırmada farklı cinsiyet, ırk, yaş ve sosyal çevrede bakımı üstlenen, klinik bulgu gösteren ya da göstermeyen 40 sahipli kedide FCoV enfeksiyonu serolojik olarak çalışılmıştır. Bu amaçla alınan serum numunelerinde antikor tespiti için ELISA ve Rapid test yöntemleri uygulanmıştır.

Örneklerin Toplanması

Araştırma içerisinde kullanılan kan örnekleri *vena cephalica antebrachii*'den steril koagülanlı tüplere alınarak, kontrollü bir şekilde soğuk zincir altında laboratuvara getirilmiştir. Ardından 3000-4000 rpm'de 20 dakika santrifüj uygulamasından sonra serum kısmı steril ependorflara aktarılarak testlerin uygulanma aşamasına kadar -80°C'de muhafaza edilmiştir.

İndirekt ELISA

Stok durumundaki serum örneklerinde indirekt ELISA yöntemi kullanılarak Feline Coronavirus'a karşı oluşan spesifik antikorların varlığı araştırıldı. Bu amaçla Agralabo ticari firmasının üretmiş olduğu FCoV Ab ELISA kiti kullanıldı. Test aşamasında üretici firmanın bildirdiği prosedür baz alındı ve spektrofotometrik olarak okunan absorbans değerleri ile sonuçlar yorumlandı.

Araştırma dahilinde kullandığımız ELISA kitinin içeriğinde FCoV antijen ile kaplanmış pleyt, peroksidaz konjugat (100x), negative kontrol, pozitif kontrol, serum diluent, substrat solüsyonu, stop solüsyonu ve yıkama solüsyonu (10x) bulunmaktadır.

Kullanım öncesi oda ısısında bir süre bekletildi ve daha sonra pleytler numaralandırıldı. Mikropleytin A1 kuyucuğuna 100 µl pozitif kontrol, A2 kuyucuğuna 100 µl negatif kontrol ve değerlendirilmesi yapılacak her örnek için 1/200 oranında serum diluent ile sulandırılmış serum numuneleri diğer kuyucuklara 100 µl koyuldu. Mikropleytin üzeri yapışkan bir film ile kapatılarak 18-26 °C'de 30 dakika inkübasyona bırakıldı. İnkübasyon süreci sonunda 1/10 oranında distile su ile sulandırılarak hazırlanan yıkama solüsyonundan bütün kuyucuklara 300 µl koyuldu ve 4 kez yıkama işlemi gerçekleştirildi. Ardından 1/100 oranında diluent solüsyonu ile sulandırılan konjugat bütün kuyucuklara 100 µl olacak şekilde eklenerek üzeri yeniden yapışkan bir film tabaka ile kapatıldı. Daha sonra 18-26 °C'de 15 dakika inkübasyona bırakıldı ve inkübasyon bitiminde yıkama işlemi tekrarlandı. Kurutulan mikropleytin her bir kuyucuğuna 100 µl substrat solüsyonu eklenerek 18-26 C'de 5 dakika inkübasyona bırakıldı ve süre sonunda bütün kuyucuklara 100 µl stop solüsyonu eklenerek reaksiyon durduruldu. Mikropleyt 450 nm dalga boyunda filtreye sahip olan ELISA okuyucusunda (Mindray MR-96A, Hamburg-



Almanya) değerlendirildi. Elde edilen sonuçlar kitin prosedüründe belirtildiği şekilde örneğin koyulduğu kuyucuğun optik dansite (OD) değerinin negatif kontrol optik dansite değerine bölünerek çıkan sonucun 100 ile çarpılması ile hesaplandı. Sonuçların yorumlanması aşamasında negative control optik dansite değerinin 4 katı olarak hesaplanan cut off değerinin aşağısında yer alan numune değerlendirmeleri negatif, yukarısında yer alan değerlendirmeler ise pozitif olarak kabul edildi.

Rapid FCoV Ab Testi

Kan serumu numunelerinde FCoV'a spesifik antikorların tespiti amacı ile Asan Easy Test FCoV Ab Feline Coronavirus Antikor Test adı verilen hızlı test kiti kullanılmıştır. Test kiti üretici firmanın belirlediği test prosedürüne uygun bir şekilde yapılmıştır.

3. BULGULAR

Araştırmamızda indirekt ELISA yöntemi kullanılarak analiz edilen 40 kedi kan serumunda FCoV enfeksiyonunun seroprevalans oranı %55 (22/40), Ab Rapid Test yönteminde ise %20 (8/40) olarak tespit edildi.

Tablo 1. ELISA ve Rapid Test sonuç dağılımı

Kullanılan yöntem	ELISA (Ab)	%	Rapid Test (Ab)	%
Pozitif (+)	22	55	8	20
Negatif (-)	18	45	32	80
Toplam	40	100	40	100

Çalışma kapsamında örnekleme yapılan klinik belirti gösteren hayvanlarda ateş, halsizlik, iştahsızlık, asites, asitese bağlı hırıltılı solunum ile güç soluma ve okuler semptomlar tespit edildi.



Resim 1. Efüziv FIP şüphesi bulunan bir kedide asites bulgusu (Orijinal)



İSTATİSTİKSEL DEĞERLENDİRME

Araştırma sonucunda elde edilen verilerin istatistiksel analizi SPSS 21 paket program kullanılarak yapıldı. Indirekt ELISA ile Rapid Test Ab yöntemlerinde tespit edilen pozitiflik oranlarındaki farklılığın istatistiksel olarak önemi Ki-Kare (χ^2) testi ile araştırıldı ve $P \leq 0,0001$ değeri ile elde edilen veriler anlamlı (önemli) olarak kabul edildi.

Çalışmada serum numunelerinde FCoV'a yönelik spesifik antikor tespiti için kullandığımız ELISA ve Rapid test sonuçları arasındaki farkın istatistiksel olarak anlamlı ($P \leq 0,001$) olduğu bulunmuştur ($\chi^2=10,453$; $P=0,001$).

4. TARTIŞMA ve SONUÇ

İnsanlarda ve hayvanlarda progresif şekilde ilerleyen hastalık tablolarının meydana gelmesinde rol oynayan, türler arasında bulaşmaya ve yüksek mutasyon kabiliyetine sahip olan coronaviruslara yönelik kontrol ve koruma programlarının uygulanması oldukça zordur. FCoV enfeksiyonları incelendiğinde dünya genelinde evcil ve yabani kedilerde meydana gelen yüksek morbidite seyrettiği belirlenmiştir. Özellikle bir poopülasyon içerisinde barınan kedilerde oldukça yüksek seroprevalans gösterebilmektedir. FIP enfeksiyonunun gelişmesiyle beraber artan mortalite oranı göz önünde bulundurulduğunda hem hayvan sahipleri hem de veteriner hekimler için kesin laboratuvar tanı yöntemleri önemli bir konumdadır. Bu amaca yönelik olarak teşhis yöntemlerinin araştırılması, geliştirilmesi ve güvenilirliğinin test edilmesi üzerine çalışmalar yoğunlaşmıştır (Tasker, 2018; Zhao ve ark., 2019).

Dünya çapında gerçekleştirilen FCoV seroprevalans çalışmalarında ülkeler bazında oransal olarak değişiklikler mevcuttur. Avusturalya'da yapılan bir çalışmada 306 adet kedi serum örneği indirekt ELISA yöntemi ile incelenmiş ve %34 (104/306) oranında seropozitiflik belirlenmiştir (Bell ve ark., 2006). Pratelli'nin 2008 yılında İtalya'dan örneklediği 120 kedi kan serumunda virus nötralizasyon ve ELISA yöntemlerini kullanarak yaptığı çalışmada FCoV antikor oranını %82 (98/120) olarak tespit etmiştir. Japonya'da gerçekleştirilen başka bir çalışmada ise Tharaguchi ve ark. (2012), 2001-2010 yılları arasında topladığı 17.392 kedi kan serumunun 6.433'ünde (%37.9 pozitiflik tespit etmişlerdir. Genel seropozitiflik oranını ise %37 olarak bildirmişlerdir. Mürniece ve ark. tarafından 2021 yılında Letonya'da gerçekleştirilen başka bir çalışmada 40 kedi serum numunesinin antikor yönünden değerlendirilmesi sonucunda 33'ünün pozitif olduğu tespit edilerek genel seropozitiflik oranı %82,5 olarak bildirilmiştir. Yunanistan'da Kokkinaki ve ark.(2022)'nin yaptıkları çalışmada ise %12,1 (55/453) oranında FCoV seropozitiflik rapor edilmiştir.



Söz konusu enfeksiyona yönelik olarak ülkemizde de çeşitli seroprevalans çalışmaları gerçekleştirilmiştir. Pratelli ve ark. (2009)'nın Bursa'da ELISA yöntemi kullanarak yapmış olduğu seroprevalans çalışmasında %26 (26/100) oranında pozitiflik bildirilmiştir. Akın (2013)'ın yaptığı başka bir seroprevalans çalışmasında ise 142 kedi serum örneğinin 59'u (%26) FCoV pozitif belirlenmiştir. 2010 yılında Oğuzoğlu ve ark.'ları tarafından indirekt ELISA yöntemi kullanılarak yapılan başka bir araştırmada test edilen 53 kedi numunesinden 37'sinin antikör pozitif olduğu tespit edilerek genel seropozitiflik oranının %69,8 olduğu bildirilmiştir. Çalışmamızda FCoV'a karşı oluşmuş spesifik antikörlerin tespiti amacıyla indirekt ELISA ve rapid test (Ab) yöntemleri kullanılarak duyarlılık oranları karşılaştırıldı. İndirekt ELISA yöntemi ile FCoV seroprevalansı %55 oranında belirlenmişken aynı numunelerde Rapid test (Ab) yöntemiyle %20 oranında pozitiflik belirlendi. Elde ettiğimiz değerler diğer çalışmalarla kıyaslandığında (Pratelli (2009); Mürniece ve ark. (2021); Oğuzoğlu ve ark. (2016)) daha düşük bir seropozitiflik elde edilmiştir. Fakat Bell ve ark. (2006), Tharaguchi ve ark. (2012), Kokkinoki ve ark. (2022), Pratelli ve ark. (2009) ve İleri (2013)'nin yapmış olduğu çalışmalarla kıyaslandığında ise yüksek bir sonuç olduğu görülmektedir. Bu yüksekliğin sebebinin örneklemelerde kullandığımız bazı hayvanların çok kedili ortamlardan sahiplenilmesiyle ortaya çıktığı düşünülmektedir. Düşük sonuçlar elde ettiğimiz çalışmalarda kullanılan sahipsiz hayvan numunelerinin de yüksek seropozitif sonuçlara etki ettiği kanaatine varıldı. Ayrıca tespit amacıyla kullanılan yöntemlerin (IFA, ELISA ve Rapid Test) karşılaştırıldığı başka bir çalışmada bu yöntemlerin duyarlılık oranları IFA testi için %100, ELISA testi için %100 ve hızlı test kitleri için %64,1-%84,6 oranlarında olduğu bildirilmiştir (Addie ve ark., 2015). Bizim çalışmamızda da hızlı test kitleri ile negatif sonuç veren 14 numunenin ELISA yöntemi ile pozitifliği tespit edilerek istatistiksel analiz sonucunda da bu oransal farklılığın anlamlı olduğu ortaya konulmuştur.

Sonuç olarak FCoV enfeksiyonunun sahipli ev kedilerindeki varlığının/yaygınlığının yüksek oranda olduğu ve söz konusu enfeksiyonun kedilerin sağlığı açısından risk teşkil ettiği belirlenmiştir. Ayrıca FCoV'a spesifik antikörlerin tespitinde indirekt ELISA'nın hızlı test (Ab) yöntemine nazaran çok daha duyarlı olduğu tespit edildi. FCoV enfeksiyonunun yüksek morbiditeye sahip olması ve FCoV mutasyonu sonucu oluşan FIP'in tedavisi maddi ve manevi zorlu şartları barındırdığından dolayı teşhis sürecine katkı sağlayabilecek olan tüm diagnostik testler büyük bir önem arz etmektedir. Ancak bu noktada teşhiste kullanılacak laboratuvar metodunun seçiminde spesifite ve sensitivite oranı yüksek yöntemlerin tercihine dikkat edilmelidir.



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VETERİNER CERRAHİDE ÜÇ BOYUTLU BASKI KULLANIMININ İNCELENMESİ

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ÖZET

Veteriner cerrahi uygulamaları açısından yapılan bu çalışmayla; üç boyutlu (3D) baskının kullanımının ameliyat öncesi planlama, kişiye özel cerrahi aletler, laboratuvar cihazları ve özel kılavuzlar, cerrahi açıdan kullanımı, hastaya özel cerrahi implantlar ve protezler ile hastada kullanımı açısından öneminin vurgulanması amaçlanmıştır. Çalışmanın metodolojisinde; geçmişten günümüze konu ile ilgili yapılan bilimsel araştırmalara ait literatür taramaları yapılmıştır. Elde edilen verilerin ışığında veterinerlik cerrahisi alanında üç boyutlu (3D) baskının kullanım alanları ortaya konulmaya çalışılmıştır. 3D baskı kullanımı yaygın olarak; cerrahi açıdan yapılan operasyon sürenin azalmasına, cerrahin güveninin artmasına ve daha az hasta komplikasyonuna izin veren karmaşık cerrahi prosedürlerinin provasına imkân sağlamıştır. Elde edilen modellerin kolayca sterilize edilebilmesi ameliyathanede kullanımı açısından büyük avantajlar sunmuştur. Ayrıca ameliyat öncesi implantların şekillendirilmesine izin vermesi operasyon sırasında cerraha büyük kolaylık tanımıştır. 3D modellerin kullanımı, hasta sahiplerinin cerrahi prosedürler ve beklenen sonuçları hakkındaki anlayışını da olumlu yönde arttırmıştır. Veteriner cerrahisinde; Ortopedi ve travmatolojik açıdan 3D baskı ürünlerine genellikle; kafatası kırıklarında, kraniomaksillofasiyal operasyonlarda, parçalı kırıklarda, doku kaybıyla oluşan hasar durumlarda, gelişimsel deformasyon ve anomalilerin düzeltilmesinde ihtiyaç duyulur. Yumuşak doku cerrahisi açısından ise; kardiyovasküler sistem gibi karmaşık anatomik yapılara sahip bölgelerdeki operasyonlarda, transplantasyon ameliyatlarında ya da önemli hayati fonksiyonlara sahip komşu organları şekillendiren tümöral kitlelerin çıkarılmasında 3D baskı ürünlerinin avantajlarından başarıyla yararlanılmaktadır. Sonuç olarak; Dünya giderek yaygınlaşan bu teknolojinin veteriner cerrahide kullanılmasıyla olumlu ve etkili sonuçların alındığı, cerrahlar açısından önerildiği ve yoğun bir şekilde üzerinde çalışıldığını ve gelişmekte olduğunu söylemek mümkündür. Yapılacak yeni araştırmalar sayesinde gelecekte çok daha yaygın kullanım alanları bulacağı açıktır.

Anahtar Kelime: Üç boyutlu baskı, hayvan, cerrahi, veteriner



EXAMINATION OF THREE DIMENSIONAL PRINTING IN VETERINARY SURGERY

ABSTRACT

With this study conducted in terms of veterinary surgery applications; It is aimed to emphasize the importance of the use of three-dimensional (3D) printing in terms of preoperative planning, personalized surgical instruments, laboratory devices and special guides, use in terms of surgery, patient-specific surgical implants and prostheses, and patient use. In the methodology of the study; A literature review of scientific research on the subject from past to present has been made. In the light of the data obtained, the usage areas of three-dimensional (3D) printing in the field of veterinary surgery have been tried to be revealed. 3D printing is widely used; In terms of surgery, it has allowed the rehearsal of complex surgical procedures, which allows for reduced operation time, increased surgeon confidence, and fewer patient complications. The easy sterilization of the obtained models offered great advantages in terms of use in the operating room. In addition, the fact that it allows the shaping of the implants before the operation has given the surgeon great convenience during the operation. The use of 3D models has also positively increased the patient's understanding of surgical procedures and expected outcomes. In veterinary surgery; Orthopedic and traumatological 3D printing products are generally; It is needed in skull fractures, craniomaxillofacial operations, comminuted fractures, damage caused by tissue loss, and correction of developmental deformations and anomalies. In terms of soft tissue surgery; The advantages of 3D printing products are successfully utilized in operations in regions with complex anatomical structures such as the cardiovascular system, in transplantation operations or in removing tumoral masses that shape neighboring organs with important vital functions. In conclusion; It is possible to say that positive and effective results have been obtained with the use of this technology, which is becoming increasingly widespread in the world, in veterinary surgery, it is recommended for surgeons, and it is intensively studied and developed. It is clear that it will find much more common usage areas in the future thanks to new researches to be done.

Keywords: 3D printing, animal, surgery, veterinary



GİRİŞ

Günümüzde dijitalleşmenin her alanda hayatımıza girmesiyle birlikte sonuçlarıyla; yapay zekâ (Artificial Intelligence-AI), sanal gerçeklik (Virtual Reality-VR) ve artırılmış gerçeklik (Augmented Reality-AR) uygulamaları, e-öğrenme ve uzaktan eğitim olanakları da kullanım alanı bulmuştur. Bu uygulamaların tüm avantajlarına rağmen sayısal verilerin uygulamalı bilimlerdeki kullanımının bazı noktalarda sınırlı kaldığı bilinmektedir. Bu açıdan 3D dijital görüntüleri fiziksel olarak prototiplemenin ve gerçek bir temsil modeli oluşturmasını mümkün hale getiren 3D baskı uygulamalarının kullanımı umut verici bir yaklaşım oluşturmaktadır. Bu sayede insan hekimliği açısından 3 boyutlu dijital verilerin kullanımını bilimsel yönden üst düzeye taşıdığı bildirilmiştir (Fejzic, vd., 2019). Son yıllarda veteriner hekimlikte hem yazılım ve donanım hem de kullanılan malzeme alanında gelen yeniliklerle 3D baskının kullanımı yaygınlaştığı vurgulanmıştır (Hespel, 2015).

Üretim süreci açısından bakıldığında 3D baskı modeli; 3D dijital veri oluşturma, Görüntü işleme, Modelleme ve 3D yazdırma şeklinde dört temel basamaktan oluşur. 3D dijital verileri oluşturmak için; bilgisayar destekli tasarım (CAD) yazılımı ile modeller oluşturmak ve tarayıcıların (Bilgisayarlı Tomografi, Magnetik Rezonans veya Ultrasonografi gibi aktarıcı tıbbi tarayıcılar) kullanımı şeklinde iki yöntem mevcuttur. Üretim aşamasının ikinci basamağında; 3D görüntülerin işlenmesi ve segmentasyonu ile 3D hacimsel veriler oluşturmak ve sonrasında görüntüleri Surface Mozaik Dili (STL) gibi uyumlu bir dosya formatı olarak dışa aktarılması vardır. Bir sonraki adım ise; 3D dijital nesneyi katmanlara ayırıp, ardından her katman için kodlar vererek 3D baskı için sürecin başlatılmasıdır. Nesne, yazdırma ayarlarına göre de değiştirilebilir. 3D baskının son aşaması; 3D yazıcılar tarafından gerçekleştirilen işlemler kullanılarak elde edilir. Eklemeli imalat yönteminde ana prensip olarak, nesne tamamen oluşana kadar birbiri ardınca gelen malzeme tabakalarının yerleştirilmesi suretiyle nesne oluşturulur. Bu tabakaların her biri, nesnenin ince bir katmanı şeklinde görülebilir (Sönmez, vd., 2018).

Günümüzde veterinerlik cerrahisinde en sık baskı malzemesi olarak kullanılan yazıcılar gözden geçirilmiş ve baskı teknolojilerine göre: (1) termoplastik malzemelerin ekstrüzyonu (erimiş biriktirme modellemesi, FDM); (2) ultraviyole ışık stereolitografi aparatı (SLA), polijet (PJ), renkli jet / multijet (CJ/MJM) kullanılarak sıvı reçinelerin bir teknede ya da jetlerle polimerizasyonu; (3) lazer tarama (seçici lazer sinterleme, SLS) veya elektron ışını eritme (EBM) ile termoplastik veya metal toz parçacıklarının füzyonu; veya (4) mum, kompozitler, metaller, polimerler veya seramikler gibi damlalı talep katmanları (inkjet / IJ) ile bağlayıcı



püskürtme malzemeleri şeklinde sınıflandırılmıştır. Bir yazıcı seçilirken uygulama türü, doğruluk, baskı hızı, teknik gereksinimler, alt tabakaları veya renkleri karıştırma yeteneği, boyut, maliyet ve malzemeler dahil olmak üzere çok sayıda kriter dikkate alınmalıdır (Wilhite ve Wölfel, 2015).

Veteriner cerrahi uygulamalarında kullanabilecekleri her türlü malzeme 3 boyutlu baskı ile tasarlanıp üretebilir. Bu temel uygulamaların dışında ileri cerrahi planlama ve deneme prosedürleri, hastaya özel delme ve kesme kılavuzlarının üretimi ve intraoperatif kullanımı, hastaya özel implant ve çeşitli biyomalzemelerin üretimi ile tedavide tekili etkili avantajlar sağladığı bildirilmiştir. (Bose, vd., 2019, Gyles, 2019). Doku veya organ üretebilen 3D biyoyazıcıların biyoyumlu, doku veya organ replasmanında kullanılabilen ürünleri yapma konusunda umut verici sonuçlar elde edildiği bildirilmiştir (Jamieson, vd., 2021). 3D baskı kullanımının, teşhisten tedaviye kadar birçok aşamada farklı amaçlarla gelişmeye devam ettiği 3D baskı ürünlerinin cerrahi açısından sağladığı fayda ve avantajlar; Etkin ve gerçekçi bir eğitim uygulamasının sağlanması, daha detaylı teşhis prosedürlerinin yapılması, cerrahi planlamanın daha gerçekçi bir biçimde şekillendirilmesi, hastaya özel cerrahi prosedürün 3D model üzerinde denenmesi, uygulanacak yöntem için 3D baskı ile üretilen hastaya özel cerrahi delme ve kesme kılavuzları aracılığı ile hata payının azaltılması, ameliyat ve anestezi süresinin kısaltılarak ortaya çıkabilecek risklerin azaltılması, hasta sahiplerine tanı ve tedavi ile ilgili sürecin daha iyi anlatılması, ameliyatlarda iyatrojenik hasar, kan kaybı gibi risklerin minimize edilmesi ve operatif tedavinin başarı ve etkinliğini arttırıp komplikasyon risklerini azaltılması şeklinde sıralanabilir (Altwal, vd., 2022).

3D baskı, cerrahi eğitimi açısından modellerinin hızla oluşturulduğu, öğrencilerin üzerinde çalışabileceği ve pratik yapabileceği mükemmel bir araçtır. Özelleştirilmiş aletler, cihazlar yaparak ilgili sorunların çözümü ve hayvan refahı açısından olumlu sonuçlar sağlar (Paudyal, 2017). Bu bakımdan 3D baskı kullanımı ile kalp, iç kulak ve kafatası (Giannatsis ve Dedoussis, 2009; Hull, 1990) gibi karmaşık yapıların cerrahi anatomisini öğretmek veya test etmek bakımından da uygun görünmektedir (Waran, vd., 2014). Özellikle nöroanatomi, beyin ve omurga anatomisi ile bunlara ait dokuların ortaya çıkarılması zordur. Bunun kapsamlı diseksiyon gerektirmesi, zor ve zaman alıcı olması ayrıca güvenlik bakımından endişe oluşturabilecek keskin aletlerin kullanımını içermesi eğitimi zorlaştırmaktadır. Bu kısıtlamaları hafifletmede 3D baskı ile plastik kadavra örnekleri kullanımı bu eğitimleri kolaylaştırmıştır. Böylece eğitim sonrasında cerrahların; beyin ve omurga cerrahisi sırasında dokuları ortaya



çıkarmada ve manipüle etmede cerrahi becerilerin gelişmesinde daha başarılı oldukları tespit edilmiştir (Sun ve Wu, 2004).

Cerrahi bakımından hastaya özel kılavuzların üretimi, yerel anatomisi doğru 3D baskılarını gerektirir. Aynı zamanda baskı malzemesinin biyomekanik özellikleri, biyouyumluluğu ve sterilizasyon tekniğinin de dikkate alması gerekir. İntraoperatif kullanımı; yumuşak doku diseksiyonu gerektiren ve önerilen giriş bölgesinin yüzeyi ile iyi bir uyum göstermesi esasına dayanır (Mariani, vd., 2021; Guevar, vd., 2021).

Cerrahi açıdan operasyonlarda özellikle 3D baskı ile üretilmiş greftlerin tedavi amaçlı uygulamalarının süreç açısından başarılı sonuçların alınmasına önemli bir etken olduğu vurgulanmıştır. Köpeklerdeki kraniyal çapraz bağ yırtıklarının tibial tüberozite ilerletme (TTA) cerrahisinde implant olarak kullanılan 3D baskı ile üretilmiş trikalsiyum fosfat (TCP) kafeslerden başarılı sonuçlar elde edildiği bildirilmiştir (Castilho, vd., 2017). Köpeklerde maksilladaki kemik defektlerinin tedavisinde kök hücre tedavisiyle birlikte PCL (Polikaprolakton)/TCP (Trikalsiyumfosfat) kompozit malzeme kullanarak 3D baskı ile ürettikleri kemik greftlerini uygulamışlar ve sonuçların olduğu vurgulanmıştır (Park, vd., 2018). Köpeğin maksillada saptanan tümörün rezeksiyonunun neden olduğu kemik defektinin onarımında hastaya özel 3D baskılı bir greft kullandığı ve başarılı sonuçların alındığı ifade edilmiştir (Kim, vd., 2018).

Veteriner ortopedi ve travmatoloji açısından esas olarak, kemik modellerinin, hastaya özel implantların ve cerrahi kılavuzların oluşturulmasında 3D baskıdan yararlanılmıştır. 3D baskılı modellemeler; rekonstrüktif çene ameliyatları, yüz kırıkları ile açısız uzuv ve kafatası deformitelerinin operatif tedavileri açısından cerrahi planlama bakımından önemli faydalar sağlar. Veteriner cerrahi planlama açısından özellikle de yaralanma ve çevre dokular hakkında tam bilgi sağlamayan 2 boyutlu görüntü verilerinin yerine kullanılır (Vaughan, 2018). Bu teknoloji, kırıklar, uzuv deformiteleri, patellar luksasyon, humerus kondil fissürleri ve spinal kırıklar gibi koşullar altında hayvanlar için uygun şekilde kullanılabilir. Sınırsız geometrik üretim özgürlüğü sayesinde 3D baskı yöntemiyle, tam uyumlu veteriner implantları oluşturmak mümkündür. Bu teknoloji, herhangi bir karmaşık tasarımın üretimi için bile mükemmel esneklik sağlar. Veterinerlik alanındaki araştırma ve geliştirmede, farklı karmaşık problemleri ve uygulamaları çözmek için umut verici bir araçtır (Graham, 2018). Veteriner cerrahlar 3D baskılı fiziksel modellemeler yardımıyla kemik defektinin koşullarını kolayca anlayabilir, bu sayede hayvanların refahını arttırarak minimum yan etki ile esnek çözümler sunabilirler. Bu durum da cerrahi açıdan uygulanan operasyonun başarı oranını arttırır. Radius kemiğinde



büyük hasar olan bir köpeğe 3D baskılı ile hastaya özel titanyum alaşımlı protez implantın başarıyla kullanıldığı (Harrysson, vd., 2015), ateşli silahla yaralanma nedeniyle kemik dokusu kaybı olan köpeğe özel diz protezinin uygulanması (Liska, vd., 2007), kaput humeride problemi olan hayvanlarda humerus başı implantının üretilmesi (Sparrow, vd., 2014; Castilho, vd., 2017) 3D baskı kullanımına olarak örnek gösterilebilir.

Yumuşak doku cerrahisinde 3D baskı kullanımı; göz ve kulak gibi hassas ve anatomik yönden karmaşık yapılara sahip organlarda ameliyat gerektiren hastalıkların prevalansı açısından oldukça fazladır (Deveci, vd., 2020; Dorbandt, vd., 2017). Kardiyotorasik vasküler anomalilerde, kalp ve damarların tam ölçekli 3D baskı kullanımının; tanı, değerlendirme, ileri cerrahi planlama, intraoperatif iletişim ve koordinasyon açısından önemli avantajlar sağladığı bildirilmiştir. Ayrıca bu sayede anestezi ve ameliyat sürelerinin daha kısa olduğu ve özellikle ameliyat esnasında atravmatik damar diseksiyonunun sağlanmasında faydalı olduğu vurgulanmıştır (Wang, vd., 2020). Kronik oronazal fistül (Soares, vd., 2018) ile orbital ve periorbital kitlelerin (Dorbandt, vd., 2017) tedavisinde 3D baskı uygulamaları kullanılmış, bronş yapıları (Hespel, 2015) ve otoskopi eğitiminde değerlendirilmek üzere dış kulak kanalı (Nibblett, vd., 2017) 3 boyutlu olarak basılmıştır. Yine bioprinting teknolojisi kullanılarak cilt lezyonlarını onarımında transplantasyon için deri fibroblastlar ve keratinositler gibi biyouyumlu materyallerle dermal hücre bileşenlerinin bir kombinasyonunun da kullanıldığı bildirilmiştir (Li, ve Fan, 2016; Augustine, 2018).

Ülkemizde veteriner cerrahisi açısından 3D baskı yöntemleri üzerine yeterince araştırma yapılmadığı vurgulansa da (Sen, 2020), Dünyada yürütülen 3D baskı çalışmalarının ilerlemesi, beşerî tıp bilimlerine önemli katkılar sağlayacağı ifade edilmiştir (Jamieson, vd., 2021). Dünyanın çeşitli ülkelerinde her geçen gün yaygınlaşan bu teknolojinin veteriner klinik bilimlerinde kullanıldığı, olumlu ve etkili sonuçların alındığı, önerildiği ve yoğun bir şekilde çalışılmaya devam edilerek halen gelişmekte olduğu bildirilmiştir. Gelecekte çok daha yaygın kullanım alanı bucağı vurgulanmıştır (Vaughan, 2018).

2. SONUÇ

Veteriner cerrahide açısında 3D baskı teknolojisinin kullanımı teşhisten tedaviye kadar olan sürece benzersiz ve önemli yenilikler katmaktadır. Mevcut sürece bakıldığında gelecekte 3D baskı kullanımının veteriner cerrahide daha yaygın ve etkin bir şekilde kullanılacağı kaçınılmazdır. Bu teknolojinin dünyada ve ülkemizdeki hem beşerî hem de veteriner cerrahi uygulamalarındaki gelişmeleri hızla devam ederken, ülkemizde özellikle veteriner klinik



bilimlerindeki kullanımı oldukça yeni bir alan olarak yavaş bir şekilde de olsa devam etmektedir.

3D baskı uygulamalarına yönelik yapılan araştırma bulgularından elde edilen çıkarımlar çok heyecan verici ve yenilikçi düşüncülerin modern cerrahi açısında yeni bir yol haritası çıkarmak için yeni ufuklar açarak eski sorunlara yeni çözümler üretebilecek gibi görünmektedir. 3D baskı uygulaması devriminin veteriner cerrahiye ulaştığını ve bir gün organ nakli için gerekli tüm organların yazdırılarak kullanımını mümkün kılacaktır. Bununla birlikte, tartışıldığı gibi, 3D baskı uygulamalarının mevcut cerrahi kullanımları henüz emekleme aşamasındadır ve farklı uzmanlıkları arasında değişen düzeylerde uygulama alanları bulmuştur. Üç boyutlu baskı uygulamalarının gelecek yüzyıl içerisinde cerrahların, çok disiplinli ekipler oluşturmada ve sağlık hizmeti ağlarını şekillendirmede düşünme biçimlerini tamamen değiştirecek gibi görünmektedir.



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BUĞDAYDA VERİM KOMPONENTLERİNİN TANE VERİMİ ÜZERİNDEKİ ROLÜ

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ÖZET

Buğday talebi, dünya nüfusunun hızla artmasına paralel olarak artmaktadır. Buğday tanesi; ham veya işlenmiş olarak farklı gıdaların üretiminde yer almakta ve insanların temel gıdası konumunu korumaktadır. Nüfus artışının yanısıra doğal afetler (sel, yangın, deprem vs.) gıdaya ulaşmayı zorlaştırdığından dolayı buğday yetiştiriciliği, üretimi ve birim alan verimi daha önemli hale gelmiştir. Tüm bunlara ilaveten buğday yetiştiriciliğinde biyotik ve abiyotik stres faktörleri de birim alandan elde edilen tane verimini sınırlandırmaktadır. Durum ve ekmeclik buğday üretiminde genetik ve çevresel faktörlerin belirleyici olduğu birçok araştırmacı tarafından doğrulanmış olmakla birlikte genetik potansiyeli yüksek ve farklı çevre koşullarında stabilitesini koruyabilen buğday çeşitlerinin tercih edilmesi yüksek verim için elzemdir. Buğday yetiştiriciliğinde; çeşit, toprak yapısı, iklim ve agronomik uygulamalar birim alan üretim miktarında en önemli faktörlerdendir. Verim kapasitesi yüksek çeşit dışında diğer faktörler optimum olsa bile hedeflenen birim alan verimini yakalamak güçtür. Bu bağlamda, lokasyon bazında verim potansiyeli yüksek çeşitleri belirlemek ve tercih etmek önemli bir adımdır. Herhangi bir buğday çeşidinin verim potansiyelini tahmin etmede verim bileşenleri yol göstericidir. Verim bileşenlerinden; metrekarede başak sayısı, başak uzunluğu, başakta başakçık sayısı, başakta tane sayısı ve başak ağırlığı gibi verim bileşenleri tane verimi ile önemli korelasyon göstermektedir. Bu bileşenlerin birim alandan elde edilen tane verimi ile yüksek korelasyon gösterdiği birçok araştırmacı tarafından teyit edilmiştir. Verim bileşenlerine ilişkin gözlemlerin alınması kolay ve aynı zamanda maliyeti çok düşüktür. Son olarak, yüksek tane verimi elde etmeye odaklanmış buğday ıslah programlarında; özellikle metrekarede başak sayısı ve başak ağırlığı dikkate alınarak seleksiyonların yapılmasının yüksek verimli buğday genotiplerinin seçilmesine ve sonrasında tescil edilmesine katkı sağlayacağı öngörülmektedir.

Anahtar Kelimeler: Buğday, tane verimi, metrekarede başak sayısı, başak ağırlığı



THE ROLE OF WHEAT YIELD COMPONENTS ON GRAIN YIELD

ABSTRACT

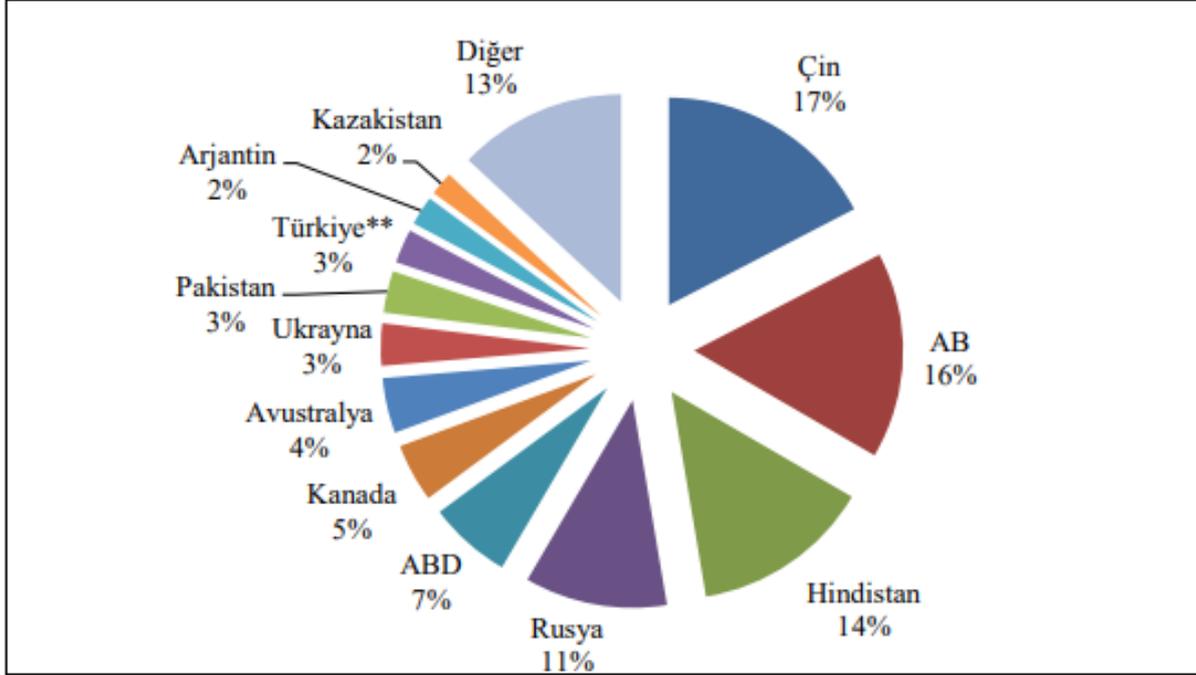
Wheat demand is increasing in parallel with the rapid increase in the world population. Wheat grain; It takes part in the production of different foods as raw or processed and maintains its position as the basic food of people. In addition to the increase in population, natural disasters (flood, fire, earthquake, etc.) make it difficult to reach food, so wheat cultivation, production and unit area yield have become more important. In addition to all these, biotic and abiotic stress factors in wheat cultivation also limit grain yield per unit area. Although it has been confirmed by many researchers that genetic and environmental factors are determinant in durum and bread wheat production, it is essential to choose wheat varieties with high genetic potential and which can maintain their stability in different environmental conditions. In wheat cultivation; variety, soil structure, climate and agronomic practices are front of the most important factors in unit area production. Even if the factors other than the high yielding variety are optimum, it is difficult to achieve the targeted unit area yield. In this context, it is an important step to identify and prefer varieties with high yield potential on the basis of location. Yield components are a guide in estimating the yield potential of any wheat variety. From the yield components; yield components such as spike number per square meter, spike length, number of spikelets per spike, number of grains per spike and spike weight show a significant correlation with grain yield. It has been confirmed by many researchers that these components are highly correlated with grain yield per unit area. Observations on yield components are easy to obtain and at the same time very low cost. Finally, in wheat breeding programs focused on achieving high grain yield; It is predicted that making selections, especially considering the number of spike per square meter and spike weight, will contribute to the selection and registration of high-yielding wheat genotypes.

Keywords: Wheat, grain yield, number of spike per square meter, spike yield



1. Giriş

Buğday, ekmeklik (*Triticum aestivum* L.) ve durum (*Triticum durum* L.) buğday olmak üzere iki ana gruba ayrılmaktadır. Ekmeklik buğday, durum buğdayı ile kıyaslandığında iklim ve toprak isteklerinin daha az olması ve buna bağlı olarak adaptasyon yeteneğinin yüksek olmasının yanı sıra ana besin kaynağı olmasının avantajı ile daha fazla araştırma konusu olmuş ve dünyada daha geniş ekim alanlarına sahip olmuştur (Oral ve ark., 2018).



Şekil 1. Dünya buğday üretiminde önemli üretici ülkeler ve üretimdeki payları (%) (Kaynak: IGC Nisan 2021)

2020-2021 yetiştirme sezonu dünya buğday üretimi ülkeler bazında değerlendirildiğinde; Çin, AB ülkeleri ve Hindistan sırasıyla; %17, %16 ve %14 oranında buğday üretim payına sahip olmuştur. Türkiye 10. sırada yer alarak dünya buğday üretiminin %3'nü gerçekleştirmiştir (IGC, Nisan 2021).



Tablo 1. Ülkeler ve üretim sezonları bazında birim alan tane verimi (ton/ha)

Ülkeler	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
AB	5,28	5,2	5,57	5,84	5,97	5,34	5,84	5,4	5,97
Çin	4,84	4,99	5,06	5,24	5,39	5,4	5,48	5,42	5,63
Ukrayna	3,35	2,8	3,39	3,94	3,83	4,14	4,06	3,73	4,16
Kanada	2,96	2,87	3,6	3,08	2,89	3,58	3,38	3,27	3,26
ABD	2,93	3,11	3,17	2,94	2,93	3,54	3,12	3,2	3,47
Hindistan	2,99	3,18	3,12	3,15	2,75	2,85	3,2	3,37	3,47
Rusya	2,27	1,77	2,23	2,5	2,39	2,68	3,11	2,72	2,7
Pakistan	2,72	2,69	2,79	2,82	2,78	2,78	2,94	2,85	2,81
Türkiye**	2,69	2,67	2,84	2,4	2,87	2,69	2,8	2,74	2,78
Arjantin	3,23	2,66	2,67	2,8	2,86	3,3	3,18	3,22	2,95
Avustralya	2,15	1,76	2,01	1,92	1,97	2,61	1,92	1,69	1,49
Kazakistan	1,66	0,79	1,08	1,09	1,19	1,21	1,24	1,23	1,01
Dünya	3,18	3,07	3,27	3,31	3,31	3,4	3,5	3,4	3,51

Kaynak: TÜİK, 2021

Birim alan tane verimi incelendiğinde AB Ülkeleri, Çin ve Ukrayna'nın ön sırada yer aldığı, ülkemizde yıllara göre dalgalanma görülmekle beraber birim alan tane veriminin 2019-2020 üretim sezonunda 2.78 ton ha⁻¹ olduğu görülmektedir (Tablo 1).

Buğdayda; Başak uzunluğu, Başakçık sayısı, başak ağırlığı, başakta tane sayısı ve metrekarede başak sayısı önemli verim bileşenleridir. Verim bileşenlerinin tane verimi üzerindeki etkisi bazen direkt bazen de bileşenlerin birbirini etkilemesi suretiyle dolaylı olmaktadır. Bu sebeple verim bileşenlerinin tane verimini etkileme şekli ve oranının açık bir şekilde ortaya konması ıslah programları için önem arz etmektedir (Dofing ve Knight, 1992; Mohamed, 1999; Yağmur ve Kaydan, 2008).



Şekil 1. Kuş bakışı GAP UTAEM tahıl deneme alanı/Diyarbakır (Kaynak: Doç. Dr. Mehmet Karaman)

Özellikle yağış miktarının düşük ve sezonun kurak geçtiği yıllarda metrekarede başak sayısını ve başak uzunluğunu diğer genotiplere göre yüksek tutabilen genotipler seleksiyon çalışmalarında mutlaka tercih edilmelidir. Buğdayda tane ağırlığı artışının başak ekseninde başakçıkların sıkı dizilimi ile ilişkili olduğu, başak uzunluğunun birim alan tane verimi ile önemli korelasyon gösterdiği bildirilmiştir (Şengün, 2006; Sakin ve ark., 2015). Farklı araştırmacılar tarafından; tane verimi ile başakta tane sayısı ve metrekarede başak sayısı arasında pozitif ve önemli korelasyon olduğu doğrulanmıştır (Bilgin, 1997; Dokuyucu ve ark., 2001; Sakin ve ark., 2015).

Ekmeklik buğday ile ilgili yapılan çalışmada başakta tane sayısının %40, başakta tane ağırlığının %40 ve metrekarede başak sayısının ise %20 oranında tane verimi üzerinde etkili olduğu bildirilmiştir (Olgun ve ark., 1999; Yağmur ve Kaydan, 2008). Kahramanmaraş koşullarında ekmeklik buğdayda yapılan çalışmada tane verimi ile başaktaki tane sayısı ve tane ağırlığı, arasında olumlu ve önemli, başak uzunluğu ile olumsuz ve önemli korelasyon olduğu vurgulanmıştır (Kara ve ark., 2016).



Şekil 2. GAP UTAEM tahıl deneme alanı/Diyarbakır (Kaynak: Doç. Dr. Mehmet Karaman)

Erzurum koşullarında ekmeklik buğdayda yapılan çalışmada ise, tane verimi ile başaktaki tane sayısı ve metrekaredeki başak sayısı arasında $p < 0.001$ seviyesinde çok önemli ilişki olduğu görülmüştür (Bayram ve ark., 2017). Bu çalışmada amaç, birim alan tane verimi üzerinde belirleyici rol oynayan verim bileşenlerini incelemek ve seleksiyon çalışmalarında kullanılabilecek özelliklere odaklanmaktır.

2. VERİM KOMPONENTLERİ

2.1. Metrekarede Başak Sayısı: Buğdayda metrekaredeki başak sayısı genotip ve çevre koşullarından önemli ölçüde etkilenmekle beraber 250-800 adet m^{-2} arasında değişim göstermektedir. Nitekim metrekaredeki başak sayısının 415.0-633.3 adet arasında değişim gösterdiği bildirilmiştir (Usta ve Yağmur, 2021). Ayrıca, Yağmur ve Kaydan (2008), kurak koşullarda birim alandaki fertil başak sayısının tane verimi üzerinde önemli düzeyde etkili olduğunu bildirmiştir.

2.2. Başak Uzunluğu: Farklı çevrelerde ve farklı araştırmacılar tarafından yapılan çalışmalarda buğdayda ortalama başak uzunluğunun 6.6-13.8 cm arasında değişim gösterdiği bildirilmektedir (Karaman ve ark., 2015; Sakin ve ark., 2015; Kara ve ark., 2016; Akkaya ve Kara, 2018; Aydoğan, 2018; Güngör ve ark., 2019; Usta ve Yağmur, 2021).



2.3. Başakta Başakçık Sayısı: Durum ve ekmeclik buğdayda farklı olmakla beraber buğdayda başakta ortalama başakçık sayısı 15-25 adet arasında değiştiği bildirilmiştir (Kahrıman, 2007; Tayyar ve Gül, 2008; Aydoğan, 2018).



Şekil 3. Hasada yakın GAP UTAEM tahıl deneme alanı/Diyarbakır (Kaynak: Doç. Dr. Mehmet Karaman)

2.4. Başakta Tane sayısı: Buğday başağındaki tane sayısının birim alan tane verimi üzerinde etkili olduğu birçok araştırmacı tarafından vurgulanmıştır. Ayrıca, buğday başağında ortalama tane sayısı 15.5 ile 71.9 adet arasında değişmektedir (Özen ve Akman, 2015; Bayram ve ark., 2017; Karaman, 2022)

2.5. Başak Ağırlığı: Buğdayda başak ağırlığı ön önemli verim bileşenlerindedir. Başak ağırlığının birim alan tane verimi ile $p < 0.01$ veya $p < 0.05$ düzeyinde önemli korelasyon gösterdiği birçok çalışmada teyit edilmiştir. İlaveten, ortalama başak ağırlığının 0.60 ile 2.48 g arasında değiştiği vurgulanmıştır (Sakin ve ark., 2015; Aktaş ve ark., 2017; Aydoğan ve Soylu, 2017; Karaman, 2022).

3. SONUÇ VE ÖNERİLER

Verim bileşenleri, herhangi bir buğday çeşidinin verim potansiyelini tahmin etmede bir kılavuzdur. Metrekare başak sayısı, başak uzunluğu, başakta başakçık sayısı, başakta tane sayısı ve başak ağırlığı gibi verim bileşenleri tane verimi ile önemli bir korelasyon göstermektedir. Bu bileşenlerin birim alan başına tane verimi ile ilişkili olduğu birçok araştırmacı tarafından doğrulanmıştır. Fakat, yüksek tane verimi elde etmeye odaklanan buğday ıslah programlarında;



tane verimi ile ilişkili olduğu bildirilen özelliklerden Özellikle metrekaresindeki başak sayısı ve başak ağırlığının dikkate alınarak seleksiyon yapılmasının yüksek verimli buğday genotiplerinin seçimine ve tesciline katkı sağlayacağı öngörülmektedir.



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MUŞ KOŞULLARINDA BAZI İLERİ KADEME EKMEKLİK BUĞDAY HATLARININ (*Triticum aestivum* L.) TESCİLLİ ÇEŞİTLER İLE KIYASLANMASI

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ÖZET

Artan dünya nüfusu, doğal afetler, biyotik ve abiyotik stres faktörleri buğdaya olan talebi her geçen gün artırmaktadır. Birim alan buğday veriminin yanında kalite de buğday ıslahçıların öncelikleri arasındadır. Bu bağlamda, tane verimi ticarete mal olmuş çeşitlerden daha üstün ve kalitesi kabul edilebilir sınırlarda olan yeni ekmeklik buğday çeşitlerinin geliştirilmesi ihtiyaçtır. Bu çalışma, Türkiye'nin en büyük 3. ovasına sahip Muş ilinde yapılmıştır. Muş ilinde, ekmeklik buğdayda bölgeye uygun çeşitleri belirlemek amacıyla birkaç adaptasyon çalışması yapılmış olmak ile birlikte çalışma sayısı yeterli düzeyde değildir. Bu ihtiyaç doğrultusunda deneme yağışlı koşullarda ve üç tekerrürlü olarak kurulmuştur. Çalışmada, 2 kışlık çeşit, 5 kışlık ve 5 fakültatif ileri kademe ekmeklik buğday hattı kullanılmıştır. Rutubet oranı hariç incelenen tüm özelliklerde genotipler arasında $p < 0.01$ seviyesinde anlamlılık olduğu tespit edilmiştir. Araştırmada; tane verimi (GY), normalize edilmiş vejetasyon indeksi (NDVI), metrekarede başak sayısı (SN), hektolitre ağırlığı (TW) ve rutubet oranı (MR) özellikleri araştırılmıştır. GY, NDVI ve TW özelliklerinde G8 hattı, NS'de ise Kenanbey çeşidi en yüksek değere sahip olmuştur. GY; 203.32-375.82 kg/da, NDVI; 0.530-0.760, MBS; 61-125 adet/m², HL; 660-75.7 kg/hl ve RTO; 8.07-8.20 arasında farklılık göstermiştir. Korelasyon analizi sonuçlarına göre; tane verimi ile NDVI (GS33) arasında pozitif, hektolitre ağırlığı ile metrekarede başak sayısı arasında negatif ve önemli ilişki olduğu belirlenmiştir. Son olarak, Hat-8 ileri kademe ekmeklik buğday hattının kontrol olarak kullanılan tescilli çeşitlerden ve çalışmada kullanılan tüm hatlardan incelenen özellikler bakımından daha üstün olduğu belirlenmiştir. Bu bağlamda, Hat-8'in farklı çevrelerde tekrar denenerek gözlem altına alınması gerektiği ve elde edilen bu sonuçların teyit edilmesi sonrasında gen havuzuna alınması ve ıslah programlarında ebeveyn olarak kullanılması kanaati hasıl olmuştur.

Anahtar Kelimeler: Tane verimi, metrekarede başak sayısı, ndvi, hektolitre ağırlığı



COMPARISON OF SOME ADVANCED BREAD WHEAT LINES (*Triticum aestivum* L.) WITH REGISTERED VARIETIES IN MUS CONDITIONS

ABSTRACT

Increasing world population, natural disasters, biotic and abiotic stress factors increase the demand for wheat day by day. In addition to wheat yield per unit area, quality is among the priorities of wheat breeders. In this context, there is a need to develop new bread wheat varieties whose grain yield is superior to commercial varieties and whose quality is within acceptable limits. This study was carried out in the province of Mus, which has the third largest plain in Türkiye. Although a few adaptation studies have been carried out in order to determine the varieties suitable for the region in bread wheat in Mus province, the number of studies is not sufficient. In line with this need, the experiment was established under rainfed conditions and with three replications. In the study, 2 winter varieties, 5 winter and 5 facultative advanced bread wheat lines were used. It was determined that there was a $p < 0.01$ level of differences significance between the genotypes in all the properties examined except the moisture ratio. In the research; grain yield (GY), normalized difference vegetation index (NDVI), number of spike per square meter (SN), test weight (TW) and moisture ratio (MR) properties were investigated. G8 line had the highest value in GY, NDVI and TW characteristics, while Kenanbey variety had the highest value in NS. GY; 203.32-375.82 kg/da, NDVI; 0.530-0.760, MBS; 61-125 pcs/m², HL; 660-75.7 kg/hl and RTO; It differed between %8.07-8.20. According to the results of the correlation analysis; It was determined that there was a positive and significant relationship between grain yield and NDVI (GS33), and a negative and significant relationship between test weight and the number of spike per square meter. Finally, it was determined that the line-8 advanced bread wheat line was superior to the proprietary varieties used as control and all lines used in the study in terms of the examined characteristics. In this context, it was concluded that the line-8 should be tested and observed again in different environments, and after these results were confirmed, it should be included in the gene pool and used as a parent in breeding programs.

Keywords: Grain yield, number of spikes per square metre, ndv1, test weight



1. Giriş

Buğday, geniş adaptasyon yeteneğine sahip olmakla birlikte gerek ham gerekse işlenerek tüketilmesi yönüyle tahıllar içerisinde ilk sıralarda yer almaktadır. Buğdayın, farklı çevrelere uyum kabiliyetinin yüksek olması Türkiye’de ve dünyada ekim alanlarının çok geniş yelpazeye dağılması ile sonuçlanmıştır.



Şekil 1. Türkiye’de iller bazında buğday üretim payı (Anonim, 2019).

Buğday yetiştiriciliğinde; yıllar bazında düşen yağış miktarı, yağışın aylara göre dağılımı, agronomik uygulamalar, çeşidin adaptasyon kabiliyeti gibi faktörlerin birim alandan elde edilecek tane verimi üzerinde belirleyici olduğu belirtilmiştir (Mut ve ark. 2005; Aktaş ve ark., 2017). Mardin ilinde yağışa dayalı koşullarda ekmeklik buğdayda yapılan bir çalışmada, tane veriminin; 133.50-198.75 kg/da ve hektolitre ağırlığının; 67.40-72.20 kg/hl arasında farklılık gösterdiği bildirilmiştir (Akan ve ark., 2021). Ekmeklik buğdayda metrekaredeki başak sayısı birim alan tane verimini tahmin etmede en önemli özelliklerden biri olmakla beraber özellikle agronomik uygulamalardan önemli ölçüde etkilendiği, iki yıllık çalışma sonuçlarına göre ortalama metrekaredeki bitki sayısının 383.8 ile 429.0 adet/m² arasında değişim gösterdiği belirlenmiştir.

Bu çalışmada amaç, ileri kademe ekmeklik buğday hatları ile tescilli ekmeklik buğday çeşitlerini kıyaslamak ve tarımsal özellikler bakımından tescilli çeşitlerden üstün olan hatları belirlemektir.



2. Materyal ve Metot

Araştırma, Muş ili koşullarında 2020-2021 yetiştirme sezonunda yağışa dayalı koşullarda yürütülmüştür. Deneme materyalini 2 tescilli çeşit ve 10 ileri kademe ekmeclik buğday hattı olmak üzere toplamda 12 genotip oluşturmuştur. Deneme parsellerine; her parsel 6 sıra, sıra arası 20 cm ve net 6 m² olacak şekilde ekim yapılmıştır. Tesadüf blokları deneme desenine göre kurulan denemede her genotip 3 tekrarlamalı olarak parsel mibzeri ile ekilmiştir.

Bitki besin elementi takviyesi amacıyla saf madde hesabıyla 6 kg fosfor ve 9 kg azot uygulanmıştır. Azotun 3 kg'ı ekim ile, kalan 6 kg ise kardeşlenme döneminde Calsiyum Amanyum Nitrat formunda verilmiştir. Ayrıca, ihtiyaç durumunda dar ve geniş yapraklı yabancı otlar ile, yabancı otun 3-4 yapraklı olduğu dönemlerde uygun herbisitler ile kimyasal mücadele yapılmıştır.

Tablo 1. Deneme materyaline ilişkin bilgiler

S.N	Genotiple r	Gelişme Tabiatı	Orijini/İslahçı kuruluşu
1	Kenanbey	Kışlık	Tarla Bitkileri Merkez Araştırma Enstitüsü Müdürlüğü
2	Ekiz	Kışlık	Bahri Dağdaş Uluslararası Tarımsal Araştırma Enstitüsü Müdürlüğü
3	Hat-1	Kışlık	Uluslararası Kışlık Buğday Geliştirme Programı
4	Hat-2	Kışlık	Uluslararası Kışlık Buğday Geliştirme Programı
5	Hat-3	Kışlık	Uluslararası Kışlık Buğday Geliştirme Programı
6	Hat-4	Kışlık	Uluslararası Kışlık Buğday Geliştirme Programı
7	Hat-5	Fakültatif	Uluslararası Kışlık Buğday Geliştirme Programı
8	Hat-6	Kışlık	Uluslararası Kışlık Buğday Geliştirme Programı
9	Hat-7	Fakültatif	Uluslararası Kışlık Buğday Geliştirme Programı
10	Hat-8	Fakültatif	Uluslararası Kışlık Buğday Geliştirme Programı
11	Hat-9	Fakültatif	Uluslararası Kışlık Buğday Geliştirme Programı
12	Hat-10	Fakültatif	Uluslararası Kışlık Buğday Geliştirme Programı

Çalışmada kullanılan genotipler araştırma enstitülerinden ve uluslararası buğday ve mısır geliştirme merkezi (CIMMYT)'nden temin edilmiştir.



Tablo 2. 2020-2021 Yetiştirme sezonu ve uzun yıllar yağış ve ortalama sıcaklık değerleri

Aylar	Yağış miktarı (mm)		Ortalama Sıcaklık (°C)	
	2020-2021	Uzun yıllar	2020-2021	Uzun yıllar
Eylül	1.2	14.7	23.8	20.0
Ekim	0.0	63.5	16.2	12.6
Kasım	38.2	94.1	9.8	4.5
Aralık	16.6	89.7	-2.3	3.0
Ocak	94.0	86.0	-8.1	-7.4
Şubat	49.8	100.4	2.7	-6.1
Mart	166.4	103.3	3.9	0.6
Nisan	7.8	107.4	14.6	9.0
Mayıs	11.6	69.0	19.1	14.9
Haziran	0.6	28.2	23.0	20.2
Temmuz	0.4	6.6	27.5	25.3
Toplam	386.6	762.9	-	-

Sezona ilişkin yağış miktarının ocak ve mart ayları hariç geriye kalan tüm aylarda uzun yıllar ortalamasının altında olduğu belirlenmiştir. Sıcaklığın ise aralık ve ocak ayları hariç tüm aylarda uzun yılların üzerinde değerler olduğu görülmüştür. 2020-2021 üretim sezonu genel olarak değerlendirildiğinde genotiplerin kuraklık stresine maruz kaldığı söylenebilir.

2.1. İstatistiksel analizler

İstatistiksel analizler JMP 7.0 paket programında yapılmıştır. Oluşan gruplar LSD testine göre $p<0.01$ veya $p<0.05$ anlamlılık düzeyinde değerlendirilmiştir (Kalaycı, 2005).

3. Bulgular ve Tartışma

Çalışmada, rutubet oranı hariç incelenen tüm özelliklerde genotipler arasında %1 seviyesinde önemli farklılıklar olduğu tespit edilmiştir.



Tablo 3. İncelenen özelliklere ilişkin ortalama değerler ve oluşan gruplar

Genotipler	TV (kg/da)	NDVI	MBS (adet/m ²)	Hektolitire (kg/hl)	Rutubet (%)
Kenanbey	317.09 bc	0.657 bc	125 a	66.0 b	8.07
Ekiz	342.50 abc	0.637 cd	100 bc	73.7 a	8.20
Hat-1	271.27 de	0.657 bc	61 g	73.3 a	8.13
Hat-2	302.91 cd	0.593 def	71 fg	73.7 a	8.13
Hat-3	203.32 f	0.633 cde	80 ef	73.5 a	8.17
Hat-4	249.44 e	0.653 bc	70 fg	74.1 a	8.13
Hat-5	315.41 bc	0.580 efg	80 ef	73.3 a	8.13
Hat-6	310.00 cd	0.557 fg	110 b	73.3 a	8.20
Hat-7	353.77 ab	0.697 b	95 cd	72.9 a	8.10
Hat-8	375.82 a	0.760 a	85 de	75.7 a	8.20
Hat-9	253.77 e	0.557 fg	94 cd	72.6 a	8.13
Hat-10	306.39 cd	0.530 g	92 cd	73.7 a	8.10
Ortalama:	300.14	0.626 g	89.0	73.0	8.14
LSD (0.05):	39.9**	0.05**	11.0**	3.2**	ö.d.
CV (%):	7.9	5.1	7.3	2.6	0.7

ö.d.: önemli değil

Araştırmada, tane verimi bakımından Hat-8'in ilk sırada yer aldığı, Hat-7 ve Ekiz çeşidinin de aynı grubu paylaşarak takip ettiği belirlenmiştir. Mevcut ileri kademe ekmeçlik buğday hatlarından 2 tanesinin (Hat-7 ve Hat-8) kontrol çeşitlerden daha yüksek tane verimine sahip olduğu belirlenmiştir. Sapa kalkma dönemi NDVI bakımından, Hat-8'in en yüksek değer verdiği görülmüştür. Hat-8'in tane verimi yönüyle de en iyi genotip olduğu tespit edilmiştir.

Diyarbakır ili koşullarında yapılan bir çalışmada fizyolojik özellikler bakımından öne çıkan çeşitlerin tane verimi yönüyle de ilk sıralarda yer aldığı bildirilmiştir (Karaman ve ark., 2014). Çalışmamız bu yönüyle benzerlik göstermektedir. Mevcut hatlardan, 2 tanesinin (Hat-7 ve Hat-8) kontrol çeşitlerden daha yüksek NDVI değerine sahip olduğu görülmüştür (Tablo 3).

Metrekarede başak sayısı bakımından, Kenanbey çeşidinin (125 adet/m²) ilk sırada yer aldığı ve daha yüksek değere sahip hattın olmadığı gözlenmiştir. Fakat, 4 adet ileri kademe ekmeçlik buğday hattının deneme ortalamasının üzerinde metrekarede başak sayısına sahip olduğu tespit edilmiştir (Tablo 3). Birim alan tane verimi üzerinde metrekaredeki başak sayısının çok önemli olduğu birçok araştırmacı tarafından vurgulanmıştır (Kılıç ve ark., 2010; Akçura ve ark., 2011; Çığ ve Karaman, 2019).

Hektolitire ağırlığında, Kenanbey çeşidi hariç tüm genotiplerin aynı grubu paylaştığı belirlenmiştir. Hektolitire ağırlığının çevre koşullarının ve agronomik uygulamaların etkisi altında olduğu, tanenin şekli yoğunluğu, karın çizgisi boşluğu, boyutu ve saydamlılığına bağlı



olarak değişim gösterdiği bildirilmiştir (Boyacıoğlu ve Tülbek, 2002; Aktaş, 2017; Yıldırım ve Atasoy, 2020; Karaman, 2020; Akan ve ark., 2021). Rutubet oranı yönünden, genotipler arasında anlamlı bir farklılık belirlenmemiştir.

Tablo 4. İncelenen özelliklere ait korelasyon bilgileri

Özellikler	Tane Verimi (kg/da)	NDVI (Zadoks 33)	M2'de başak sayısı	Hektolitre ağırlığı
NDVI (Zadoks 33)	0.3309*			
M2'de başak sayısı	0.3245	-0.0807		
Hektolitre ağırlığı	-0.0173	0.0047	-0.5424**	
Rutubet oranı	-0.0261	-0.0882	-0.0822	0.3622

Korelasyon analizi sonucuna göre; tane verimi, NDVI (GS33) ile pozitif ve önemli, metrekarede başak sayısı ise hektolitre ağırlığı ile negatif ve önemli ilişki gösterdiği tespit edilmiştir (Tablo 4).

4. Sonuçlar ve Öneriler

Çalışmada yer alan materyaller içerisinde Hat-8'in tane verimi başta olmak üzere incelenen birçok özellik bakımından öne çıktığı gözlenmiştir. Muş ilinde üretici koşullarında ekilen ekmeçlik buğday çeşidi sayısının çok fazla olmadığı dikkate alındığında bölgeye uygun yeni çeşitlerin geliştirilmesi büyük önem arz etmektedir. Bu bağlamda Hat-8'in adaptasyonunun yüksek olduğu ve tarımsal özellikler açısından öne çıktığı belirlenmiştir. İleriye dönük olarak bu ileri kademe ekmeçlik buğday hattının çeşit adayı olabileceği umuduyla çalışmanın en az bir yıl daha yapılması faydalı olacaktır.



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**AĞRI DOĞUBAYAZIT İKLİM KOŞULLARINDA FARKLI AZOT
DOZLARININ ASPİR (*Carthamus tinctorius* L.) ÇEŞİTLERİNİN VERİM VE VERİM
UNSURLARI ÜZERİNE ETKİSİ¹⁵**

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ÖZET

Bu çalışmada, Ağrı Doğubayazıt iklim koşullarında aspir (*Carthamus tinctorius* L.) çeşitlerine değişik dozlarda uygulanan azotun verim ve verim öğeleri üzerine etkilerinin belirlenmesi amaçlanmıştır. Deneme faktörü olarak üç aspir çeşidi (Dinçer, Balcı ve Ayaz) ve dört farklı azot dozunun (0, 10, 15, 20 kg/da) kullanıldığı çalışma, tesadüf bloklarında bölünmüş parseller deneme desenine göre 2019 yılında yürütülmüştür. Araştırma sonucunda, uygulanan azot dozlarının incelenen tüm özelliklerden sadece ikincil dal sayısı, tohum verimi ve ham yağ verimi üzerine olan etkisi önemli bulunmuştur. Çalışmada en yüksek tohum verimi ortalama değerleri Ayaz çeşidinden dekara 15 ve 20 kg azot uygulamalarından 136.36 ve 134.71 kg/da olarak elde edildiği saptanırken, en düşük tohum verimi ortalama değeri ise (97.17 kg/da) Dinçer çeşidinin kontrol uygulamasından alındığı tespit edilmiştir.

Anahtar kelimeler: Aspir (*Carthamus tinctorius* L.), verim, azot dozu



**THE EFFECT OF DIFFERENT NITROGEN DOSES ON YIELD AND YIELD
COMPONENTS OF SAFFLOWER (*Carthamus tinctorius* L.) CULTIVARS IN AĞRI
DOĞUBAYAZIT CLIMATE CONDITIONS**

ABSTRACT

In this study, it was aimed to determine the effects of nitrogen applied at different doses on yield and yield components of safflower (*Carthamus tinctorius* L.) cultivars under Ağrı Doğubayazıt climatic conditions. The study, in which three safflower varieties (Dinçer, Balcı, and Ayaz) and four different nitrogen doses (0, 10, 15, 20 kg/da) were used as the trial factor, was carried out according to the split plot in randomized blocks experimental design in 2019. As a result of the research, it was found that the effect of applied nitrogen doses on the number of secondary branches, seed yield, and crude oil yield was significant among all the properties studied. In the study, it was determined that the highest seed yield average values were obtained from 15 and 20 kg nitrogen applications per decare from Ayaz variety, as 136.36 and 134.71 kg/da, while the lowest seed yield average value (97.17 kg/da) was obtained from the control application of Dinçer variety.

Keywords: Safflower (*Carthamus tinctorius* L.), nitrogen dose, yield



GİRİŞ

Beslenmek ve yaşamak adına birçok gıda maddesinde olduğu gibi yağlara da gereksinim duyulmaktadır. İnsan beslenmesinde gerekli yağların bir kısmı çeşitli gıdaların içerisinde temin edilebilmekle birlikte bir kısmı da yağlı tohumlardan elde edilen ham yağların tüketilmesiyle sağlanmaktadır. Dünya 2021/2022 yılı yağlı tohum üretimi 606.92 milyon tondur. En büyük payı 358.10 milyon ton ile soya fasulyesi almaktadır. Bunu sırasıyla 74.24 milyon ton ile kolza, 57.31 milyon ton ile ayçiçeği, 50.43 milyon ton ile yerfıstığı ve izlemektedir. 2021/2022 üretim döneminde Brezilya'nın %22.13 ile en büyük yağlı tohum üreticisi olduğu ve bu ülkeyi %21.64 ile ABD, %10.27 ile Çin, %8.18 ile Arjantin ve %6.77 ile Hindistan'ın izlediği görülmüştür. Dünya bitkisel ham yağ üretimi 2021/2022'de 208.81 milyon ton olurken en büyük payı 73.83 milyon ton ile son dönemde dünyada tartışılan palm yağı almıştır. Endonezya %49.19 ile en büyük ham yağ üreticisi ülke konumundadır (USDA, 2023).

En fazla yağlı tohum üreten ülkeler arasında yer almayan Türkiye ise yağlı tohum ithal eden ülkeler arasında 3.68 milyon ton ile 7. sırada yer aldığı tespit edilmiştir (USDA, 2023). Yağlı tohumlar arasında ülkemiz coğrafyasında en fazla üretimi yapılan bitkiler ayçiçeği, soya, çiyit ve kanola olarak sıralanmaktadır. Ülkemizde, yağ üretiminde kullanılmayan diğer bazı yağlı tohumlu (Haşhaş, yer fıstığı ve kenevir) bitkilerin üretimine başka alanlarda değerlendirilmek üzere devam edilmektedir (Taşlıgil & Şahin, 2016).

Türkiye, yağ ve yağlı tohumların kullanımını açısından büyük ölçüde dışarıya bağımlı bir ülkedir. Doğal olmayan enerji kaynaklarından sonra ithalatı yapılan yurt dışına döviz kaybının yaşandığı ürünlerin başında yağlı tohumlar gelmektedir. Yağ konusunda yaşanan problemler geçmişten günümüze uzun yıllardır devam etmektedir. Ülkemiz coğrafi şartlarına bakıldığında yağlı tohumların kolaylıkla yetiştirilebildiği ve çoğunda dünya ortalamasının üzerinde verim alındığı bilinmektedir. Tarımda sürekli tekrarlanan problemler, üreticilerin içinde bulunduğu ekonomik sorunlar ve anapara da oluşan yetersizlik çoğu zirai faaliyette olduğu gibi yağlı tohum ekiminde de kendini göstermektedir. Konuyla ilgili bir devlet politikasının olmayışı da üretici ve diğer sektörleri önemli ölçüde endişeye düşürmektedir (Köse et al., 2008). 2022 yılı TÜİK verilerine göre ayçiçeği tohumu 2 milyon 215 000 ton, pamuk tohumu ise 1 350 000 ton olurken, yerfıstığı 234 164 ton, soya fasulyesi üretimi 182 000 ton, kolza üretimi 140 000 ton ve susam üretimi ise 17 657 olarak ton gerçekleşmiştir. Aspir üretimi ise 145 882 dekarlık alandan dekara 111.0 kg/da'lık verimle 16 200 ton olarak gerçekleşmiştir.



Yağlı tohumlar açısından dışa bağımlılığımızı azaltmada alternatif bir bitki olan aspirin ülkemizde Orta Anadolu Bölgesinde, Isparta, Eskişehir ve Balıkesir gibi illerde üretimi yapılmaktadır. Kurağa çok dayanıklı olduğu için, ülkemizin hemen hemen her bölgesinde yetişebilme kabiliyeti vardır. Özellikle nadas uygulamasının yapıldığı bölgelerde buğday bitkisi ile iyi bir münavebe oluşturmaktadır. Bu açıdan bakıldığında; Orta Anadolu ve Doğu Anadolu Bölgeleri aspir tarımı için çok elverişlidir (Arıoğlu et al., 2010). Aspir bitkisi ayçiçeği, kanola, soya gibi diğer yağlı tohumlu bitkilere göre çok daha az su tüketimi olan, kurak iklim koşullarında rahatlıkla yetiştirilebilen bir bitkidir. Günümüzde dünya üzerinde oluşan iklim değişiklikleriyle dikkatleri bu yönüyle üzerine çeken bir bitkidir. Aspir, kuraklığa dayanma gücünün yüksek olması nedeni ve diğer yağlı tohumlu bitkilerle ekim alanlarını paylaşma yönünden rekabete az girmesi nedeniyle değerli bir yağlı tohum bitkisidir (Köse & Köse, 2011). Aspir esas olarak bir yağ bitkisi olmasına karşın, çok amaçlı olarak kullanılabilir. Tohumundan çıkarılan yağın yemeklik kalitesinin yüksek olmasının yanı sıra, yarı kuruyan özellikte olmasından dolayı boya sanayiinde de oldukça değerlidir. Genellikle yağ, sabun, boya vernik ve cila yapımında kullanılmaktadır. Ayrıca küspesinden hayvan beslenmesinde, saplarından ise yakacak ve barınak amacıyla yararlanılmaktadır. Renkli çiçeklerinden de boya yapımında yararlanılması olağandır (Köse, 2020).

Bitkisel üretimin artırılması büyük çoğunlukla sentetik gübrelerin yeterli miktarda ve doğru zamanda kullanımıyla ilişkilidir. Bitki yetiştiriciliğinde gübre uygulamaları; bitkinin çeşidine, ekim tarihine, ekim alanının toprak ve iklim faktörlerine göre değişiklik göstermektedir. Gübreleme yapılmadan önce toprak analizinin yapılması ve ekimi yapılacak bitkinin ihtiyaç duyduğu gübre ve dozunun tespit edilmesi önemli bir adımdır (Yolci & Tunçtürk). Bitki gelişimi üzerinde kültürel uygulamalardan farklı gübre dozlarının etkili olması, bu uygulamalara ait etkilerin bölgelere göre değişmesi, bu tip araştırmaların her bölgenin ekolojik koşulları içerisinde yapılmasını zorunlu kılmaktadır. Bu nedenle Ağrı Doğubayazıt iklim koşullarında yapılan bu araştırmadaki amaç; farklı azotlu gübre dozlarının bazı aspir çeşitlerinin verim ve verim unsurları üzerine etkilerini belirlemek ve daha sonraki yıllarda aspir ile ilgili yapılabilecek çalışmalara ışık tutmaktır.

MATERYAL VE YÖNTEM

Materyal

Çalışma 2019 yılında Ağrı Doğubayazıt ilçesinde çiftçi şartlarında yürütülmüştür. Çalışmada, Balcı, Dinçer ve Ayaz çeşitleri deneme materyali olarak kullanılmıştır.



Deneme Alanının Toprak Özellikleri

Araştırmanın yürütüldüğü Ağrı-Doğubayazıt Karabulak köyü coğrafi koordinatları 39° 32' Kuzey enlemleri ve 44° 4' Doğu boylamlarında yer almakta olup denizden yüksekliği 1900 m'dir. Denemenin kurulduğu alandan 0-30 cm derinlikte üç farklı noktada toprak örneği alınarak Iğdır Üniversitesi Alum Toprak ve Su Analiz Laboratuvarında analiz edilmiştir. Araştırma sahası toprağının killi-tınlı tekstür yapısında, pH'sının 8.24 alkali ve tuz içeriğinin ise 0.0105 (mmhos/cm) olduğu tespit edilmiştir (Çizelge 1). Bitkilere yararlı besin maddeleri bakımından ise 0.521 kg/da P₂O₅, 160.278 kg/da K₂O, %0.7092 oranında yararlı kireç (CaCO₃) ve %1.955 oranında organik madde içeriğine sahip olduğu saptanmıştır.

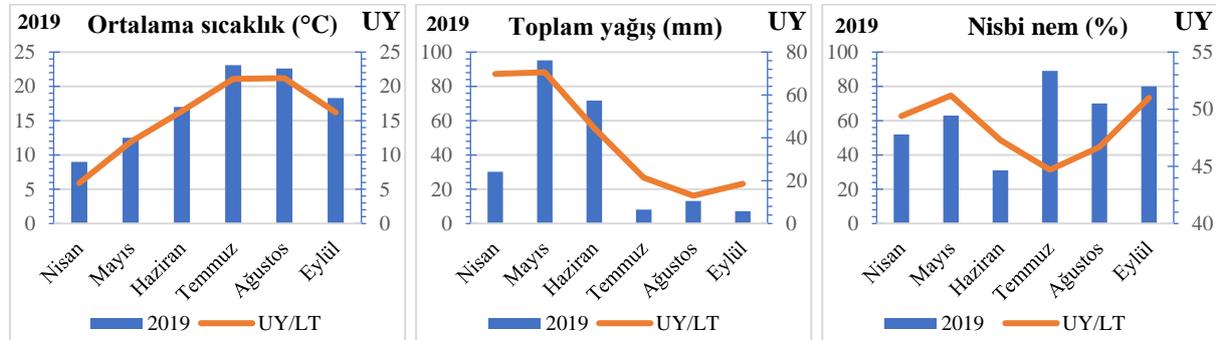
Tablo 1. Araştırma sahası toprak yapısına ait önemli bazı fiziksel ve kimyasal özellikler

Tekstür Sınıfı	Toplam Tuz (mmhos/cm)	pH	Kireç (% CaCO ₃)	Organik Madde (%)	Bitkiye Yararlı Besin Maddeleri (kg/da)	
					P ₂ O ₅	K ₂ O
Killi-tınlı	0.0105	8.24	0.7092	1.955	0.521	160.27

*Iğdır Üniversitesi Alum Toprak ve Su Analiz Laboratuvarı

Deneme Alanının İklim Özellikleri

Ağrı Doğubayazıt ilçesi yaz aylarına oranla kış aylarında daha fazla yağış alan bir yerdir (Karaoğlu, 2011). Denemenin yürütüldüğü 2019 yılında, yıllık ortalama sıcaklık 9.6 °C olarak uzun yıllar ortalamasından daha yüksek olduğu ve ortalama yağış miktarının da yıllık 592.1 mm ile uzun yıllar ortalamasından daha yüksek olduğu tespit edilmiştir (Şekil 1). Bitki vejetasyon döneminde saptanan ortalama aylık yağış değerlerinin uzun yıllar ortalamasının aynı aylarına ait değerlerinden yüksek olduğu saptanmıştır. Ortalama en fazla yağış miktarı 95.2 mm ile Mayıs ayında ve en yüksek sıcaklık değeri ise 23.1 °C Temmuz ayında görülmüştür (Şekil 1).



Şekil 1. Ağrı ilinin 2019 ve uzun yıllar (UY) ortalamalarına ait önemli bazı meteorolojik değerler *Ağrı Meteoroloji 12. Bölge müdürlüğü



Yöntem

Doğubayazıt koşullarında Tesadüf Bloklarında Bölünmüş Parseller deneme desenine göre üç tekerrürlü olarak 2019 yılında yürütülmüştür. Deneme faktörü olarak üç farklı aspir çeşidinin yanında Amonyum Sülfat (AS) gübresinin dört farklı (0, 10, 15 ve 20 kg/da) dozu kullanılmıştır. Ayrıca bütün parsellere dekara 10 kg TSP (%43 - 46) taban gübresi olarak ekimden hemen önce toprağa verilerek tırmıkla karıştırılmıştır. Amonyum sülfatın yarısı ekimle beraber ve diğer yarısı ise sapa kalkma döneminde uygulanmıştır. Deneme, çeşitler ana parsellere ve daha hassas incelenmek istenen azot dozları ise alt parsellere gelecek şekilde tasarlanmıştır. Her parsel 5m uzunluğunda ve 30 cm sıra aralığında 4 sıradan ibaret olup, parseller arasında 1 m, ana parseller ve bloklar arasında 2m aralık bırakılmıştır. Çalışmada, bitki boyu, ana sap kalınlığı, anadal sayısı (adet/bitki), ikincil dal sayısı (adet/bitki), bitki başına tabla sayısı (adet/bitki), tabla çapı (cm), bin tane ağırlığı (g), tohum verimi (kg/da), ham yağ oranı (%) ve ham protein oranı (%) gibi verim ve bazı kalite özellikleri incelenmiştir (Esental, 1981; Pahlavani, 2005).

Verilerin İstatistiksel Olarak Değerlendirilmesi

Deneme sonunda kaydedilen veriler Costat istatistik (v.6.3) programı yardımıyla varyans analizine tabi tutulmuş ve ortalamalar arasındaki farklılıkların tespiti ve değerlendirilmesinde ise LSD (%5) çoklu karşılaştırma testi uygulanmıştır.

BULGULAR VE TARTIŞMA

Bitki boyu

Çalışmada bitki boyu ortalama değerleri açısından çeşitler arasında ve uygulanan azot dozları arasında istatistiksel ($P>0.05$) olarak herhangi bir farkın olmadığı görülmüş ve kullanılan farklı çeşitlere ait bitki boyu değerlerinin 45.97 cm ve 47.86 cm arasında değişim gösterdiği ve azot dozları sonucu elde edilen bitki boyu ortalama değerlerinin ise 45.54 - 48.77 cm arasında değiştiği görülmüştür (Çizelge 2). Bu durum, çalışmanın uygulanan azotlu gübrenin etkinliğini azaltan kurak şartlarda yürütülmesinden kaynaklanmış olabilir. Çalışma sonuçlarının kuraklığın azot etkinliğini azalttığını bildiren Shahrokhnia and Sepaskhah (2017) ve aynı zamanda aspir bitkisinde bitki boyunu düşürdüğünü rapor eden Malambane et al. (2022) ve Joshan et al. (2019) sonuçları ile uyumlu olduğu tespit edilmiştir.



Ana sap kalınlığı

Çeşitlerin uygulanan azot dozlarına olan tepkileri arasında istatistiksel ($P>0.05$) olarak herhangi bir fark görülmemiş ve çeşitlerden elde edilen ana sap kalınlığı ortalama değerleri sırasıyla Ayaz 3.19, Dinçer 3.63 ve Balcı 4.29 mm olarak tespit edilmiştir (Çizelge 2). Çizelge 2'nin incelenmesinden anlaşılacağı üzere azot dozları arasında ana sap kalınlığı bakımından gözlemlenen farklılıkların istatistiksel olarak önemli ($P>0.05$) olmadığı tespit edilmiştir. Farklı oranlarda azot uygulaması sonucunda ana sap kalınlığı ortalama değerlerinin 3.54 - 4.13 mm arasında değişim gösterdiği görülmüştür. Bitki besin maddeleri, mahsullerin su kullanım verimliliği ile doğrudan ilişkili (Anicésio et al., 2018) olduğundan kurak koşullarda yürütülen çalışmada deneme yılında yetersiz yağış olduğundan uygulanan azotun etkinliği sınır kalmıştır.

Ana dal sayısı

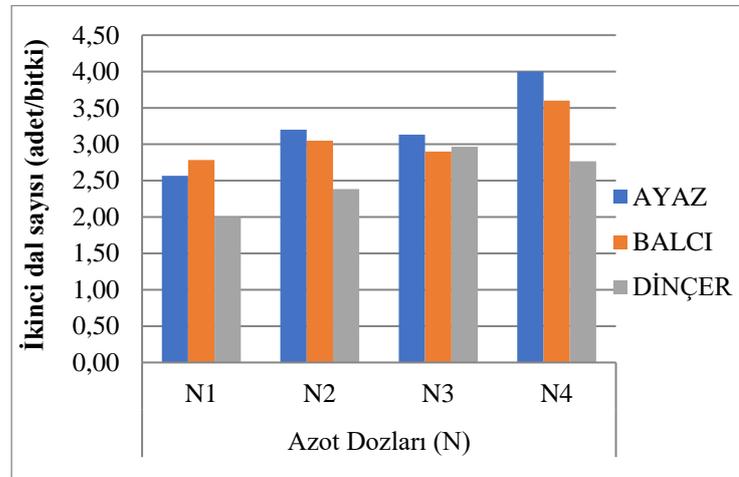
Çeşitlerin uygulanan azot dozlarına olan tepkileri arasında ana dal sayısı bakımından istatistiksel ($P>0.05$) olarak herhangi bir fark görülmemiş ve çeşitlere ait ortalama değerler sırasıyla Dinçer 4.66, Ayaz 6.28 ve Balcı 6.42 adet/bitki olarak tespit edilmiştir (Çizelge 2). Çizelge 2'nin incelenmesinden anlaşılacağı üzere azot dozları arasında ana dal sayısı bakımından gözlemlenen farklılıkların istatistiksel olarak önemli ($P>0.05$) olmadığı saptanmış ve farklı azot uygulamaları sonucunda ana dal sayısı ortalama değerlerinin 5.42 - 6.37 adet/bitki arasında değişim gösterdiği saptanmıştır. Genel olarak, nem noksanlığı, ürün büyümesi ve birincil dalların sayısı üzerinde olumsuz bir etki yaratarak potansiyel verimi düşürmektedir (Arshad et al., 2020). 2019 büyüme mevsiminin, bölgedeki yağmurla beslenen tarımsal mahsul üretimi için oldukça sıcak ve kurak geçtiği ve bu durumun uygulanan azotlu gübrenin de etkinliğini azalttığı görülmüştür. Polat (2007) ve Soleymani and Shahrajabian (2011) çalışma sonuçlarının aksine azot dozu artışının dal sayısını artırdığını bildirmişlerdir. Bu durumun çalışmanın azotun etkinliğini arttıran sulu koşullardan ve de genotipik farklılıktan kaynaklandığı düşünülmektedir.

İkincil dal sayısı

Çeşitlerin uygulanan azot dozlarına olan tepkileri arasında ikincil dal sayısı bakımından istatistiksel olarak çok önemli ($P<0.01$) farklılıkların olduğu ve en fazla ikincil dal sayısına Ayaz çeşidinin (3.23 adet/bitki) sahip olduğu görülürken, en az ikincil dal sayısına (2.53 adet/bitki) ise Dinçer çeşidinin sahip olduğu tespit edilmiştir. Bu farklılığın, genotipik yapılarından kaynaklı olduğu düşünülmektedir. Çizelge 2'de görüldüğü üzere azot dozları arasında ikincil dal sayısı bakımından gözlemlenen farklılıkların istatistiksel olarak çok önemli ($P<0.01$) olduğu ve en yüksek ikincil dal sayısı ortalama değerinin 3.46 adet/bitki ile dördüncü azot dozundan



alındığı, en düşük ise 2.45 adet/bitki ile kontrol uygulamasından alındığı saptanmıştır. Bu araştırmada azot dozundaki artışın ikincil dallanmayı olumlu yönde etkilediği görülmüş ve Polat (2007)'in azot miktarı artışının dal sayısını artırdığını belirten araştırma bulgularıyla uyumlu olduğu saptanmıştır. Çizelge 2’de ikincil dal sayısına etkileri bakımından çeşit × azot dozu interaksiyonunun istatistiksel olarak çok önemli ($P<0.01$) olduğu görülmüş ve çeşit x azot dozu interaksiyonlarına ait en yüksek ikincil dal ortalama değeri 4.00 adet/bitki ile Ayaz × 20 kg/da azot dozu interaksiyonundan alınırken, en düşük ise 2.00 adet/bitki ile Dinçer × 0 kg/da azot dozu interaksiyonu sonucunda tespit edilmiştir (Şekil 2).



Sekil 2. İkinci dal sayısı ortalama değerlerine ilişkin çeşit x azot dozu interaksiyonu

Tuncturk and Yildirim (2004), azotun vejetatif gelişmeyi arttırdığını ve çeşitlerin azot uygulamalarına farklı tepki gösterdiğini bu nedenle bitkilerdeki dal sayısının çeşitler bazında farklı arttığını bildirmişlerdir.

Bitki başına tabla sayısı

Çalışmada, bitki başına tabla sayısı bakımından çeşitler arasındaki farklılıklar istatistiksel olarak çok önemli ($P<0.01$) bulunmuş ve Ayaz ve Balcı çeşitlerinin (8.17 ve 7.90 adet/bitki) en fazla bitki başına tabla sayısına sahip olduğu görülürken, Dinçer çeşidinin ise en az bitki başına tabla sayısına (5.44 adet/bitki) sahip olduğu tespit edilmiştir (Çizelge 2). Çizelge 2’de görüldüğü gibi uygulanan azot dozları arasında bitki başına tabla sayısı açısından gözlemlenen farklılıkların istatistiksel olarak önemli ($P>0.05$) olmadığı görülmüş ve bitki başına tabla sayısı ortalama değerlerinin 6.69 - 7.47 adet/bitki arasında değişim gösterdiği tespit edilmiştir. Deneme sonuçları, yaptıkları çalışmada azot dozlarının tabla sayısında önemli bir artışa neden olmadığını bildiren Strasil and Vorlicek (2002) ve Tuncturk and Yildirim (2004)’in bulgularıyla uyumlu olduğu saptanmıştır.



Çizelge 2. İncelenen bazı özelliklere ait ortalamalar ve oluşan LSD grupları

ÇEŞİT***	Azot Dozları (N) *	Bitki boyu (cm)	Ana Sap kalınlığı (mm)	Ana dal sayısı (adet)	İkincil dal sayısı (adet)	Bitki başına tabla sayısı (adet)
Ayaz	N1	44.83	3.74	6.43	2.57 ef	7.80
	N2	45.43	3.56	6.43	3.20 c	7.83
	N3	46.67	3.60	6.07	3.13 c	8.60
	N4	47.37	3.61	6.20	4.00 a	8.45
	Ort.	46.08	3.63	6.28	3.23 A	8.17 A
Balcı	N1	46.37	3.70	6.00	2.78 c-f	7.38
	N2	46.47	3.82	5.90	3.05 cd	8.32
	N3	46.00	4.14	5.83	2.90 c-e	7.83
	N4	52.60	5.48	7.93	3.60 b	8.07
	Ort.	47.86	4.29	6.42	3.08 A	7.90 A
Dinçer	N1	48.27	3.54	4.67	2.00 g	4.90
	N2	44.73	3.02	4.63	2.38 fg	5.17
	N3	44.53	2.90	4.37	2.97 c-e	5.80
	N4	46.33	3.29	4.97	2.77 d-f	5.90
	Ort.	45.97	3.19	4.66	2.53 B	5.44 B
N dozu ort. **	N1	46.49	3.66	5.70	2.45 C	6.69
	N2	45.54	3.47	5.66	2.88 B	7.11
	N3	45.73	3.54	5.42	3.00 B	7.41
	N4	48.77	4.13	6.37	3.46 A	7.47
CV (%)		9.97	17.43	15.53	5.65	12.76
Çeşit LSD (%5)		Öd	Öd	Öd	0.19	1.09
Azot dozu LSD (%5)		Öd	Öd	Öd	0.16	Öd
Ç x N LSD (%5)		Öd	Öd	Öd	0.49	Öd

Öd: İstatistiksel olarak %5 düzeyinde önemli değil.

*Aynı sütunda aynı küçük harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir (P>0.05)

**Aynı sütunda ve aynı büyük kalın harfle gösterilen ortalamalar arasındaki fark istatistiksel (P>0.05) olarak önemli değildir.

***Aynı sütunda ve aynı büyük italik harfle gösterilen ortalamalar arasındaki fark istatistiksel (P>0.05) olarak önemli değildir.

Tabla çapı

Tabla çapı bakımından çeşitler arasında istatistiksel olarak çok önemli (P<0.01) farklılıkların olduğu saptanmış ve en büyük tabla çapına Dinçer çeşidinin (22.97 mm) sahip olduğu görülürken, Balcı çeşidinin ise en küçük tabla çapına (17.67 mm) sahip olduğu tespit edilmiştir (Çizelge 3). Çalışmada azot dozları arasında tabla çapı açısından gözlemlenen farklılıkların istatistiksel olarak önemli (P>0.05) olmadığı görülmüş ve tabla çapı ortalama değerlerinin 19.90 - 21.12 mm arasında değişim gösterdiği tespit edilmiştir (Çizelge 3). Araştırma sonuçları, sulu koşullarda yaptıkları çalışmada azot dozundaki artışa bağlı olarak tabla çapının arttığını bildiren Eryiğit et al. (2021)'nin sonuçlarıyla farklılık gösterdiği tespit edilmiştir. Bu değişikliğin sebebi kullanılan çeşitlerin ve yörenin ekolojik koşullarının farklılığından ve de denemelerinin azotun etkinliğini arttıran sulu koşullarda yapılmış olmasından kaynaklanmış olabilir. Deneme bulgularıyla uyumlu olarak Esendal (1981), uygulanan azot dozlarının tabla çapı üzerine etkisinin istatistikî olarak önemsiz olduğunu bildirmiştir.



Çizelge 3. İncelenen bazı özelliklere ait ortalamalar ve oluşan LSD grupları

ÇEŞİT***	Azot Dozları (N) *	Tabla çapı (mm)	Bin dane ağırlığı (g)	Tohum verimi (kg/da)	Ham yağ oranı (%)	Ham protein oranı (%)
Ayaz	N1	20.12	41.65	112.67 f	22.23	20.20
	N2	21.59	42.96	123.51 cd	22.31	20.69
	N3	22.23	42.05	136.36 a	22.25	21.33
	N4	21.92	42.35	134.71 a	22.52	21.04
	Ort.	21.47 B	42.25	126.81 A	22.33 C	20.82 A
Balcı	N1	17.04	42.82	121.01 c-e	34.91	20.05
	N2	17.37	43.24	129.39 b	36.03	20.20
	N3	18.16	44.43	125.18 bc	33.67	20.51
	N4	18.09	41.44	124.31 c	34.11	20.28
	Ort.	17.67 C	42.98	124.97 A	34.68 A	20.26 B
Dinçer	N1	22.55	42.33	97.17 g	25.44	19.53
	N2	23.54	44.50	116.94 ef	25.12	20.51
	N3	22.96	43.00	126.75 bc	25.08	20.13
	N4	22.82	44.10	118.82 d-f	25.18	19.84
	Ort.	22.97 A	43.48	114.92 B	25.20 B	20.00 C
N dozu ort. **	N1	19.90	42.27	110.28 C	27.53	19.93
	N2	20.84	43.57	123.28 B	27.82	20.47
	N3	21.12	43.16	129.43 A	27.00	20.66
	N4	20.94	42.63	125.94 B	27.27	20.39
CV (%)		5.34	2.97	2.27	2.27	2.27
Çeşit LSD ($\alpha<0.05$)		0.90	0.21	1.87	1.15	0.30
Azot dozu LSD ($\alpha<0.05$)		Öd	0.13	2.75	0.91	0.52
Ç x N LSD ($\alpha<0.05$)		Öd	0.38	8.24	2.74	1.56

Öd: İstatistiksel olarak %5 düzeyinde önemli değil.

* Aynı sütunda aynı küçük harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir ($P>0.05$)

** Aynı sütunda ve aynı büyük kalın harfle gösterilen ortalamalar arasındaki fark istatistiksel ($P>0.05$) olarak önemli değildir.

*** Aynı sütunda ve aynı büyük italik harfle gösterilen ortalamalar arasındaki fark istatistiksel ($P>0.05$) olarak önemli değildir.

Bin tane ağırlığı

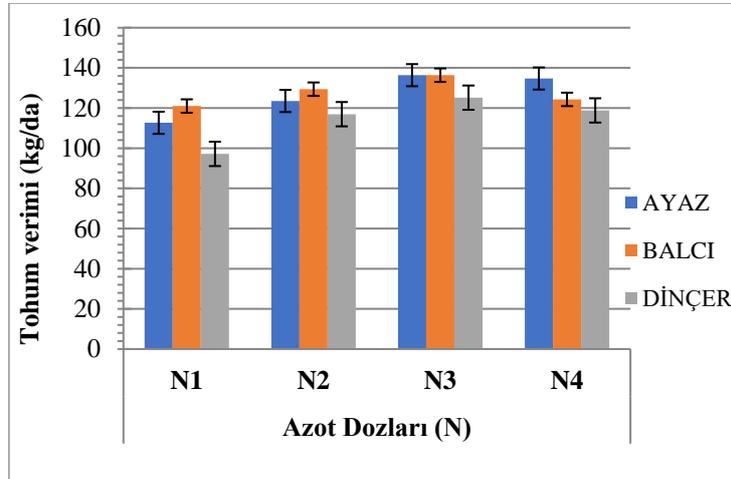
Çizelge 3'te görüldüğü üzere, bin tane ağırlığı ortalama değerleri açısından çeşitler arasında ve azot dozları arasında istatistiksel ($P>0.05$) olarak herhangi bir farkın olmadığı ve bin tane ağırlığı ortalama değerlerinin çeşitler bazında sırasıyla Ayaz 42.3g, Balcı 43.0g ve Dinçer 43.5g olarak tespit edilmiştir. Farklı oranlarda azot uygulaması neticesinde bin tane ağırlığı ortalama değerlerinin ise 42.3 - 43.6 g arasında değişim gösterdiği tespit edilmiştir. Çalışma bulgularıyla uyumlu olarak Soleymani and Shahrajabian (2011) ve Strasil and Vorlicek (2002) yaptıkları araştırmalarda azot dozlarının aspir bitkisinin bin tohum ağırlığı üzerinde önemli bir etkisinin olmadığını bulmuşlardır.

Tohum verimi

Yapılan çalışmada tohum verimi açısından çeşitler arasında istatistiksel olarak önemli ($P<0.05$) farklılıklar tespit edilmiş ve Ayaz ve Balcı çeşitlerinin (126.81 ve 124.97 kg/da) en yüksek tohum verimine sahip oldukları görülürken, Dinçer çeşidinin ise en düşük tohum verimine



(114.92 kg/da) sahip olduğu tespit edilmiştir (Çizelge 3). Çizelge 3'te görüldüğü gibi, azot dozları arasında tohum verimi bakımından gözlemlenen farklılıkların istatistiksel olarak çok önemli ($P<0.01$) olduğu saptanmış ve en yüksek tohum verimi ortalama değerinin 129.43 kg/da ile üçüncü azot dozundan, en düşük ise 110.28 kg/da ile birinci azot dozu uygulamasından alındığı saptanmıştır. Polat (2007), Dordas and Sioulas (2008) ve Malek and Ferri (2014) yaptıkları çalışmalarda tohum veriminin azot dozuna bağlı olarak bir seviyeye kadar arttığını sonra azalmaya başladığını bildirmişlerdir. Çizelge 3'te tohum verimine etkileri bakımından çeşit \times azot dozu interaksiyonunun istatistiksel olarak çok önemli ($P<0.01$) olduğu görülmüş en yüksek tohum verimi ortalama değerleri 134.71 ve 136.36 kg/da ile Ayaz \times 15 kg/da ve 20 kg/da azot dozlarının interaksiyonlarından alınırken, en düşük ise 97.17 kg/da ile Dinçer \times 0 kg/da azot dozu interaksiyonu sonucunda tespit edilmiştir (Şekil 3). Azot, kuru alanlarda tarımsal üretimde ana toprak sınırlayıcı faktördür, çünkü bu besin maddesinin miktarı genellikle maksimum bitki üretimi için gerekli olandan daha azdır (Malek & Ferri, 2014). Azot dozunun artışına bağlı olarak tohum veriminin artması bu elementin bitki gelişmesiyle olan olumlu ilişkisinin bir sonucu olabilir.



Şekil 3. Çeşitlerin tohum verimi ortalama değerlerine ilişkin çeşit \times azot interaksiyonu

Ham yağ oranı

Çalışmada, ham yağ oranı bakımından çeşitler arasında istatistiksel olarak çok önemli ($P<0.01$) farklılıkların olduğu saptanmış ve Balcı çeşidinin (%34.68) en yüksek ham yağ oranına sahip olduğu görülürken, Ayaz çeşidinin ise en düşük ham yağ oranına (%22.33) sahip olduğu tespit edilmiştir (Çizelge 3). Meydana gelen bu farklılığın genotipik farklılıktan kaynaklandığı düşünülmektedir. Çizelge 5'te görüldüğü gibi azot dozları arasında ham yağ oranı açısından



gözlemlenen farklılıkların istatistiki olarak önemli ($P>0.05$) olmadığı ve ham yağ oranı ortalama değerlerinin % 27.00 - 27.82 arasında değişim gösterdiği tespit edilmiştir.

Ham protein oranı

Çalışmada, ham protein oranı bakımından çeşitlerin arasında istatistiksel olarak çok önemli ($P<0.01$) farklılıkların olduğu saptanmış ve Ayaz çeşidinin (%20.82) en yüksek ham protein oranına sahip olduğu görülürken, Dinçer çeşidinin ise en düşük ham protein oranına (%20.00) sahip olduğu tespit edilmiştir (Çizelge 3). Çeşitlerin arasındaki bu farkın genotipik yapılarından kaynaklandığı söylenebilir. Çizelge 3'te görüldüğü gibi azot dozları arasında ham protein oranı açısından gözlemlenen farklılıkların istatistiki olarak önemli ($P>0.05$) olmadığı görülmüş ve farklı oranlarda azot uygulaması neticesinde elde edilen ham protein oranı ortalama değerlerinin % 19.93 - 20.66 arasında değişim gösterdiği tespit edilmiştir. Azot bütün bitkilerin yapısal bileşeni olarak kabul edilen proteinin önemli yapıtaşıdır (Polat, 2007). Bundan dolayı bitkilerin azota tepkisi, protein ve amino grubu asitlerin yapısında yer almasıyla protein oluşumunu artırmaktadır (Esendal, 1981). Azot uygulamalarının aspir bitkisinin protein oranını artırdığı Dordas and Sioulas (2008) tarafından yapılan çalışmada belirtilmiştir. Ancak bu çalışmada kuraklıktan kaynaklı olarak azotun etkinliğinin sınırlı kaldığı düşünülmektedir.

SONUÇ

Farklı aspir çeşitlerine kuru koşullarda uygulanan azot dozlarının, ikincil dal sayısı ve tohum verimi hariç, diğer incelenen özellikler üzerine olan etkisi önemli bulunmamıştır. Azot dozu artışına bağlı olarak ikincil dal sayısı ve tohum verimi değerlerinde dekara 15 kg azot uygulamasına kadar düzenli bir artış görülmüş ve azot dozunun 20 kg/da'a çıkarıldığı uygulamada azalma eğilimi göstermiştir. Bu araştırmaya göre Ağrı Doğubayazıt ikliminin kuru koşullarında aspir yetiştiriciliğinde 15 kg/da azot dozunun ekonomik olacağı sonucuna varılmıştır. Oldukça kurak geçen deneme yılında bölgede aspir bitkisi yetiştiriciliği için daha sağlıklı azotlu gübre miktarı önerilebilmesi için bu tür çalışmaların birkaç yıl tekrarlanması gerektiği sonucuna varılmıştır.



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FARKLI UYGULAMALARIN VE STRES KOŞULLARININ MEYVELERDE ANTIOKSİDAN KAPASİTEYE ETKİSİ

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ÖZET

Dünya’da son yıllarda görsel ve yazılı medyada meyve ve sebzelerin içerdiği ve insan sağlığına önemli pozitif katkı sağlayan spesifik fitokimyasalların etkileri (antioksidan etki) yoğun bir şekilde dile getirilmektedir. İnsan vücudunda sindirim olayları sonrasında ortaya çıkan, kısa ömürlü fakat olumsuz etkisi fazla olan tekli oksijen (O_2), süperoksit anyonu (O_2^-), hidroksi ($\cdot OH$), peroksi ($ROO\cdot$) ve alkoksi ($RO\cdot$) en bilindik serbest radikal molekülleri başta kanser olmak üzere, kalp hastalıkları, akciğer hastalıkları ve katarakta neden olmaktadır. Antioksidanlar serbest radikallerin sebep olduğu reaksiyonu durdurarak insan sağlığına zararlı etkileri engellerler. İnsan sağlığı ile meyvelerin antioksidan içerikleri arasındaki ilişkinin önemi anlaşılmış, antioksidan kapasiteleri meyvelerin kalite kriterleri arasına girmiş ve bunun üzerine çok sayıda bilimsel çalışma yürütülmüştür. Bu çalışmalar antioksidanların kanser, kalp hastalıkları, göz hastalıkları ve Alzheimer gibi hastalıkları engellediğini göstermiştir. Yapılan bilimsel çalışmalarda bitkilerin arazi koşullarında maruz bırakıldıkları çevresel ve stres faktörlerinin veya kontrollü şartlarda uygulanan farklı kimyasal ve yetiştirme tekniklerinin antioksidan kapasiteyi arttırdığı belirlenmiştir.

Anahtar Kelimeler: Antioksidan kapasite, meyve, stres faktörü, kimyasal uygulamalar



STRESS CONDITIONS AND EFFECT OF DIFFERENT APPLICATIONS ON ANTIOXIDANT CAPACITY IN FRUITS

ABSTRACT

In recent years, the effects of specific phytochemicals contained in fruits and vegetables in the visual and written media in the world have been expressed intensively and their positive effects on human health are detected by antioxidant capacity determination. Singlet oxygen (O_2), superoxide anion (O_2^-), hydroxy ($\cdot OH$), peroxy ($ROO\cdot$) and alkoxy ($RO\cdot$), which occur after digestion events in the human body, causes many diseases such as cancer, heart diseases, lung diseases and cataract. Antioxidants prevent harmful effects on human health by stopping the reaction caused by free radicals. The importance of the relationship between human health and antioxidant contents of fruits has been understood. Antioxidant capacities have been among the quality criteria of fruits, and a large number of scientific studies have been carried out on this subject. These studies have shown that antioxidants prevent such as cancer, heart disease, cataracts, eye diseases and Alzheimer. In the scientific studies, it was determined that the environmental and stress factors or the different chemicals and growing techniques applied under controlled conditions have increased the phenolic content and antioxidant capacity of the plants.

Keywords: Antioxidant capacity, fruit, stress factor, chemical applications



1. GİRİŞ

Tüketilen gıdalarla insan yaşamı için gerekli olan protein, karbonhidrat, yağ, vitamin ve mineraller vücuda alındıktan sonra sindirim olaylarından geçerek vücut için yararlı hale gelirler. Sindirim olayı sonrasında kısa ömürlü, fakat olumsuz etkisi fazla olan serbest radikal olarak da isimlendirilen bazı moleküller açığa çıkmaktadırlar. Tekli oksijen (O_2), süperoksit anyonu (O_2^-), hidroksi ($\cdot OH$), peroksi ($ROO\cdot$) ve alkoksi ($RO\cdot$) gibi en bilindik serbest radikal molekülleri kanser, kalp hastalıkları, akciğer hastalıkları, katarakt gibi pek çok hastalığa ve insan vücudunun hızlı bir şekilde hücre yaşlanmasına neden olmaktadır (Kaur ve Kapoor, 2001; Rahmani vd., 2022). Serbest radikaller sadece alınan besin maddelerinin sindirimi sonucu açığa çıkmaz, vücut dışından da direkt gelebilmektedir. Canlı hücrelerdeki oksijen metabolizması, radyasyon, çevre kirlenme etmenleri, pestisitler, sigara dumanı, çeşitli tıbbi tedavi yöntemleri ve kirli sular gibi birçok etmen kaçınılmaz bir şekilde oksijen türevi serbest radikallerin oluşumuna yol açmaktadır. Ancak vücutta zarar oluşturabilecek moleküllere karşı vücut kendi savunma mekanizmasını geliştirmiştir (Alpkent ve Demir, 2006). Serbest radikallerin sebep olduğu oksidatif zararı önleyen, serbest radikalleri yakalama ve stabilize etme yeteneğine sahip olan maddelere “antioksidan” adı verilmektedir (Elliot, 1999; Sengul vd., 2009).

Antioksidanlar fonksiyonlarına göre iki gruba ayrılmaktadırlar, bunlar birincil ve ikincil antioksidanlardır. Süperoksit dismutaz (SOD), glutatyon peroksidaz (GSHPx) ve katalaz gibi enzim sistemleri birincil antioksidanlar grubunu oluştururlar. Bu gruptaki antioksidanlar serbest radikalleri yok etme yeteneğindedir. Birincil antioksidanlar serbest radikallerle tepkimeye girerler ve onların daha zararlı bir forma dönüşmelerini engellerler (Diplock, 1998). İkincil antioksidanlar ise E vitamini, ürik asit, C vitamini, bilirubin ve polifenoller gibi bileşiklerdir. Bunlar oksijen radikalini yakalayarak radikal zincir reaksiyonlarını kırarlar (Gana vd., 2022; Spiegel vd., 2022; Ou vd., 2002). Canlı dokularda oksidatif strese neden olan başlıca etmenler şunlardır: Sigara dumanı, ağır egzersiz, çevre kirlenimci, ateşli hastalıklar ve radyasyon. Oksidatif stresin zararlı etkilerini azaltabilen ve antioksidan savunma mekanizması oluşturan bazı etmenler ise şunlardır: Süperoksit dismutaz, katalaz, glutatyon peroksidaz, glutatyon, selenyum, ürik asit, E vitamini, C vitamini, β -karoten ve diğer karotenoidler (Diplock, 1998; Spiegel vd., 2022). Vitamin E (tokoferoller) yağda çözünebilir, antioksidan özellik gösteren, hücre membranının yapısına katılan ve çoklu doymamış yağ asitlerinin okside olmasını önleyen bir bileşiktir. Yapılan bir çalışmada yüksek dozda β -karoten ve vitamin E verilen insanların LDL (Low Density Lipoprotein) düzeylerindeki değişim incelenmiştir. Yüksek dozlu E



vitamini diyetinin insanlarda LDL'yi arttırdığı ve oksidatif strese karşı koruma sağlandığı fakat β -karotenin etki etmediği belirtilmiştir (Reaven vd., 1993; Li vd., 2022). Bir antioksidan olarak C vitamini O_2^- , H_2O_2 , O_3 , NO_2 , ve HOCL gibi serbest radikalleri etkisiz hale getirir. Hücrelerin DNA'sını serbest radikallerin ve mutajenlerin etkilerinden korur (Iqbal vd., 2004; Sarker vd., 2022).

Vücutta bulunan antioksidan maddelerin içeriği büyük ölçüde beslenmeye bağlıdır. Besin yetersizlikleri durumunda vücudun savunma mekanizması zayıflar, patolojik etmenler ve oksidatif stres dokularda zarara neden olabilir. Vücudun antioksidan savunma mekanizmasının etkinliği tokoferoller ve askorbik asit gibi antioksidan etki gösteren vitaminler ve iz mineralleri içeren gıdaların tüketilmesiyle artmaktadır (Duthie vd., 1989; Matsunaga vd., 2021). Meyve ve sebze tüketilerek daha sağlıklı bir yaşam sürdürülebileceği son 20 yıldır bilim dünyasında bilinen bir gerçektir. Bu gerçeğin temeli meyve ve sebzelerin içerdikleri antioksidan maddelerin serbest radikal moleküllerini süpürücü etkisine dayanmaktadır. Meyve ve sebzelerin içerdiği antioksidan maddelerin serbest radikalleri süpürücü etkisi antioksidan kapasite tayin metotları ile saptanmaktadır. Bu metotlardan en çok kullanılanları FRAP (Ferric Reducing Antioxidant Power), TEAC (Trolox Equivalent Antioxidant Capacity) ve DPPH (2,2-diphenyl-1-picrylhydrazyl)'dır (Huang vd., 2005; Sariburun vd., 2010).

Laboratuvar çalışmalarında meyvelerin insan sağlığı üzerine olumlu etkilerinin meyvelerin içerdikleri çok sayıda fitokimyasallardan ileri geldiği tespit edilmiştir ve bunların birbirleri üzerine sinerjistik etki yaptıkları da görülmüştür. Bu maddelerden özellikle askorbik asit, flavonoidler, karotenoidler oldukça güçlü antioksidan özelliklerine sahiptirler (Liu, 2003). Meyve ve sebze tüketimi ile farklı kanser türleri arasındaki ilişki araştırılmış ve 156 beslenme programının 128'inde meyve ve sebze tüketiminin kansere karşı koruyucu etkisi olduğu bildirilmiştir. Yüksek miktarda meyve ve sebze tüketimi olan insanların kansere yakalanma riski, düşük tüketime sahip olanlara göre iki kat daha düşük olduğu saptanmıştır. Meyve ve sebze tüketiminin akciğer kanseri üzerine etkisini incelemek için çoğunlukla sigara içen 25 kişide araştırma yapılmıştır. Bu tüketim alışkanlığı 25 kişinin 24'ünde kansere karşı önemli koruma sağlamıştır. Kalın bağırsak kanseri ve mesane kanserleri üzerine yapılan 38 çalışmanın 23'ünde, pankreas ve midenin kanserleri üzerine yapılan 30 çalışmanın 26'sında meyve ve sebze tüketiminin koruyucu bir etkisi olduğuna dair güçlü kanıtlar mevcuttur (Block vd., 1992).

Meyve ve sebze tüketiminin insan sağlığını olumlu yönde etkileme gerçeği bilim insanlarınca kabul görmüş ve bu olumlu etkinin daha çok nasıl artırılabilirliği konusu da agronomistler tarafından yeni bir çalışma alanı olmuştur. İnsan sağlığı ile meyvelerin antioksidan içerikleri



arasındaki ilişkinin önemi anlaşılmıştır. Pomolojik kriterlere ek olarak antioksidan kapasiteleri meyvelerin kalite kriterleri arasına girmiş ve bunun üzerine çok sayıda bilimsel çalışma yürütülmüştür. Özel ıslah çalışmalarında da fitokimyasal içeriği yüksek çeşitler elde edilmeye çalışılmaktadır. Yapılan bilimsel çalışmalarda bitkilerin arazi koşullarında maruz bırakıldıkları çevresel ve stres faktörlerinin veya kontrollü şartlarda uygulanan farklı kimyasalların ve yetiştirme tekniklerinin fenolik madde içeriğini ve antioksidan kapasiteyi arttırdığı tespit edilmiştir.

2. Gelişme

2.1. Yabani ve kültür formu meyvelerin fitokimyasal özellikler yönüyle çeşitliliği

Türkiye’de Çoruh Vadisi’nde bulunan 24 incir genotipi ve 2 standart incir çeşidinin (Sarılöp ve Bursa Siyahı) meyvelerinin antioksidan kapasiteleri incelenmek üzere bir araştırma yapılmıştır. Genotiplerin meyvelerinin renkleri açık yeşilden siyaha kadar değişkenlik göstermiştir. Genellikle meyve rengi koyu olan genotiplerin antioksidan kapasiteleri açık renklilere göre daha yüksek bulunmuş ve bunun yanında standart çeşitlerin antioksidan kapasiteleri çoğu genotipin antioksidan kapasitelerinden daha düşük bulunmuştur (Ercisli vd., 2012).

Türkiye’de Çoruh Vadisi’nde bulunan 25 farklı zerdali genotipi ve 2 standart kayısı çeşitleri (Şalak ve Abul) pomolojik ve fitokimyasal özellikler yönüyle incelenmiştir. Zerdali genotiplerinin pomolojik özellikleri standart çeşitlerden düşük bulunmuş fakat tüm genotiplerin antioksidan kapasiteleri kayısı çeşitlerinden daha üstün oldukları saptanmıştır (Sagbas, 2016). Çin’de *Malus spp.* türlerinde bulunan polifenolik bileşiklerin varyasyonu üzerine 103 *Malus* genotipinde HPLC ve spektrofotometre cihazları kullanılarak analizler yapılmıştır. Çin’in kuzey bölgelerinden yapay seleksiyonla elde edilmiş olan yerel çeşitlerin polifenolik bileşiklerce zengin olduğu tespit edilmiş ve bunların sofralık elma çeşidi ıslah programlarında ebeveyn olarak kullanılabileceği belirtilmiştir (Wang vd., 2018).

Polonya’da 3 adet yabani formu ve Amerikan Maviyemişi olarak isimlendirilen 1 adet kültür formu maviyemiş arasındaki mineral madde (Al, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, ve Zn elementleri) içerikleri arasındaki farklılıklar incelenmiştir. Yabani formu maviyemişlerin Ca, Na, Mg, Mn ve Zn element içerikleri kültür formu maviyemiş’ten daha yüksek bulunmuştur. Ancak Cu, Cr, Fe ve Ni element düzeyleri her iki grupta da benzer düzeyde olduğu saptanmıştır (Drózdź vd., 2018).

Türkiye’de Çoruh Vadisi’nden alınan tohumdan çoğaltılmış maviyemiş genotipleri fitokimyasal karakterler bakımından birbirleriyle kıyaslanmıştır. Araştırmada C vitamini, toplam fenolikler, toplam antosiyanin içeriği ve antioksidan aktivite analizleri yapılmıştır.



Antioksidan aktivite analizinde FRAP metodu kullanılmıştır. Yabani maviyemişlerin toplam fenolikleri, toplam antosiyanin içerikleri ve antioksidan kapasiteleri yüksek bulunmuştur (Celik vd., 2018).

Yabani meyvelerin sahip olduğu yüksek biyoçeşitliliğini göstermek amacıyla Çoruh Vadisi'nde bulunan yabani kızamık bitkileri (*Berberis vulgaris* L.) üzerinde bir araştırma yapılmıştır. Araştırmada bitkilerin morfolojik ve biyokimyasal karakterleri incelenmiş ve biyokimyasal karakterler açısından büyük çeşitlilik olduğu görülmüştür. Toplam fenolik (2281-3462 mg GAE/L) ve antosiyanin içeriği (360-874 mg cyanidin-3-glucoside/L) genotipler arasında büyük farklılık ortaya koymuştur (Ersoy vd., 2018).

Aronya fonksiyonel gıda özelliğine sahip bir meyve türüdür. *Aronia mitschurinii* türüne ait ticari çeşitlerin görünüşü, meyvelerinin biyokimyasal içeriği ve arazideki performansı benzerlik göstermektedir. Bunun sebebi *Aronia mitschurinii* 'nin 1800lerin sonunda Rusya'da ıslah yoluyla elde edilmiş ve apogami göstermesidir (Skvortsov ve Maitulina, 1982; Skvortsov vd., 1983). Toplam fenolik, antosiyanin ve antioksidant aktivite analizleri koyu renkli meyvelere sahip olan yabani ve kültür formlu aronya' da (*A. melanocarpa*, *A. prunifolia* ve *A. mitschurinii*) yapılmıştır. En yüksek toplam fenoliğe *A. prunifolia*, en yüksek antioksidant ve antosiyanin içeriğine *A. melanocarpa* sahip olmuştur. Yıllara göre yabani aronyalarda polifenolik maddelerin içeriği farklılık göstermiş ve yabani genotiplerde önemli derecede fitokimyasal çeşitlilik ortaya çıkmıştır (Brand vd., 2017).

2.2. Aşılamanın meyvedeki fitokimyasallar üzerine etkisi

Meyve türlerinde aşılama en üstün çoğaltım metotlarından birisidir. Aşılama yapılarak bitki büyüklüğü kontrol altına alınır, gençlik kısırlığı periyodu kısaltılır, toprak kaynaklı hastalık, zararlı ve stres koşullarına karşı adaptasyon sağlanmış olur (Atucha vd., 2014; Machado vd., 2013). Genellikle meyveler tohumla çoğaltılmazlar. Çünkü çoğu meyve türü yabancı tozlaştığı için tohumla çoğaltımda genetik açılım görülmektedir. Bu durum yabani meyvelerin içerdiği fitokimyasalların varyasyonunun kaynağını oluşturur. Ekonomik meyve yetiştiriciliğinde ana çeşidin aynı özelliklerini taşıyan fidanlar elde edebilmek için aşılama olmazsa olmaz bir tekniktir (Barut, 2014). Son yıllarda yapılan araştırmalara göre aşılamanın meyvedeki fitokimyasalları önemli derecede etkilediği belirtilmiştir.

Passiflora (*Passiflora spp.*) meyvesi fonksiyonel gıda olarak değerlendirilmekte ve besin değeri üzerine birçok çalışma yapılmaktadır. Yabani passiflora anaçlarına aşılamanın çeşitlerdeki fitokimyasalların değişimi üzerine bir çalışma yapılmıştır. Çalışmada tohumdan yetişmiş ve farklı türlere aşılamanın çeşitler kontrol grubu olarak değerlendirilmiştir. *Passiflora gibertii* ve



Passiflora mucronata türleri yabani anaç; *Passiflora edulis*, *P.flavicarpa* çeşit olarak kullanılmıştır. *P. edulis*/*P. giberti* kombinasyonunda β -karoten içeriği ile meyve suyu rengi arasında önemli derecede korelasyon bulunmuştur. Üstün özellikli yabani passiflora anaçlarının üzerine aşılanan çeşitlerde ticari değerin korunduğu ve fitokimyasal özelliklere ise pozitif etki yaptığı belirtilmiştir (Salazar vd., 2016).

Sırbistan’da Çakal Eriği (*P. Spinosa*) ve Myrobalan anaçları üzerine aşılanan 5 kayısı çeşitinde (Roxana, Aleksandar, Biljana, Vera ve Harcot) vejetatif karakterler ve meyvelerin antioksidan kapasiteleri incelenmiştir. Myrobalan anaçları üzerine aşılanan çeşitlerin antioksidan kapasiteleri, ağaç büyüme kuvvetleri ve ağaç başı verimi artmıştır. Myrobalan anaç/Roxana kombinasyonunda toplam antioksidan aktivite en yüksek bulunmuş fakat Roxana çeşidinin her iki kombinasyonunda da toplam fenolik ve toplam flavonoid içeriği diğer dört çeşitten daha düşük olduğu tespit edilmiştir (Milošević vd., 2015).

İspanyada aşılamanın portakaldaki etkisini göstermek üzere FA5, FA13, FA41 (3 yapraklı x mandarin melezi), Alemow anaç (*Citrus macrophylla*), Cleopatra mandarini (*Citrus reshni*), Carrizo sitranjı üzerine aşılı Lane Late Navel portakalında bir araştırma yapılmıştır. Alemow anaç ve Carrizo sitranjı üzerine aşılı çeşidin toplam fenolikleri ve antioksidan kapasiteleri en düşük düzeyde kalmış, fakat Cleopatra mandarini, FA5 ve FA13 anaçlarını üzerine aşılananların toplam fenolik ve antioksidan kapasite değerleri en yüksek düzeyde olduğu ortaya çıkmıştır (Hervalejo vd., 2015).

2.3. Stres koşullarının meyvedeki antioksidan kapasiteye etkisi

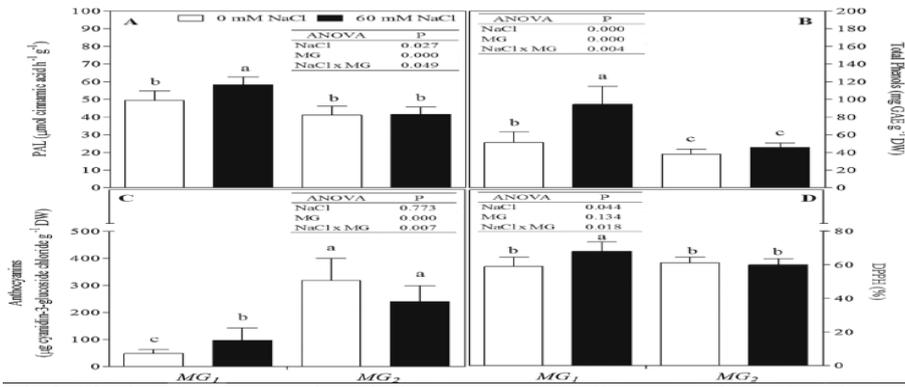
Yabani böğürtlen meyveleri, kültür böğürtlenleriyle kıyaslandığında, yüksek biyoaktivite içeriğinin olduğu tespit edilmiştir (Reyes-Carmona vd., 2005). Bunun sebebi yabani bitkilerin maruz kaldığı ekstrem sıcaklıklar, hastalık ve zararlı etmenlerine karşı savunma mekanizmasının bitkide polifenolik enzimlerin sentezini tetiklemesidir. Fenolik bileşikler stres koşullarında bitkinin savunma mekanizmasını oluştururlar (Anttonen ve Karjalainen, 2005).

‘Fuji’ elma çeşidi 6 farklı elma anacına (M26, M9-T337, CG24, SH1, SH6 ve SH40) aşılanarak kuraklık stresi durumunda antioksidan enzimlerin değişimi, gövde büyümesi, fotosentez aktivitesi, yapraktaki su içeriği incelenmiştir. 50 günlük gözlemin sonunda en dayanıklı anaçların sırasıyla SH6 >SH40>SH1>M9-T337> M26 > CG24 olduğu belirtilmiştir. Süperoksit dismutaz (SOD), askorbat peroksidaz (APX), dehidroaskorbat redüktaz (DHAR) enzimlerinin kuraklık stresinden sorumlu enzimler oldukları belirlenmiştir (Li vd., 2017).

Zeytinde tuz stresinin etkilerini araştırmak amacıyla tuza hassas olan Leccino çeşidinde bir çalışma yürütülmüştür. Dört yaşlı ve saksıda bulunan zeytin bitkilerine tuz uygulaması meyve



çekirdeğinin sertleşmeye başlaması ve meyveye ben düşmesi dönemi arasında 49 gün boyunca devam etmiştir. Meyvenin olgunlaşma dönemine göre uygulamanın sonuçları değerlendirilmiş ve bitkiler iki gruba ayrılmıştır. Birinci grup (MG₁): meyve kabuğundaki mor rengin %50 'den daha az olan gruptur. İkinci grup (MG₂): meyve kabuğundaki mor rengin %50 'den daha fazla olan gruptur. Kontrol grubuyla kıyaslandığında MG₁ grubunun toplam fenol içeriği %58 artmıştır. Antioksidan aktivite tayininde DPPH metodu kullanılmıştır ve MG₁ grubunun antioksidan aktivitesi kontrol grubuna göre %15 artmıştır (Şekil 1) (Moretti vd., 2018). 60 mM tuz uygulanan zeytinlerde sinamik asit ve toplam fenol konsantrasyonları ve DPPH etkisi MG₁'de MG₂'ye göre yüksek olduğu belirtilmiştir. Fakat olgunlaşma dönemi ilerledikçe meyvenin kabuğun mor rengi ve meyvenin antosiyanin konsantrasyonunun arttığı belirlenmiştir. Bu yüzden MG₂ 'deki antosiyanin konsantrasyonu MG₁ 'e göre daha yüksek bulunmuştur (Şekil 1).



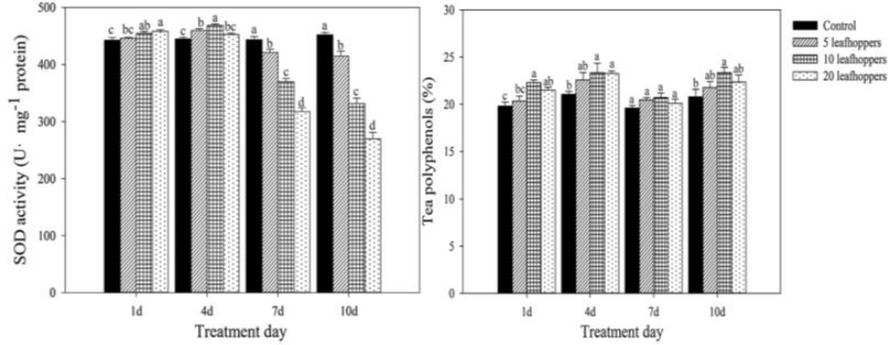
Şekil 1. Zeytinde farklı olgunlaşma zamanlarında (MG₁ ve MG₂) 0-60 mM NaCl uygulamalarının sinamik asit, toplam fenol, antosiyanin ve DPPH düzeylerine etkileri (Moretti vd., 2018)

Çay (*Camellia sinensis*) yaprağında %20-30 civarında bulunan fenolik maddeler çayın kalitesini (çayın rengini ve tadını) belirlemede ana faktördür. Aralarında kateşin, fenolik asit ve siyanidin gibi 30 farklı fenolik madde çayda bulunmaktadır ve bunlar antioksidan aktiviteye sahiptir (Wang ve Kang, 2007; Xu vd., 2007; Rui, 2008).

Çay (*Camellia sinensis*) plantasyonlarında ciddi yaprak zararına neden olan *Empoasca vitis* (Hemiptera: Cicadellidae) zararlısının bitki bünyesinde bulunan antioksidan aktiviteye etkisi araştırılmıştır. 2 yaşındaki saksıda yetiştirilen hiç pestisit uygulanmamış çay bitkilerin her sürgününde en uçta bulunan 3 yaprakta zararlıların sayılarına bakılmıştır. SOD aktivitesine yaprak zararlısına 1 günde olumlu etki yaptığı, 4 günde herhangi bir etkiye sahip olmadığı, daha sonraki günlerde olumsuz etki yaptığı görülmüştür (Şekil 2). Yaprak zararlısının çay fenoliklerini dördüncü güne kadar olumlu etkilediği fakat daha sonraki günlerde olumsuz

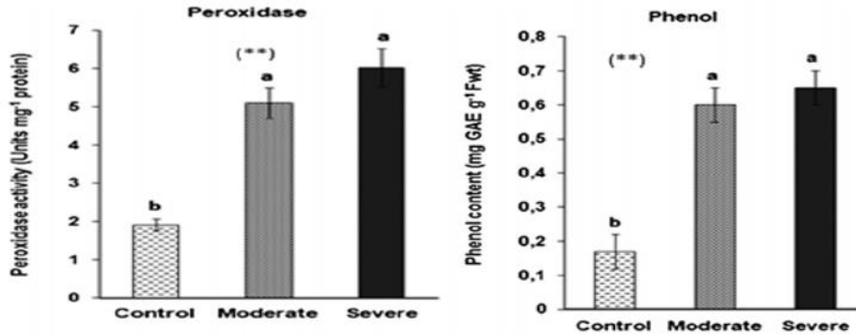


etkilediği belirtilmiştir. Buna ek olarak bütün günlerde yaprak zararlısının sayısının fazlalığı çay fenoliklerini sürekli arttırdığı ifade edilmiştir (Şekil 2) (Li vd., 2018).



Şekil 2. Çay (*Camellia sinensis*) yaprağında bulunan farklı yoğunluktaki (0-5-10-20 adet) *Empoasca vitis* zararlısının farklı günlere göre SOD aktivitesi ve çay fenoliklerine etkisi (Li vd., 2018)

Su stresine maruz bırakılan Myrobolan 29 C erik anacındaki fitokimyasal değişiklikleri gözlemek için bir araştırma yapılmıştır. 3 farklı uygulama grubu oluşturulmuştur (saksı kapasitesinin %100'ü kontrol, %75'i orta, %50'si şiddetli grup). 15 lt 'lik saksıda bulunan Myrobolan 29 C anaçlarının tümü gözlemlerin başlayacağı döneme kadar aynı düzeyde sulanmıştır. Uygulama temmuz ortası-dormant periyod başlangıcı arasında yapılmıştır. Su stresine maruz kalan anaçlarda peroksidaz aktivite ve fenol içeriği artmıştır. Antosiyanin içeriği ise orta grupta (%75) en yüksek bulunmuştur (Şekil 3) (Bolat vd., 2016).



Şekil 3. Myrobolan 29 C anacındaki farklı seviyelerdeki su stresi uygulamasının peroksidaz aktivitesi ve fenol içeriğine etkisi (Bolat vd., 2016)

2.4. Farklı uygulamaların meyvelerde antioksidan kapasiteye etkisi

Kuersetin ve kaempferol 3-glukozit gibi flavanoller antioksidan aktivite gösterir ve özellikle üzümü meyvelerin insan sağlığını serbest radikallere karşı koruyucu etkileri üzerine önemli rol oynarlar (Hubbard vd., 2003; Knekt vd., 2002). Özellikle kuarsetin güçlü bir antioksidandır (Makris ve Rossiter, 2001).



CO₂ konsantrasyonunun çilek bitkisinde (*Fragaria x ananassa* Duch.) antioksidan aktiviteye etkisini incelemek üzere bir araştırma yürütülmüştür. Açıkta yetiştirilen çilek bitkilerine 300 ve 600 $\mu\text{mol mol}^{-1}$ CO₂ uygulaması yapılmıştır. Yüksek orandaki CO₂ konsantrasyonu antosiyanini, fenolikleri, askorbit asiti (AsA), glutasyonu (GSH), askorbik asit/dehidroaskorbik asit (DHAsA) oranını, dehidroflavanolu, kuarsetin 3-glukoziti, kaempferol 3-glukozit içeriğini arttırdığı belirtilmiştir (Çizelge 1) (Wang vd., 2003).

Çizelge 1. Farklı konsantrasyonlarda CO₂ uygulamasının çilek meyvesindeki askorbit asit(AsA), glutasyonu (GSH), dehidroaskorbik asit (DHAsA) içeriğine etkisi (Wang vd., 2003)

CO ₂ treatment ($\mu\text{mol mol}^{-1}$)	($\mu\text{mol/g dry weight}$)		(nmol/g dry weight)	
	AsA	DHAsA	GSH	GSSG
ambient (350)	32.3 ± 1.3	6.0 ± 1.2	745.2 ± 7.3	160.0 ± 2.4
ambient +300	35.6 ± 0.4	3.8 ± 0.3	768.0 ± 8.8	164.9 ± 2.1
ambient +600	36.6 ± 0.4	3.1 ± 0.2	2019.9 ± 22.9	210.6 ± 18.2
LSD _{0,05}	0.42	0.35	18.7	46.8
significance ^b	sig	sig	sig	ns

^a Data expressed as mean ± SEM ($n = 12$). ^b sig = significant, ns = nonsignificant at $p \leq 0.05$.

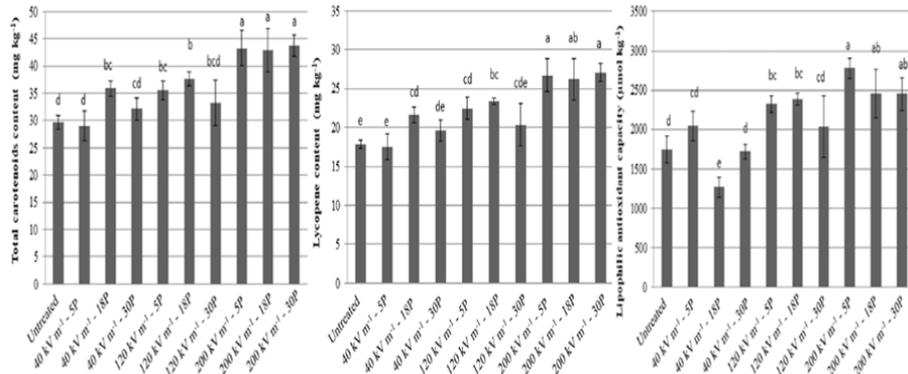
Ellajik asit bazı kanser tiplerine karşı potansiyel koruyucu etkiye sahip biyoaktif bir bileşiktir ve antioksidan aktivite gösterir (Maas vd., 1991; Stoner ve Morse, 1997; Mullen vd., 2002). Ahududu'da (*Rubus idaeus* L.) çevresel faktörler ve genetik çeşitliliğin biyoaktiviteye etkisi incelenmiştir. Kuersetin içeriği Balder çeşidinde 0,32-1,55 mg/100 g yaş meyve aralığında bulunmuştur. Ellajik asit en düşük 38 mg /100 g taze ağırlık ile Gatineau ve Nova çeşidinde, en yüksek 118 mg/100 g taze ağırlık ile Ville çeşidinde bulunmuştur. Toplam antosiyanin içeriği Balder çeşidinde sıfıra yakinken Gatineau çeşidinde 51 mg/100 g taze ağırlık olarak bulunmuştur. Toplam fenolikler Gatineau çeşidinde 192 mg/100 g ile Ville çeşidinde 359 mg/100 g taze ağırlık aralığında bulunmuştur. Çevre faktörlerinin ahudududa kuersetine önemli derecede etkisinin olduğu belirtilmiştir (Anttonen ve Karjalainen, 2005). Yapılan araştırmanın sonuçlarına göre ahudududa farklı genotiplerin biyoaktiviteye önemli derecede etki ettiği tespit edilmiştir.

Depolamanın ahudududa bulunan aroma maddelerine (α -pinene, citral, β -pinene, phellandrene, linalool, α -ionone, caryophyllene ve α -ionone) etkisini incelemek üzere bir araştırma yapılmıştır ve araştırmada İspanya'da yetiştirilmiş olan 4 ahududu çeşidi (Heritage, Autumn



Bliss, Zeva ve Rubi) kullanılmıştır. Örnekler 3 farklı depolama döneminde 1) hasat edildiği anda analiz edilen örnek, 2) 12 saat -80 °C’de depolanmış örnek, 3) 12 ay -20°C’de depolanmış örnek, GC-MS ve HPLC cihazları kullanılarak analiz edilmiştir. 12 ay depolanmış Heritage çeşidinin α -ionone maddesinde %27’lik ve caryophyllene maddesinde %67’lik artış görülmüştür. Hasat dönemine göre de antosiyaninlerde değişiklik olmuştur. Erkençi çeşitlerde (Heritage ve Autumn Bliss) işleme ve 12 aylık depolama aroma maddelerini olumlu etkilemiştir. Toplam pigment Heritage çeşidinde %17 ve Autumn Bliss çeşidinde %5 artmıştır. Fakat geççi çeşitlerin depolanmasıyla aroma maddeleri olumsuz etkilenmiştir. Depolama sonucunda antosiyanin içerikleri Ruby çeşidinde %4,0 ve Zeva çeşidinde %17,5 azalmıştır (De Ancos vd., 2000).

Pulsed Electric Field (PEF), yüksek sıcaklık uygulanmadan gıdaların mikroorganizmalardan arındırılmasında kullanılan bir metottur (Jeyamkondan vd., 1999). Yapılan bir araştırmada PEF uygulamaları ile domates (*Lycopersicon esculentum* cv. Raf) meyvesindeki antioksidan aktivitenin değişiklikleri incelenmiştir. Raf ömrü için örnekler farklı şiddette (40, 120 ve 200 kV m⁻¹) ve farklı sayıda sinyal (5, 18 ve 30 sinyal) elektrik alanına maruz bırakılmıştır. 30 sinyalli 200 kV m⁻¹ (2,31 kJ kg⁻¹) elektrik alanına maruz bırakılan meyvelerin toplam karotenoid konsantrasyonu %50 ve likopen konsantrasyonu %53 artmıştır. Bununla beraber lipofilik antioksidan kapasitelerinin arttığı da gözlenmiştir (González-Casado vd., 2018) (Şekil 4). Likopen meyve ve sebzelerde bulunan kanser ve kalp hastalıkları gibi kronik hastalıklara karşı etkili olan bir karotenoiddir (Rao ve Agarwal, 2000).



Şekil 4. PEF uygulanmamış ve uygulanmış domates meyvelerinin toplam karotenoid (mg kg⁻¹) ve likopen (mg kg⁻¹) konsantrasyonları ve lipofilik antioksidan kapasiteleri (μmol kg⁻¹) (González-Casado vd., 2018)

3. SONUÇ

Bitki ıslahının tarihi, insanların göçebe hayattan yerleşik hayata geçtikleri döneme kadar dayanmaktadır. Yerleşik hayatta bitkilerin kültüre alınma süreci başlamıştır. Bitkiler kültüre



alınırken verim ve kalite yönünden üstün özellikli olanlar seçilmiş ve daha sonraki süreçte introdüksiyon, seleksiyon ve melezlemeler yapılarak bitkilerin özellikleri belli amaçlar doğrultusunda geliştirilmeye çalışılmıştır. Son yıllarda artan kanser vakalarıyla birlikte yapılan çalışmalarda tüketilen meyve ve sebzelerin insan sağlığı yönünden etkileri araştırma konusu olmuş ve yapılan ıslah çalışmalarıyla meyve ve sebzelerde bulunan fitokimyasalların arttırılabileceği belirtilmiştir. Modern ıslah yöntemleri kullanılarak daha kısa sürede ve daha az maliyetle bitki ıslahında kesin sonuçlar alınabilmektedir. Bu bilgiler göz önüne alındığında yapılan ıslah çalışmalarıyla sadece verim ve kalite unsurlarını geliştirmenin yanında meyvelerin toplam fenolikleri, antosiyanin maddelerini, antioksidan kapasitelerini arttırmak da ıslah amaçları arasında yer almaktadır. Yabani ve kültür formlu meyvelerin fitokimyasal içeriklerinin karşılaştırıldığı birçok çalışma mevcut olup yabani meyveler fitokimyasallarca kültür formlulardan daha üstün bulunmuştur. Melezleme ıslahı ile yabani bitkilerdeki fitokimyasal karakterleri kontrol eden genler kültür bitkilerine aktarılabilir ve bu şekilde meyve ve sebzeler hem daha sağlıklı hem de yüksek verimli olabilir. Bu konuya ekonomik açıdan değerlendirecek olursak, genellikle meyvelerin pazar değeri, meyve büyüklüğü ve renk gibi farklı pomolojik özelliklere göre değişkenlik göstermektedir. Fitokimyasal madde içeriği yüksek meyvelerin ıslah edilmesi ve bunların pazara sunulmasıyla pazarda fitokimyasal maddelerce zengin meyveler daha yüksek fiyat bulabileceklerdir.



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Althea officinalis L. BİTKİSİNİN MİNERAL KOMPOZİSYONUNUN ARAŞTIRILMASI

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ÖZET

Geleneksel Avrupa Tıbbında 2000 yıldan beri kullanılan *Althaea officinalis* L. (Malvaceae), Avrupa, Asya ve Amerika'da doğal olarak yetişen bitkinin Batı Avrupa'dan Rusya'ya kadar kültürü yapılmaktadır. 2 m kadar boylanabilen bitki, Anadolu'da yaygın olarak bulunmaktadır. Birçok ülkede, bitkinin kök, yaprak ve çiçekleri başlıca soğuk algınlığı ve öksürükte antitussif olarak, gastrik, renal ve ürolojik rahatsızlıklarda, ayrıca emoliyan ve antiseptik olarak kullanılmaktadır. Ülkemizde hatmi bitkisi, halk arasında idrar söktürücü, göğüs yumuşatıcı ve koruyucu olarak, öksürükten ileri gelen solunum yolu tahrişlerinde ve cilt yaralarında yumuşatıcı, koruyucu ve yara iyi edici olarak kullanılmaktadır. Çalışmada kullanılan hatmi çiçeği 2021 yılında Van Yüzüncü Yıl Üniversitesi Tıbbi ve Aromatik Bitkiler Bahçesi'nden toplanmıştır. Toplanan bitki çiçekleri distile su ile sterilize edilmiş, kurutma kağıtları arasında doğrudan güneş ışığına maruz kalmayacak şekilde kurutulmuştur. Bu çalışmada, Hatmi çiçeklerinin bazı mineral (K, Ca, Mg, Fe ve Zn) ve ağır metal (Mn, Cu, Ni, Al, As, Cd, Co, Cr, ve Pd) içerikleri incelenmiş ve tüm analizler 3 tekrarlamalı olarak yapılmıştır.

Araştırma sonucunda; hatmi çiçeğinin K (20.05 g/kg), Ca (54.00 g/kg), Mg (9.54 g/kg), Fe (2116.1 mg/kg) ve Zn (63.56 mg/kg) içeriği bakımından Ca ve Mg içeriğinin normal sınır değerlerin üzerinde olduğu, diğer minerallerin ise sınır değerler arasında yer aldığı belirlenmiştir. Ağır metaller bakımından ise, Mn (124.3 mg/kg), Cu (8.22 mg/kg), Ni (5.87 mg/kg), Al (36332.1 mg/kg), As (0.88 mg/kg), Cd (0.10 mg/kg), Co (1.05 mg/kg), Cr (10.20 mg/kg) ve Pb (4.21 mg/kg) içeriklerinin insan sağlığı açısından belirlenen tolerans sınır değerler arasında olduğu ancak Ni ve Cr içeriğinin kısmen toksik doz sınırları içerisinde yer aldığı tespit edilmiştir.

Anahtar Kelimeler: *Althea officinalis* L., ağır metal, hatmi, mineral



INVESTIGATION OF THE MINERAL COMPOSITION OF THE PLANT *Althea officinalis* L.

ABSTRACT

Althaea officinalis L. (Malvaceae), which has been used in Traditional European Medicine for 2000 years, is a plant that grows naturally in Europe, Asia and America, and is cultivated from Western Europe to Russia. The plant, which can be up to 2 m tall, is widely available in Anatolia. In many countries, the root, leaves and flowers of the plant are mainly used as an antitussive in colds and coughs, gastric, renal and urological ailments, as well as emollient and antiseptic. In our country, the marshmallow plant is used as a diuretic, chest softener and protector among the people, as a softener, protector and wound healer in respiratory tract irritations and skin wounds caused by coughing. The marshmallow flower used in the study was collected from Van Yuzuncu Yil University, Medicinal and Aromatic Plants Garden in 2021. The collected plant flowers were sterilized with distilled water and dried between blotter papers in a way that they would not be exposed to direct sunlight. In this study, some mineral (K, Ca, Mg, Fe and Zn) and heavy metal (Mn, Cu, Ni, Al, As, Cd, Co, Cr, and Pd) contents of marshmallow flowers were examined and all analyzes were performed with 3 replications. As a result of the research; In terms of K (20.05 g/kg), Ca (54.00 g/kg), Mg (9.54 g/kg), Fe (2116.1 mg/kg) and Zn (63.56 mg/kg) content of marshmallow flower, the Ca and Mg contents are below the normal limit values. It was determined that the other minerals were between the limit values. In terms of heavy metals, Mn (124.3 mg/kg), Cu (8.22 mg/kg), Ni (5.87 mg/kg), Al (36332.1 mg/kg), As (0.88 mg/kg), Cd (0.10 mg/kg). kg), Co (1.05 mg/kg), Cr (10.20 mg/kg) and Pb (4.21 mg/kg) contents were found to be within the tolerance limit values determined in terms of human health, but Ni and Cr contents were partially within the toxic dose limits.

Keywords: *Althea officinalis* L., heavy metal, marshmallow, mineral



Giriş

Althaea officinalis L. taksonomik olarak *Althaea* cinsine ait olan, dünyada geniş bir dağılışı gösteren, 243 cins ve 4300'den fazla tür ile temsil edilen Malvaceae familyasının bir üyesidir (Bayer ve Kubitzki 2003). Bu cins Türkiye'de; *Althaea officinalis* L., *Althaea cannabina* L., *Althaea hirsuta* L., *Althaea armeniaca* Ten. olmak üzere 4 türle temsil edilmektedir. Bitkinin ticarete *Alcea* L. ve *Hibiscus* L. türleriyle sıklıkla karıştığı bilinmektedir (Baytop 1999).

Hatmi çiçeği genellikle pembe ve mor renkli çiçekleri olan, tıbbi bitki denilince ilk olarak akla gelen, şifalı bitki isimleri arasında adı geçen bir bitkidir. Hatmi isminin yanı sıra gülhatmi, silindir çiçeği ve deve gülü isimleri olarak da bazı yörelerde bilinmektedir. Güzel görüntüsü sayesinde hemen fark edilen hatmi çiçeği, yaz aylarında özellikle temmuz ve ağustos aylarında çiçek açmaktadır. Yurdumuzda da geniş bir yetiştirme alanına sahip ve özellikle de Akdeniz yöresinde yetiştiği bilinmektedir. Sulu arazilerde daha verimli olarak yetişmektedir. Bitkinin tıbbi özelliğinden yararlanmak için kök, yaprak ve çiçeklerinden faydalanılır (Al-Snafi, 2013). Ülkemizde yaygın şekilde yetişen hatmi, 1.5-2 metreye kadar uzayabilir. Avrupa, Amerika, Avustralya kıtalarında bulunan hatmi ülkemizde daha çok Marmara ve Akdeniz bölgeleri olmak üzere tüm Anadolu'da yaygındır. Asparagin, müsilaj, pektin, nişasta, uçucu yağ ve sabit yağ, şekerler ihtiva eder. Hatmi çiçeğinin kökleri sakinleştirici ve öksürük ilacı olarak geleneksel tıpta kullanılmaktadır. Hatmi yumuşatıcı ve tahriş giderici etkileri sebebiyle, ağız ve boğaz iltihaplarında, idrar arttırıcı, gastritte, öksürükten ileri gelen solunum yolu tahrişlerinde, cilt yaralarında kullanılmaktadır. Hatmi bitkisinin kurutulmuş çiçekleri müsilaj içerdiğinden dolayı soğuk suda bekletilerek içilir. Ağız gargarası yapılacaksa kaynatılmalıdır (Çolak, 2014).

İnsan vücudunun kuru ağırlık olarak, % 95 – 96 sını organik (C, O, H ve N), % 4- 5'ini inorganik maddeler (mineral ve eser elementler) oluşturur (Baysal, 2004). Mineral maddelerin vücuttaki işlevleri ya doğrudan sisteme katılarak neden oldukları tepkimelerle ortaya çıkmakta, ya da hormon ve enzimlerin yapısında yer alarak dolaylı etkileri görülmektedir. Sağlıklı bir vücuda sahip olmak için her mineral ve eser elementin yeterli miktarda alınması gerekir. Şayet yeterli düzeyde alınmazlarsa mineral ve eser elementin eksikliğine bağlı yetmezlik belirtileri (semptomları) ortaya çıkar, tersine, vücut için gerekenden fazla alındıklarında da zehirlenmelere ve hastalıklara yol açar. Örneğin, yer yüzünde en çok bulunan demir, Fe, aşırı miktarda alındığında kusma, ishal ve bağırsak bozukluklarına neden olur (El-Rjoob ve Massedeh, 2008). Düşük miktarlarda alındığında ise kemiklerde kırılabilirlik ve anemi gibi



sorunlar ortaya çıkar. Buna göre, günlük gerekli ve toksisiteye yol açan mineral düzeylerinin tespiti oldukça önemlidir (Ekholm ve ark., 2007)

Ca, Mg ve Na insan ve hayvan sağlığı için çok gerekli metallere olmakla birlikte bazı elementler (Cu, Zn, Mn, Mo vb.) organizmalar için gereklidir. Yokluğunda hem büyüme hem de üreme durur (Bat ve ark., 1999). Bitkilerde bulunan Cr, Pb, Cd, Co, Hg, Ni gibi ağır metalleri belirli düzeylere geldiklerinde zehir etkisi gösterirler (Özcan, 2004; Bedir 2010).

Bu çalışmanın amacı, tıbbi bitki olarak kadim bir geçmişe sahip olan hatmi çiçeğinin makro, mikro mineral içeriği ve ağır metal bileşimlerinin belirlenmesidir.

Materyal ve Yöntem

Çalışmada kullanılan hatmi (*Althea officinalis* L.) bitkisi 2021 yılında Van Yüzüncü Yıl Üniversitesi Tıbbi ve Aromatik Bitkiler Bahçesi'nden toplanmıştır. Bitkiye ait özellikler Tablo 1' de verilmiştir.

Tablo 1. *Althea officinalis* L. bitkisine ait bazı özellikler

Bilimsel Adı	<i>Althea officinalis</i> L.
Familiya	Malvaceae
Dünyada Dağılışı	Asya, Avrupa ve Amerika
Botanik Özelliği	60-120 cm yüksekliğinde çok yıllık bir bitkidir
Yerel Adı	Hire, Devegülü, Silindir Çiçeği, Gülhatmi
Faydaları	Solunum yolları açıcı, sakinleştirici, öksürük kesici, mide, bağırsak, ağız ve boğaz ülseri için kullanılmaktadır
Kullanılan Kısım	Tüm bitki (çiçek, yaprak ve kök)
Kullanım Alanları	Tıp, gıda, peyzaj, endüstri
Kullanım Şekli	İlaç, aroma verici, çay, süs bitkisi, boyar
Bileşenleri	% 11 pektin, % 25 nişasta, % 10 disakkarit sakkaroz, % 5 müsilaj, flavonoidler (hipoletin-8-glukozit, izokuersitrin, kaempferol, kaffeik, p-kumarik asit) kumarinler, fitosteroller, tanninler, asparagin ve birçok aminoasitleri içermektedir

(Shah ve ark. 2012; Du ve ark. 2016; Kumar ve ark. 2016)

Hatmi bitki örnekleri, yıkanıp kurutulduktan sonra kağıt torbalara yerleştirilmiş ve 65 °C' de kurutulduktan sonra öğütülmüştür (Kacar ve Inal, 2008). Daha sonra 0.5 gramlık öğütülmüş örnekler, nitrik ve perklorik asit yardımıyla yaş yakma metoduna göre yakılmış ve 50 ml'lik süzükler hazırlanmıştır. Hazırlanan süzüklerin Van YYÜ Bilim Uygulama ve Araştırma Merkezi'nde indüktif olarak eşleştirilmiş plazma optik emisyon spektrofotometresi (ICP-OES) ve atomik absorpsiyon spektrometre (AAS)'de makro, mikro besin elementi ve ağır metal içerikleri belirlenmiştir. Çalışmada yürütülen bütün analizler üçer tekerrür halinde yapılarak standart sapmaları tespit edilmiştir.



Bulgular ve Tartışma

Althea officinalis L. türünün bazı mineral ve ağır metal içeriklerine ait ortalamamalar ve standart sapma değerleri Tablo 2 ve Tablo 3' te verilmiştir. Bu çalışmada makro besin elementlerden magnezyum (Mg) içeriği 9.54 g/kg, potasyum (K) 20.05 g/kg, kalsiyum (Ca) 53.99 g/kg, demir (Fe) 2116.1 mg/kg, mangan (Mn) 124.31 mg/kg, çinko (Zn) 63.56 mg/kg, bakır (Cu) içeriği 8.22 mg/kg ve Nikel (Ni) 5.86 mg/kg olarak belirlenmiştir. Konu ile ilgili yapılan bir çalışmada; Görmez ve ark. (2019), *Alcea kurdica* türünde Mg içeriğini 2.46-3.04 mg/kg, K içeriğini 15.13-20.68 mg/kg), Ca içeriğini 21.28-24.82 mg/kg arasında tespit etmişlerdir. Çolak (2014), hatmi çiçeklerinde potasyum içeriğini 6453.137 mg/kg olarak kaydederken, bazı tıbbi ve yenilebilir bitkilerde yapılan farklı çalışmalarda; K içerikleri 25.00-557.91 g/kg arasında (Akgunlu, 2012; Tuncurk ve ark. 2015) kaydedilmiştir. Yine, Çolak (2014), hatmi çiçeklerinde Mg içeriğini 1150.23 mg/kg olarak tespit etmiş, farklı tıbbi ve aromatik bitkilerde ise magnezyum içeriği 1.17 ve 86.43 g/kg arasında belirlenirken (Corlett ve ark., 2002; Koca ve ark., 2009; Tuncurk ve ark., 2015); bazı yabancı sebzelerde ise 300.33-2930.8 mg/kg arasında tespit edilmiştir (Turan ve ark., 2003). Çalışma sonuçlarımız söz konusu literatürlerle uyumlu olup, magnezyum içerikleri bakımından bitkiler arasında, hatta bitkinin farklı organları arasında dahi farklılıklar olabilmektedir. Örneğin, baklagil bitkileri (nohut, mercimek vb.), baklagil olmayan bitkilere oranla daha fazla magnezyum içermektedirler (Çolak, 2014).

Konu ile ilgili yapılan farklı çalışmalarda da çok sayıda incelenen tıbbi ve yenilebilir bitkilerin Ca seviyelerinin 0.03-777.52 g/kg arasında belirlendiği (Koca ve ark., 2009; Akgunlu, 2012) bildirilmektedir. Ayrıca, *Arnebia densiflora* bitkisinin farklı kısımlarında kalsiyum (Ca) konsantrasyonunun araştırıldığı başka bir çalışmada ise kalsiyum içeriğinin 9203-37637 mg/kg arasında değiştiği gözlemlenmiştir (Koca ve ark., 2009). Yapılan çalışmalarda insan sağlığı açısından faydalı olan bazı minerallerin normal veya kabul edilebilir seviyeleri potasyum (K) için 1000-50000 mg/kg, Kalsiyum (Ca) için 3000-30000 mg/kg, Mg için 100-1000 mg/kg ve demir (Fe) için 50-250 mg/kg (Kabata-Pendias ve Pendias, 2001; Özyiğit ve ark. 2018) olarak tespit edilmiştir. Elde edilen sonuçlar literatürler ile uyum içerisinde olup Ca ile Fe içerikleri bazı literatürlerden daha fazla miktarda tespit edilmiştir. İncelenen bitkilerde mineral besin elementlerinin farklı miktarlarda olmasında, bitkilerin yetiştiği toprağın özelliklerinin, toprak pH'sının, bitkilerin mineral taşıma mekanizmalarının farklılığının ve genetik faktörlerin etkili olduğu düşünülmektedir.



Tablo 2. *Althea officinalis* L. çiçeğinin mineral besin kompozisyonu ortalama değerleri \pm SD

Makro ve Mikro Mineraller	<i>Althea officinalis</i> L.	SD
Mg(g/kg)	9.54	\pm 1.261
K(g/kg)	20.05	\pm 2.377
Ca(g/kg)	53.99	\pm 5.335
Fe (mg/kg)	2116.1	\pm 86.355
Mn (mg/kg)	124.31	\pm 0.948
Zn (mg/kg)	63.56	\pm 2.191
Cu (mg/kg)	8.22	\pm 0.187
Ni (mg/kg)	5.86	\pm 0.193

Birçok enzim için aktivatör olan mangan, enzim-S ve süperoksit dismutaz enzimlerinin yapısında yer almaktadır. Yapılan araştırmalarda, Manganın bitkide toksik değerleri, 300-500 mg/kg (Kabata-Pendias ve Pendias, 1986) olarak belirlenmiştir. Bazı doğal olarak yetişen ve sebze olarak tüketilen bitkiler üzerinde yapılan bir araştırmada bitkilerin içerdiği mangan konsantrasyonunun 21.40-77.40 mg/kg arasında (Şekeroğlu ve ark., 2005), Çolak (2014) ise, hatmide Mn içeriğini 9.337 mg/kg olarak tespit etmişlerdir. Çalışmamızdan elde ettiğimiz sonuçlar toksik sınır eşiğinden oldukça düşük ancak diğer literatürlerden kısmen fazla miktarlarda tespit edilmiştir.

Konu ile ilgili çalışmalarda, farklı yabancı bitkilerin demir miktarları 1.70-71.2 mg/kg, kültür sebzelerinde ise bu değer 3.0-16.00 mg/kg arasında tespit edilirken (Bear ve ark., 1948; Yıldırım ve ark., 2001; Chizzola ve ark., 2003; Turan ve ark., 2003), Çolak (2014), hatmide Fe içeriğini 131.756 mg/kg, Ni içeriğini 1.398 mg/kg, Zn içeriğini, 5.053 mg/kg, Cu içeriğini ise 9.8333 mg/kg olarak belirlemiştir. Görmez ve ark. (2019) *Alcea kurdica* türünde Mn içeriğini 26.59-36.21 mg/kg, Cu içeriğini 3.62-5.93 mg/kg, Zn içeriğini 9.98-18.76 mg/kg, ve Fe içeriğini 403.67-441.61 mg/kg arasında tespit ettiklerini bildirdikleri çalışma bulguları elde ettiğimiz sonuçlardan kısmen düşük bulunmuştur. Bitkilerde demir miktarı normal sınırlarının 2-250 mg/kg arasında olduğu belirtilmektedir (Kabata-Pendias ve Pendias 1986). Bitki kuru maddesinde çinko için toksisite sınırı 70 mg/kg olarak (Kabata-Pendias ve Pendias 1992), bakır konsantrasyonu 20 ppm'den fazla olduğunda toksik etkilerin ortaya çıktığı belirtilmiştir (Yılmaz ve ark., 2006). Özellikle çinko ve bakır mineralleri araştırıcı sonuçları ile kıyaslandığında, çalışmamızda daha yüksek değerlerde tespit edilmiş ve kabul edilebilir sınırlar içerisinde yer almıştır. Zn mineralinin aşırı alınması ile yorgunluk, baş dönmesi, bulantı, kusma, ishal, metalik tat ve böbrek ve mide hasarı gibi sağlık problemleri ortaya çıkmaktadır (Ekin, 2022). Bakır bitki bünyesinde enzim aktivasyonu, karbonhidrat ve yağ metabolizmasında yer



alması nedeniyle önemli bir elementtir (Kaçar ve Katkat, 2007). Bakır kirliliği insan aktivitesi sonucu oluşan emisyon, pestisit kullanımı, kanalizasyon atıklarının gübre olarak değerlendirilmesi, kömür ve maden yataklarından kaynaklanmaktadır. Yaptığımız çalışmadan elde edilen sonuçlar incelendiğinde Mg, K, Ca, Mn, Zn ve Cu içeriği bakımından hatmi çiçeklerinin mineral içeriğinin normal sınırlarda olduğu tespit edilirken, Fe bakımından yüksek değerler elde edilmiştir.

Tablo 3 incelendiğinde, hatmi çiçeklerinde Al, As, Cd, Co, Cr ve Pb gibi ağır metallerin içerikleri sırasıyla; 36332.06, 0.880, 0.099, 1.046, 10.193 ve 4.214 mg/kg olarak tespit edilmiştir. Görmez ve ark. (2019), *Alcea kurdica* bitkisinde Cd içeriğini 0.24-0.30 mg/kg, Co içeriğini 0.37-0.45 mg/kg ve Cr içeriğini 5.97-7.06 mg/kg arasında tespit ettiklerini bildirmişlerdir. Bilgiç Alkaya ve ark. (2015), sarı kantaron da Pb içeriğini 1.655 mg/kg ve Cd içeriğini 0,111 mg/kg olarak, Tekin (2019), ise hatmide Pb içeriğini 0.33 mg/kg ve Cd içeriği 0.08 mg/kg olarak belirlemişlerdir. En tehlikeli ağır metal kirleticilerinden olan kadmiyum canlılar için oldukça toksik bir elementtir. Kadmiyum diğer ağır metallere kıyaslandığında suda çözünme özelliği en yüksek olan elementtir. Bu nedenle doğada yayılım hızı yüksektir ve insan yaşamı için gerekli elementlerden değildir. Kadmiyum fotosentezi engellemekte, stomaların kapanmasına, transpirasyon ile su kaybının azalmasına ve klorofil sentezinde aksamalara neden olmaktadır. Kurşun (Pb), çevreyi kirleten ağır metallerin başında gelir ve bitkilerde olduğu kadar insanlarda da zehir etkisi gösterir. Atmosferdeki toplam kurşun miktarının %80 kadarının petrol ve petrol ürünlerinden kaynaklandığı kabul edilmektedir (Özden ve Bayçu, 2004; Rao ve ark., 2011). Kabata-Pendias ve Pendias (2001) tarafından farklı bitki türlerinde iz elementler ve ağır metal konsantrasyonlarının araştırıldığı çalışmada; Alüminyum (Al) toksik sınırınının 30.983-368.877 mg/kg, en toksik eser elementlerden biri olan arsenik (As), 5-20 mg/kg, kadmiyum (Cd) 5-30 mg/kg, kobalt (Co), 15-50 mg/kg, krom (Cr), 5-30 mg/kg ve kurşun (Pb) tolerans aralığınının 30-300 mg/kg arasında olduğunu bildirmişlerdir. Elde ettiğimiz sonuçların belirtilen toksik sınırların oldukça altında kaldığı ve söz konusu bitkinin güvenle tüketilebileceği sonucuna ulaşılmıştır. Bazı metaller (çinko, demir, bakır krom ve kobalt) sadece yüksek konsantrasyonlarda toksik iken arsenik, civa, kurşun ve kadmiyum her seviyede toksik olup bilinen bir faydası henüz ortaya konulmamıştır.



Tablo 3. *Althea officinalis* L. çiçeğinin ağır metal kompozisyonu ortalama değerleri \pm SD

Ağır Metaller	<i>Althea officinalis</i> L.	SD
Al (mg/kg)	36332.06	\pm 514.547
As (mg/kg)	0.880	\pm 0.012
Cd (mg/kg)	0.099	\pm 0.004
Co (mg/kg)	1.046	\pm 0.018
Cr (mg/kg)	10.193	\pm 0.160
Pb (mg/kg)	4.214	\pm 0.128

SONUÇ

Ülkemiz tarımsal potansiyel olarak, coğrafi konumu, iklimi ve floranın zenginliği bakımından dünya tıbbi ve aromatik bitkiler ticaretinde lider ülkeler arasında yer almaktadır. Yeryüzünde geniş bir doğal yayılış alanına sahip ve özellikle de bitkisel ilaç olarak da çok fazla tüketimi yapılan hatminin, ülkemizde de tıbbi etkilerinden dolayı kullanımı oldukça yaygındır. Tıbbi amaçla kullanılan bitkilerin birçoğu doğadan toplanarak pazarlanmaktadır. Toplanan bu bitkilerin insan sağlığına etkileri araştırılmalı, kullanım miktarları ve hazırlanış şekilleri konusunda bilinçli olunmalıdır. Bu çalışmada, incelenen bitkilerin mineral besin elementleri açısından kabul edilebilir seviyelerde oldukları, sağlık açısından zararları olduğu bilinen ağır metaller açısından da literatürde belirlenen toksik sınır değerlerin oldukça altında olduğu tespit edilmiştir. Yaptığımız çalışmada, *Althea officinalis* L. türünün ağır metal düzeylerinin WHO tarafından belirlenen sınır değerlerin altında olması bitkinin insan sağlığı bakımından risk oluşturmadığı ve tüketilmeye uygun oldukları, fakat yine de tıbbi bitkilerin bilinçli olarak doz kontrollü tüketilmesi gerektiği son derece önem arz etmektedir.



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***Hypericum perforatum* L.' UN TOPLAM ANTİOKSİDAN KAPASİTE, FENOLİK VE FLAVONOİD MADDE İÇERİKLERİNİN BELİRLENMESİ**

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ÖZET

Dünyada yaklaşık 500.000 bitki türünden 70.000'i farklı amaçlarla kullanılırken, bunların 25.000'inin tedavi amacıyla kullanıldığı tahmin edilmektedir. *Hypericum perforatum* L. bitkisi Hypericaceae familyasına ait çok yıllık önemli bir türdür. Ülkemizde binbirdelik otu, mayasıl otu, yaraotu ve kuzukıran gibi yöresel isimlerle tanınmaktadır. Sarı kantaron ülkemizde olduğu gibi Asya, Avrupa, Kuzey Afrika, Anadolu, Batı Asya ve Amerika'da da doğal yayılış göstermektedir. Çalışmada kullanılan sarı kantaron çiçeği 2021 yılında Van Yüzüncü Yıl Üniversitesi Tıbbi ve Aromatik Bitkiler Bahçesi'nden toplanmıştır. Toplanan bitki çiçekleri distile su ile sterilize edilmiş, kurutma kağıtları arasında doğrudan güneş ışığına maruz kalmayacak şekilde kurutulmuştur. Bu çalışmada; toplam antioksidan, toplam fenolik ve flavonoid madde içerikleri incelenmiştir. Tüm analizler 3 tekrarlamalı olarak yapılmıştır. Araştırma sonucunda; Toplam antioksidan kapasite, fenolik ve flavonoid madde içerikleri sırasıyla; 137.90 µmol TE/g, 242.04 mg GA/g ve 9.14 mg QE/100g olarak elde edilmiştir. **Anahtar Kelimeler:** Antioksidan aktivite, fenolik, flavonoid, *hypericum perforatum* l.



DETERMINATION OF TOTAL ANTIOXIDANT CAPACITY, PHENOLIC AND FLAVONOID SUBSTANCES OF *Hypericum perforatum* L.

ABSTRACT

While 70 000 of approximately 500 000 plant species are used for different purposes in the world, it is estimated that 25 000 of them are used for therapeutic purposes. *Hypericum perforatum* L. is an important perennial species belonging to the Hypericaceae family. In our country, it is known by local names such as binbirdelik grass, mayasil herb, yam and sorrel. St. John's Wort shows natural distribution in Asia, Europe, North Africa, Anatolia, West Asia and America as well as in our country. St. John's Wort flower used in the study was collected from Van Yuzuncu Yil University, Medicinal and Aromatic Plants Garden in 2021. The collected plant flowers were sterilized with distilled water and dried between blotter papers in a way that they would not be exposed to direct sunlight. In this study; total antioxidant, total phenolic and flavonoid substance contents were examined. All analyzes were performed in 3 replications. As a result of the research; Total antioxidant capacity, phenolic and flavonoid contents, respectively; 137.90 $\mu\text{mol TE/g}$ was obtained as 242.04 mg GA/g and 9.14 mg QE/100g.

Keywords: Antioxidant activity, phenolic, flavonoid, *hypericum perforatum* l.



Giriş

Hypericum perforatum L. dünyada yaklaşık 450 tür ile dağılım gösteren geleneksel, çok yıllık bir tıbbi bitkidir (Altun ve ark., 2013). *Hypericum* cinsi Türkiye florasında 89 türle temsil edilmektedir (Davis ve Cullen, 1984). Son yıllarda, farmakolojik etkisi olduğu varsayılan bitkilerin kronik hastalıkların tedavisinde kullanımı yaygınlaşmıştır. *Hypericum* ailesinin 500 türünden biri olan *Hypericum perforatum* L. bitkisi, Akdeniz bölgesi *Hypericum* türleri için çok zengin bir bölge olmakla birlikte Asya ve Amerika'da pek çok endemik *Hypericum* türü için önemli biyoçeşitlilik göstermektedir (Marrelli ve ark. 2020). Ülkemizde yara otu, bin bir delik otu, püren, kan otu, koyun kıran, kılıç otu ve mayasıl otu olarak bilinen *Hypericum perforatum*, dünyada St. John's Wort bitkisi olarak isimlendirilmektedir. Eski çağlardan beri bitkiler insan sağlığının iyileştirilmesinde önemli bir bitki olarak yer almaktadır. Bu bitki 2000 yıldan fazla süredir değerli bir bitkisel ilaç olarak kabul edilmektedir. Son yıllarda yapılmış bazı çalışmalarla bitkinin antidepresan, antiinflamatuvar, antiepileptik, analjezik ve yara iyileştirici etkilerinin olduğu ortaya konmuştur. *Hypericum perforatum* L. bakteriyel ve viral enfeksiyonları tedavi etmek amacıyla kadim bir geçmişe sahiptir. Sarı kantaron, egzama gibi çeşitli cilt yaraları, yanık, sindirim sistemi hastalıkları ve psikolojik bozukluklar gibi çeşitli tıbbi uygulamalarda kullanılmaktadır (Butterweck 2003). Aynı zamanda sarılık, tüberküloz, safra kesesi taşları ve karaciğer kanseri gibi hastalıkların tedavisinde de kullanıldığı bilinmektedir (Gülben ve ark., 2008).

Doğal olarak hazırlanmış bitkisel ürünlerin tüketimi uzun yıllardır insan beslenmesinde yer almaktadır. Çeşitli bitkilerden elde edilen preparatlar gıda takviyesi olarak da bilinmektedir. Gıdaların içerdikleri antioksidanlar, lifler vb. insanlar tarafından keşfedildikçe, gıda takviyelerinin sağlığı korumak amacıyla tüketimi yaygınlaşmaktadır. Çeşitli çevresel faktörlerden meydana gelen serbest radikaller, oldukça hassas yapıya sahip hücrelerin yapısını bozmak ve DNA içeriğine zarar vermek suretiyle birçok farklı önemli hastalıklara sebep olabilmektedirler. Birçok gıdanın oksidasyonunu önlemede önemli bir alternatif olan, serbest radikal süpürücü özellikleriyle literatürde antioksidan, antimutajenik ve antikanser etkileri bilinen fenolik bileşikler sarı kantaron bitkisinde önemli miktarlarda bulunmaktadır (Burunkaya ve ark. 2021). Oksidatif hasarı önlemeye yardımcı olan fenoller yani doğal antioksidanlara ilginin artmasının başlıca nedenleri arasında patojen mikroorganizmaların antibiyotiklere karşı direnç geliştirmesi antibiyotiklerin istenmeyen yan etkilere sahip olabilmesi ve oksidatif stresin kanser ve diyabet gibi birçok hastalığın epidemiyolojisinde rol



aldığının tespit edilmesidir (Düzgüner ve Erbil, 2020). Serbest radikallerin zararlı etkilerinden korunmak için hücreler antioksidan maddelere gereksinim duyarlar ve bu antioksidan maddeler, oksidasyonu başlatan serbest radikalleri nötralize ederek hücrelere zarar veren etkisini ortadan kaldırırlar.

Bu çalışmada, tıbbi etkisi bakımından önemi gittikçe artan ve kullanımı yaygınlaşan sarı kantaron bitkisinin çiçek kısımlarının, toplam fenolik ve flavonoid madde kapsamı ile antioksidan potansiyelinin belirlenmesi amaçlanmıştır.

Materyal ve Yöntem

Çalışmada kullanılan sarı kantaron çiçeği 2021 yılında Van Yüzüncü Yıl Üniversitesi Tıbbi ve Aromatik Bitkiler Bahçesi'nden toplanmıştır. Toplanan bitki çiçekleri musluk suyu ile yıkandıktan sonra distile su ile sterilize edilmiş, kurutma kağıtları arasında doğrudan güneş ışığına maruz kalmayacak şekilde kurutulmuştur. Bu çalışmada; toplam antioksidan, toplam fenolik ve flavonoid madde içerikleri 3 tekerrürlü olacak şekilde incelenmiştir.

Bitkiye ait özellikler Tablo 1' de verilmiştir.

Tablo 1. *Hypericum perforatum* L. bitkisine ait bazı özellikler

Bilimsel Adı	<i>Hypericum perforatum</i> L.
Familiya	Hypericaceae (Sarıkantarongiller)
Dünyada Dağılışı	Avrupa, Batı Asya, Kuzey Afrika
Botanik Özelliği	Çok yıllık, otsu
Yerel Adı	Binbirdelik otu, Yara otu, Kılıç otu, Kan otu
Faydaları	Travma, yanık, yara, romatizma, ağrı, depresyon, morluk, şişlik, gastrit, parazit düşürücü, kabızlık, enflamasyon, anksiyete, bakteriyel ve viral enfeksiyonlar
Kullanılan Kısım	Toprak üstü kısımları
Kullanım Alanları	Tıp, endüstri
Kullanım Şekli	Çay, kozmetik, ilaç, toz, kapsül, tablet, damla, tentür, yağ, jel, merhem
Bileşenleri	Hiperforin (% 2-4), naftodiantronlardan hiperisinler (% 0.1-0.3), flavonoidler; quersetin gikozitleri, rutin, hiperosid, quersitrin ve izoquersitrin (% 2-4) ve biflavonoidler (% 0.1- 0.5) oluşturmaktadır

(Baytop, 1999; Şanlı, 2006; Barut, 2019)

Toplam fenolik madde miktarının belirlenmesinde; Obanda ve ark., (1997) tarafından belirtilen Folin-Cicaltea spektrofotometrik yöntemin modifiye edilmesiyle geliştirilen yöntem kullanılmıştır. Folin-Cicaltea çözeltisi 1:3 oranında seyreltilmiştir. Doymun sodyum karbonat (%35) çözeltisi; 87.5 g sodyum karbonat distile suda çözdürülüp 250 ml'ye tamamlanarak bir gece bekletilmesinin ardından filtre edilmiştir. Gallik asit (GA) stok çözeltisi (500 µg/ml); 100 ml saf suda 50 mg gallik asit çözdürülerek hazırlanmıştır. Gallik asit çalışma çözeltisi; 500



$\mu\text{g/ml}$ gallik stok çözeltisinden her biri 5'er ml'lik ölçü balonlarında, konsantrasyonu 0-55 $\mu\text{g/ml}$ arasında değişen 9 ayrı çözelti olarak hazırlanmıştır. Bu çözeltilerden 1 ml alınarak 1 ml Folin Cicaltea çözeltisi ile karıştırılmıştır. 5 dk bekletildikten sonra 2 ml sodyum karbonat ilave edilerek çalkalanmış ve 2 ml su ile seyreltilmiştir. Bu karışım 60 dk karanlık ortamda bekletildikten sonra spektrofotometrede 700 nm dalga boyunda absorbans değeri okunmuştur. Gallik asidin bu farklı konsantrasyonlarına karşı okunan absorbans değerlerinin grafiğe dönüştürülmesi ile kalibrasyon eğrisi elde edilmiştir ($r^2= 0.987$).

Table 2. *Hypericum perforatum* L.' nin toplam flavonoid, fenolik madde ve antioksidan kapasite miktarı

Biyokimyasal Parametreler	<i>Hypericum perforatum</i> L.	SD
Flavonoid madde İçeriği (mg QE/100g dw)	9.14 ±	4.027
Fenolik madde içeriği (mg GAE/g dw)	242.04 ±	13.594
Antioksidan kapasite ($\mu\text{mol TE/g dw}$)	137.90 ±	4.297

Toplam flavonoid madde miktarının belirlenmesi; Toplam flavonoid madde tayini Quettier-Deleu (2000)'nin geliştirmiş oldukları yöntemle göre belirlenmiştir. 2 ml ekstrakt üzerine 2 ml %2'lik AlCl_3 eklenerek oda sıcaklığında ve karanlıkta 1 saat bekletilmiştir. Her örnekte 2 paralel çalışma yapılarak ekstrelerin toplam flavonoid içerikleri, 415 nm dalga boyunda spektrofotometre ile ölçülmüş ve standart quersetin (QE) kullanılarak hazırlanmış olan kalibrasyon eğrisinden yararlanılarak mg QE/100 g cinsinden hesaplanmıştır ($r^2= 0.998$).

Toplam antioksidan aktivitesinin belirlenmesi (FRAP) (mg Trolox Eşdeğeri (TE)/g); örnekler 0.2 g tartılıp üzerine 5 ml metanol eklenerek homojenizatörden geçirilen materyal 10 dk 10000 rpm'de santrifüj edildikten sonra üstte kalan süpernatant kısmı alınmıştır. Daha sonra 300 mM asetat tamponu (pH 3.6), 40 mM HCl'de çözülerek hazırlanan 10 mmol/L 2,4,6-tripiryridyl-s-triazine (TPTZ), 20 mmol/L $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$ çözeltileri hazırlandıktan sonra sırası ile 10:1:1 oranında karıştırılıp FRAP ayırıcı hazırlanmıştır. Örnekler 2850 μL FRAP ayırıcı ile ABTS (2,2-Azinobis 3-ethyl-benzothiazoline-6-sulfonic acid) analizi için hazırlanan karışım ayrı ayrı çözücüler ile 50 kat seyreltildikten sonra alınan 150 μL örnek karıştırılıp oda sıcaklığında 60 dk bekletilmiştir. Oluşan ferrustripiridiltriazin kompleksi spektrofotometrede 593 nm'de ölçülmüş ve sonuçlar mg Trolox/g olarak belirtilmiştir (Lutz ve ark., 2011) ($r^2= 0.995$).



Bulgular ve Tartışma

Flavonoidler, polifenoller, terpenoidler, saponinler, alkaloidler ve müsilajın lipolisakaritler şifalı bitkilerden elde edilen doğal ürünler, antiinflamatuvar, antimikrobiyal, antiülser, antioksidan ve antikanser gibi büyük farmakolojik öneme sahiptir. Bitkilerden elde edilen ekstraktların kullanımı yüksek konsantrasyonlarda bile genellikle güvenlidir. Yaptığımız araştırmada, toplam flavonoid madde içeriği 9.14 mg QE/100 g dw, toplam fenolik madde miktarı 242.04 mg GAE/g dw ve toplam antioksidan içeriği 137.90 µmol TE/g dw olarak elde edilmiştir.

Flavonoidler, antioksidan, antibakteriyel, antiviral, anti-enflamatuvar, anti-alerjik, plazmada düşük yoğunluklu lipoproteinleri azaltma, trombosit toplanmasını önleme, serbest radikalleri temizleme ve hücre çoğalmasını önleme gibi çok çeşitli biyolojik etkiler göstermektedir (Spiridon, 2011). Tıbbi ve aromatik bitkiler sekonder metabolit içerikleri, yüksek antioksidan aktiviteleri ve diğer birçok biyolojik aktiviteleri nedeniyle yaygın olarak kullanılmaktadır. Bu bitkilerin metanol, etanol, aseton ve etil asetat gibi çözücülerden elde edilen ekstraktları kullanılarak sekonder metabolit içerikleri ve antioksidan aktiviteleri yoğun bir şekilde araştırılmaktadır. Bozin ve ark., (2013), tarafından yapılan çalışmada, *Hypericum perforatum* türünün toplam fenolik madde içeriği 15.49 mg GAE/ g de (dry extract), toplam flavonoid içeriği 1.90 mg QE/g de (dry extract) , toplam antioksidan potansiyeli 92.82 µg/mL olarak belirlenmiştir. Burunkaya ve ark. (2021), sarı kantaron bitkisinde çözücü olarak farklı solventleri (metanol, etanol, su, ayçiçek yağı, etil asetat) kullandıkları çalışmada toplam fenolik madde miktarını 93.88-29.44 mg/100g arasında metanol kullanılarak elde edilen ekstraktlarda elde ettiklerini bildirmişlerdir. Bunu miktarsal olarak etanol ile elde edilen ekstrakt (81.27 mg/100g) izlemiştir. En düşük içerik ise su ile elde edilen ekstraktlardan kaydedilmiştir. Örnekler kıyaslandığında tespit edilen toplam fenolik madde miktarındaki azalma etanol ile elde edilen ekstraktlarda %14 oranında ve ayçiçek yağı ile elde edilen ekstraktlarda %68 civarında olmuştur. Marrelli ve ark. (2014), yaptıkları çalışmada 4 farklı yükseltiden topladıkları *Hypericum perforatum* L. örneklerinde, toplam fenolik madde miktarını 27.87-41.77 mg/g arasında değiştiğini, Chimshirova ve ark. (2019) yaptıkları bir çalışmada *Hypericum perforatum* ekstraktlarındaki toplam fenoliklerin 10.20-53.84 mg/g arasında değiştiğini bildirmişlerdir. Yapılan çalışmalar sonucunda sarı kantaron bitkisinin toplam fenolik madde miktarları; 200 mg GAE/g (Parzhanova ve ark., 2018), 181.02 mg GAE/g (Sarıkürkçü ve ark.,2020), 265.43 g/kg (Seyrekoğlu ve Temiz 2020), 191 g/kg (Skerget ve ark. 2005) olarak tespit edilmiştir. Burunkaya ve ark. (2021), sarı kantaron bitkisinde toplam



antioksidan kapasite potansiyelini DPPH yöntemiyle yapılan analiz sonuçlarına göre; 16.81-40.77 µm Trolox/g arasında değiştiğini, en yüksek antioksidan potansiyeli metanol ekstraktlarından ve en düşük antioksidan aktivite potansiyelini ise ayçiçek yağı ekstraktlarından elde etmişlerdir. Çalışmamızda sonuçlarımızın yüksek çıkmasında metanol ekstraksiyonu yapılmasının da etkili olduğu dikkat çekmektedir. Altun ve ark. (2013) metanol ile elde edilen ekstraktların en yüksek antioksidan potansiyeli gösterdiğini bildirmişlerdir. Bir başka çalışmada, Kalogeropoulos ve ark. (2010) *Hypericum perforatum* bitkisinin metanolik ekstraktlarının DPPH yöntemi ile antioksidan kapasitelerini araştırdıkları çalışmada antioksidan potansiyeli 890.2 mg Trolox/g olarak belirlediklerini rapor etmişlerdir. Farklı bir çalışmada 7 *Hypericum* türünün etanol ekstraktlarında antioksidan potansiyellerini FRAP (3.7 µmol Fe²⁺/mg), DPPH (20.5 EC₅₀ µg/mL) ve ABTS (1.02 mmolTrolox/g) yöntemleriyle tespit etmişlerdir (Zdunic ve ark., 2017). Gıdık ve ark. (2022) yaptığı çalışmada sarı kantaron çiçeklerinde toplam fenolik madde miktarını 6.99-10.10 mg GAE/g, toplam flavonoid madde miktarını 3.63-4.00 mgQE/g ve toplam antioksidan kapasite içeriğini 108.42-144.54 µmol FeSO₄.7H₂O/g arasında belirlemişlerdir. Çalışma sonuçlarımız genel olarak birçok araştırmacı bulgularıyla uyumlu olup farklılığın daha çok kullanılan yöntemlerden kaynaklandığı söylenebilir. Bunun yanı sıra; coğrafi özellikler, bitki organı, toprak bileşimi, hasat zamanı, su kaynağı, sulama rejimi, gübre ve genotip gibi faktörler de biyokimyasal değişimler üzerinde etkili olan elementlerdir.

Sonuç

Antioksidanlar, gıdaların oksidatif bozunmasına karşı koruma sağlamak için gıda katkı maddeleri olarak yaygın bir şekilde kullanılmaktadır. Bu nedenle antioksidanlar gıda endüstrisinde çok önemli bir rol oynamaktadır. Antik çağlardan beri farklı gıda türlerinde tatları iyileştirmek için kullanılan baharatlar, antioksidan özellikleriyle tanınmaktadır. Antioksidan etki genellikle fenollerin ve flavonoidlerin varlığı ve bunların serbest radikal süpürücü aktiviteleri ile ilgilidir. Son zamanlarda gıda kaynaklı antioksidanlar, reaktif oksijen türleri (ROT) süpürme etkileriyle büyük ilgi görmüşlerdir. Günümüzde kullanılan sentetik antioksidanların sağlıksız olmasından, kullanımlarına kısıtlamalar getirilmiştir. Dolayısıyla, doğal kaynaklardan yani bitkilerden elde edilen antioksidanların, sentetik antioksidanların yerine ikame olması açısından da son derece önemli ve değerlidir. Çalışmada özellikle şifa kaynağı olarak kullanılan sarı kantaron çiçeğinde antioksidan etki gösteren fenolik ve flavonoid madde miktarının yeterli seviyede olduğu belirlenmiştir. Dolayısıyla, yüksek antioksidan aktivite potansiyeline sahip olduğu ve herhangi bir yan etkisinin olmadığı da dikkate



alındığında gerek hastalıkları tedavi etmede ve gerekse hastalıklardan korunma aşamasında sentetik ilaçlardan daha güvenli olduğu söylenebilir. Ayrıca, sarı kantaron bitkisinin tüm kısımlarının ayrı ayrı antioksidan içeriğinin izolasyonu ve karakterizasyonuna yönelik çalışmalar geliştirilebilir.



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**THE EFFECTS OF DIFFERENT PGR CONTENTS ON *IN VITRO*
ORGANOGENESIS, AND SHOOT PROLIFERATION IN KALANCHOE (*Kalanchoe
Blossfeldiana Poelln.*)**

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ABSTRACT

The propagation of Kalanchoe (*Kalanchoe blossfeldiana* Poelln.), an ornamental plant, through tissue culture has been studied. Leaf pieces explants of two different lines were used. The most appropriate propagation flow was tried to be determined by surface disinfection, media, and phytohormone combinations. The explants were subjected to surface sterilization for 12 minutes in 15% NaOCl + 3 drops of Tween-20. The leaf explants were induced regeneration on 0, 1 or 2 mg/L of 2, 4-D in the first experiment, for indirect shoot regeneration by callus induction. No significant result was obtained, and the use of 2,4-D was abandoned. In the second experiment, 8 different combinations of NAA, and BAP were used for propagation. MS Medium using 1.0 mg/L of BAP, and 0.5 mg/L NAA were found to be balanced, and positive in terms of shoots and roots induction and their growth rate. The addition of 0.1-0.3 mg/L GA₃ to the culture facilitated the shoots elongation. It was found necessary to develop, and amplify these formations by transferring them to subculturing by adding GA₃, and activated charcoal. Appropriate combinations were determined in each subculture study, and analyzed statistically. *Kalanchoe* shoots were incubated twice in growth medium induced 29.19±5.32 to 84.52±24.21 shoots/explants in the proliferation medium (MS medium containing GA₃ with or without BAP). For safe rooting stage, 3 different hardening treatments were applied. 1 mg/L BAP, induced the highest number of (7.16 ± 0.41) shoots per explant, but these were the shortest (4.532 ± 0.051 cm) in their length. The current study manifested the flow protocol for the *Kalanchoe* propagation through tissue culture.

Key words: Tissue culture, kalanchoe, ornamental plant, *in vitro*, clonal propagation



INTRODUCTION

Kalanchoe blossfeldiana (Crassulaceae family) is a perennial and succulent species (Eggl 2003, Kahraman, and Boyacı 2021). Kalanchoes are used as ornamental potted plants around the world (due to their abundant flowering, and low water, and nutrient demand), and contains medicinal values (Ofokansi et al., 2005; Nahar et al., 2008). Kalanchoe can be propagated from seed, or using leaf cuttings (Love 1980). Vegetatively propagated hybrid varieties dominate the market due to their uniform true to type growth, and attractive flower colors (Alton, and Pertuit 1992). Since, kalanchoe is a slow growing plant therefore it is extremely necessary to develop a tissue culture system for rapid production of plant for commercial, and medicinal purposes (Khan et al., 2006). It is a reliable way for propagating pathogen-free ornamental plants. It could be an innovative alternative to seed or cutting-based propagation. Considering that the cultivated varieties are developed from interspecific hybrids. Induction of heterozygosity may arise if the plants are reproduced through seed multiplication, Therefore, if use of tissue culture techniques, can help to reproduce true to type plants from leaf, and stem cuttings. This study, which is the first scientific study on *in vitro* propagation of the Kalanchoe species in Turkey, aimed to investigate the micropropagation possibilities of *K. blossfeldiana*, and the effects of different concentrations of auxin, and cytokinins, explant type, and nutrient media on shoot reproduction.

MATERIALS, AND METHODS

Two kalanchoe lines with pink, and red flowers, and different ontogenetic leaf shapes were used as explant. The plant material was obtained from a local company engaged in commercial flower production at Yalova. Kalanchoe leaves were subjected to surface disinfection by stirring in one to 1.5 % NaOCl containing 3 drops of Tween-20/liter for 12 min. This was followed by rinsing with sterile distilled water for 3 ×5 minutes each ending up with draining of water from last rinse, thereafter, the sterilized leaf explants were placed on sterile blotting paper for drying before culture. Care was taken to remove the leaf edges, and midrib of the leaves before cutting them into smaller leaf pieces to be used as explant. All these procedures were performed under aseptic conditions in a laminar flow cabinet. The leaf explants were cultivated in in Petri[®] dishes containing MS medium (Murashige, and Skoog 1962), pH 5.7±0.1 with 3% sucrose (SigmaAldrich), and solidified with 0.7% agar (Merck). The pH of the medium was adjusted before autoclaving using 0.1 N NaOH or 0.1 N HCl. The cultures were autoclaved under a pressure of 1.2 atmospheres at a temperature of 121°C for 20 minutes.



The cultures were maintained under constant darkness, at temperature of $25\pm 2^{\circ}\text{C}$ for 3 weeks (Minas 2007). These were switched to a photoperiodic regime of 16 hours light, and 8 hours darkness during the establishment stage, of two experiment. The first experiment used 2,4-D as growth regulator, and the second experiment was carried using 8 concentrations, and combinations of NAA, and BAP. In the first PGR experiment, 1 or 2 mg/L of 2,4-D was added to the MS medium as the main medium for indirect shoot regeneration by callus induction. No growth regulator was added to the medium used as control treatment. The measurements of the cultures at the end of 8 weeks were evaluated. In the second experiment, leaf explants were cultured on MS medium containing 8 different combinations, and concentrations of plant growth regulators [four doses of BAP (0.5, 1.0, 1.5, and 2.0 mg/L), and two doses of NAA (0.5, and 1.0 mg/L)]. At this stage, surface sterilization of the material was performed in 1.5% NaOCl solution + 3 drops of Tween-20 for 12 minutes. The incubation conditions were similar to those shown in the first experiment. When the 8th, and 12th weeks of the culture were completed, observations, counting, and evaluations were made. The developing shoots, were subcultured one time. Developing explant percentages, and the number of adventitious shoots at the end of the 8th, and 12th weeks were noted. The regenerants resulting from establishment stages were subcultured twice (12 weeks of growth on $\frac{1}{2} \times \text{MS}$ or $1 \times \text{MS}$ medium, and 0.3 mg/L GA₃, or in $\frac{1}{2} \times \text{MS}$, $1 \times \text{MS}$ medium with activated charcoal) for 4 weeks before multiplication in proliferation medium supplemented with cytokinin (BAP), and GA₃. At this stage, 3 nutrient media compositions were used; Medium A: MS + 0.3 mg/L GA₃, medium B: MS + 0.3 mg/L GA₃ + 0.3 mg/L BAP, medium C: MS + 0.3 mg/L GA₃ + 1.0 mg/L BAP. 10 jars in each medium, and 10 shoots were planted in each jar. In vitro propagated shoots were incubated in proliferation medium for 6 weeks. At the end of this period, some axillary shoots were also noted. These axillary shoots per shoot explant were also noted. The data were subjected to statistical analysis of variance for evaluation.

RESULTS, AND DISCUSSION

The establishment stage of the experiment using 2,4-D

The results indicated a very large number of explants were lost due to contamination in the two Kalanchoe genotypes used in establishment stage of culture, and that the rest of the explants did not develop sufficiently. Although 2,4-D is a synthetic auxin with high callus induction ability; low-strength callus formation was achieved only at a rate of 17.1% to 23.4% on Kalanchoe leaf explants. Contamination rates in plant material varied between 26.7, and 33.9%.



A significant portion of these contaminations was of fungal origin, and they began to show up after 4 days of culture. Previous researchers emphasize the possibility of endogenous contaminations (fungus, bacteria) in the intercellular spaces in the tissues as a possible reason. The type, concentration, and application time of the disinfectants to be used, affect the success of sterilization that vary according to the plant species, and explant. Therefore, there is need to take care during preparation of the explant, which should remain undamaged during working (Babaoğlu et al. 2002). The results of the current study (disinfection with 1% NaClO for 30 min) are in agreement with other researchers, where *Anthurium* spp., needed 15 minutes sterilization for scale leaves of *Hyacinthus*, 20 minutes for stem segments of *Rhododendron*, and 15 minutes on *Gerbera* leaves (Pierik, 1997). As a result of the counts made by excluding the contamination rate that occurred in the current study, around 30% induced no regeneration on the control treatment (hormone-free MS medium), and no shoot formation or calli induced on the explants after the 12th week following the culture. The leaf explants showed only some swellings on MS medium. Callus tissues did not occur at the cutting surfaces, and no morphogenesis, shoot or root formation was observed. In fact, Yuliang et al. (2004), Zhang, and Guo (2005), Linjian et al. (2006) also obtained the regeneration on nutrient medium used singly or after adding auxin, and cytokinin additives for shoot regeneration from leaf explants. Contrarily, Bhuiyan et al. (2006) reported regeneration from *K. blossfeldiana*, explants with use of plant growth regulators. They did not induce any regeneration on any medium or without use of growth regulators, and no regeneration was recorded in growth regulators-free MS medium. The 2,4-D is actually an herbicide used to kill (to inhibit the development) dicotyledonous plants (Clark, and Pazdernik 2015). It is also commonly used as a powerful plant growth regulator (auxin) at low concentrations (Kaynak, and Memiş 1997). Especially because it encourages callus induction, it gives successful results by stimulating organogenesis or somatic embryogenesis (Malik et al. 2004, Raghavan 2004) or in studies using callus tissue (Erdem et al. 1998). When an amount of this plant growth regulator is administered beyond a specific threshold, the growth regulator reacts with the tissues resulting in uncontrolled, and unsustainable callus growth, which eventually degenerates explants. Similar behavior of 2,4-D was observed in *Kalanchoe* leaf explants tissue culture. The leaf explants induced profuse callus culture ending up with necrosis, and non-regeneration. This is an indicated need of a careful selection of optimum dose of 2,4-D. Although Wang et al. (2003) with Shuanglong et al. (2006) successfully used 2,4-D combined with BAP in tissue culture studies to initiate cell division,



and somatic embryogenesis, yet there is no literature describing the use of 2,4-D used singly for this plant.

Experiment using 8 combinations of BAP , and NAA

The leaf explants continued their healthy development on MS medium containing 4 different growth regulator combinations made up of 0.5, 1.0, 1.5, 2.0 mg/L BAP +0.5 mg/L NAA in the first experiment. Shoot induction was noted on cut leaf edges over calli using all growth combinations regardless of their BAP+NAA concentrations, which showed several of shoots counts from each of these applications at the end of the 8th , and 12th weeks. All four dissimilar combinations of BAP + NAA in the two experiments were analyzed individually as shown in Table 1. The experimental results approved that all combinations of plant growth regulators had positive effect on shoot regeneration of Kalanchoe line 1 , and Kalanchoe line 2 showed variable suitability for shoot regeneration depending on the concentration of plant growth regulators. Both genotypes used in the study did not show parallel behavior against the growth regulator combinations. The maximum callus induction on line 1 ($80.00 \pm 2.5\%$) , and 2 ($78.6 \pm 2.50\%$) were statistically similar , and were noted on MS medium having 1.5 mg/l BAP+0.5 mg/l NAA. The lowest shoot induction of $58.8 \pm 0.5\%$, and $61.7 \pm 0.30\%$ for line 1 , and 2 was indicated , and recorded on MS medium having 1 mg/L BAP+ 0.5 mg/L NAA , and 0.5 mg/l BAP+0.5 mg/l NAA for line 2 in the same order. However, the shoot regeneration on Kalanchoe 2 was statistically similar on two other combinations of 0.5, or 2 mg/L BAP+ 0.5 mg/L NAA. Again, shoot induction was noted on cut leaf edges regardless of their BAP- NAA combinations, and concentrations. They showed variable number of shoot induction after 12 weeks (Table 1). However, shoot induction behavior on 8 weeks old culture, and 12 weeks old cultures was parallel but induction pattern was inconsistent. The experimental results noted that all combinations of plant growth regulators had a positive effect on shoot regeneration of Kalanchoe 1 , and 2 depending on the concentration of plant growth regulators. The maximum shoot induction on Kalanchoe 1 ($80.00 \pm 2.5\%$), and 2 ($79.2 \pm 2.50\%$) were statistically similar , and were noted on MS medium having 1 mg/L BAP+1 mg/L NAA. The lowest callus induction of 55.6 ± 0.8 , and 53.3 ± 0.80 for Kalanchoe line 1 , and 2 was recorded on MS medium having 1 mg/L BAP+0.5 mg/L NAA for both genotypes. The results corroborate the findings of Bhuiyan et al. (2006). They have also reported first noticeable developments by swelling of the tissues, multiplication of cells, and induction of calli at the leaf edges before shoot induction. The rapidly multiplying leaf tissues at the edges of the leaves induced indirect shoot regeneration facilitated by rapidly multiplying cells with swelling tissues. The explants



showed a gradual increase in the size of leaf explants with preservation of chlorophyll, and loss of green color.

Table 1. Effects of different concentrations of BAP, and NAA on shoot regeneration from two lines of *Kalanchoe* under *in vitro* conditions

Treatments (mg/L)		Shoot induction percentage (%)		Average number of shoots / explant after 8 weeks		Average number of shoots / explants after 12 weeks	
BAP	NAA	Line 1	Line 2	Line 1	Line 2	Line 1	Line 2
0.5	0.5	66.7±0.30 ^{b*} A [‡]	61.7±0.30 ^{bB}	0.27±0.02 ^d	0.42±0.08 ^c	2.65±0.48 ^d	2.87±0.82 ^d
1.0	0.5	58.8±0.5 ^{cB}	62.1±0.50 ^b A	0.50±0.06 ^c	0.61±0.09 ^b	3.84±0.63 ^c	3.67±0.75 ^c
1.5	0.5	80.0±2.5 ^{aA}	78.6±2.50 ^a A	2.0±0.56 ^b	2.89±0.21 ^{a-c}	5.03±0.44 ^b	5.36±0.62 ^b
2.0	0.5	68.2±1.25 ^b A	64.13±1.13 ^{bB}	3.02±0.36 ^a	3.95±0.42 ^a	9.35±0.95 ^a	8.83±0.87 ^a
0.5	1.0	70.0±1.00 ^{b*} B [‡]	75.0±1.00 ^b A	0.47±0.03 ^{dB}	0.53±0.08 ^{dA}	4.87±0.76 ^d A	4.48±0.76 ^d A
1.0	1.0	80.0±2.5 ^{aA}	79.2±2.50 ^a A	1.14±0.16 ^{cB}	1.28±0.26 ^{cA}	4.65±0.59 ^c A	4.06±0.74 ^c A
1.5	1.0	55.6±0.8 ^{dA}	53.3±0.80 ^d B	2.83±0.65 ^{Bb}	3.05±0.78 ^{bA}	7.38±0.78 ^B a	6.12±0.85 ^b B
2.0	1.0	65.5±1.50 ^c A	60.0±2.50 ^c B	4.05±0.73 ^{aA}	4.22±0.57 ^{aA}	11.23±1.26 ^{aA}	10.36±0.91 ^{Ab}

*All means shown by different small letters in a column are statistically different using Duncan's test at 0.05 level of significance

‡All means shown by different capital letters in a row are statistically different using test-test at 0.05 level of significance.

Sanikhani et al. (2006), regenerated commercial kalanchoe cultivars 'Debbie', 'Molly', 'Celine', 'Gold strike', 'Cora', 'Purple Jaqueline', and one interspecies hybrid 'African Yellow'; and observed significantly different rate of shoot regeneration on them based on genotypes, and composition of growth regulators. The results of the findings are also in line with this study, where distinguished differences were noted between the two-kalanchoe lines used in this study as shown in Table 1. The rate of shoot multiplication percentage after 8, and 12 weeks of culture demonstrated the performance of the media composition under different conditions. The results showed that all four sets of plant growth regulators' treatments showed improved shoot counts after 12 weeks compared to their counts after 8 weeks of culture. The results further showed a parallel increase in the shoot counts on 8, and 12 weeks of culture on both lines of *Kalanchoe*. Maximum number of shoots per explant ranged 0.27±0.02 - 3.02±0.36, and



0.42±0.08 - 3.95±0.42 in the first experiment on kalanchoe 1 after 8 weeks of culture in the same order. These counts increased proportionately to 2.65±0.48 - 9.35±0.95 , and 2.87±0.82 - 8.83±0.87 using 0.5 mg/L BAP+0.5 mg/L NAA , and 2 mg/L BAP+0.5 mg/L NAA in the same sequence. The experiment 2 showed improvement in the regeneration percentage after 8 , and 12 weeks of culture. Maximum shoot regeneration percentage was noted on Kalanchoe 1 , and Kalanchoe 2 using 2 mg/L BAP , and 1 mg/L NAA. Previous studies also report use of BAP, Kinetin along with NAA , and IAA for shoot regeneration from leaves , and petioles as explant sources. These studies document that NAA performs better than IAA, while, and BAP is superior to Kinetin in terms of kalanchoe regeneration. The researchers used 5.7 µM NAA, and 4.5 µM BAP, and found it as most prominent growth regulator combination to regenerate from leaf explants (Mercier , and Roggemans 1985, Schneider et al. 1985, Ionnau , and Ionnau 1992). They mentioned the presence of auxin, and cytokinin for shoot induction. Chen (2007), in their study to provide *in vitro* adventitious shoot regeneration from young leaf explants, produced the highest explant regeneration, and shoot development. Liang (2013) suggested very low levels of BAP, and NAA doses (0.5 mg/L BA + 0.1 mg/L NAA) in MS medium for appropriate development of adventitious shoots from leaf explants. Although, there is a general consensus on the use of BAP, and NAA combinations, there are differences between studies in terms of doses. It is certain that these differences are caused by the use of different genotypes in each study, and even if the same genotype is used, the seasonal, and ecological diversity in which kalanchoe is grown is reflected in the results. Moreover, environmental conditions, the nutrition of the plant, whether it is under stress, the period of development (flowering, sowing, old age) , and , of course, the genotype modify the results obtained from tissue culture (Witomska 2001, Dilik 2006). The experimental results as shown in Table 1, established that shoot formation increases with the increase in BAP dose. This increase becomes more pronounced when the balance between BAP , and NAA is achieved.

The proliferation stage

After each of the 4 different treatments on 1×MS , and ½×MS medium, profuse meristem formation was noted on the explants with remarkable shoot induction in the form of clusters with thin long shoots , and micro leaves as shown in the Figure 1. These shoots gained tremendous growth , and grew like dense bushes with axillary or lateral shoots starting from the bases of the regenerated shoots within 3-4 weeks of culture (Figure 1). In Table 2, the number of shoots per explant ranged 5.23 ± 1.56 - 7.10 ± 0.23. No statistical difference was found among the number of shoots per explant. However, the use of 1×MS medium with or



without GA₃ induced 7.10 ± 0.23 , and 6.02 ± 0.97 axillary shoots/explant in the same order. This next best regeneration medium induced 6.02 ± 0.97 shoots/cluster on 1×MS medium. $\frac{1}{2}$ ×MS medium containing 0.3 mg/L GA₃ induced 5.67 ± 1.67 , and 5.23 ± 1.56 shoots/cluster. However, there was no statistical difference in the number of shoots per cluster on the 1 or $\frac{1}{2}$ × MS medium ($p \leq 0.05$). Although $\frac{1}{2}$ × MS medium induced less shoot growth compared to 1×MS medium, because it induced a large number of shoots on 1 × MS medium with dense structure, shorter stature , and difficult separating from each other. $\frac{1}{2}$ ×MS medium induced shoots were few in number , and induced fewer shoots that could be separated after some time after vegetative maturity from the clusters developing on the leaf explants. For this reason, $\frac{1}{2}$ ×MS hormone-free or GA₃-added medium can be recommended as nutrient medium that will ensure the development, and strengthening of shoots before subcultures. When GA₃ was added to the MS medium, this medium was also evaluated as usable and acceptable.

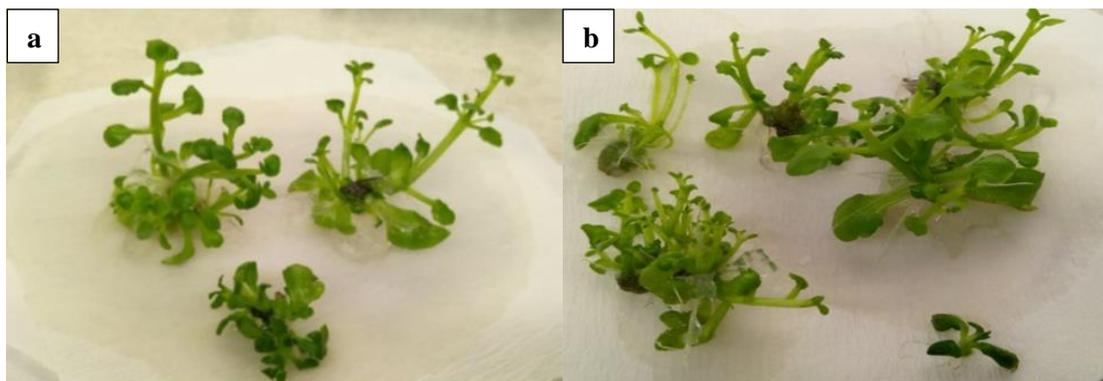


Figure 1. Development matured kalanchoe adventitious shoots with induction of lateral and new axillary shoots (a: $\frac{1}{2}$ ×MS medium; b: 1×MS medium with + 0.3 mg/L GA₃).

To develop, and extend the meristematic clusters , and shoot initiations formed after shoot differentiation in the initial setup stage, Bhuiyan et al. (2006) also used 'elongation medium' to ensure the elongation of very small , and bushy shoots formed on TDZ-containing medium. The researchers transferred them to hormone-free MS medium or medium containing any concentration of BAP. Additives at low doses (0.1-0.5 mg/L BAP) supported shoot elongation, and this effected (shoot elongation) with increased with 0.3 mg/L GA₃ added to MS or half-strength MS medium. New developing shoots were also matured in the above-mentioned manner. Thereafter, the 4th week of transfer into 3 different cultures including $\frac{1}{2}$ ×MS medium, 1×MS , and $\frac{1}{2}$ ×MS double layer medium with activated carbon, the shoots elongated , and multiplied easily. The kalanchoe shoots tended to multiply without transfer to a new medium that can be counted between 6-32 or more shoots per mother shoots (Figure 2).

At this stage, the most controlled improvement (elongation behavior) occurred in the double-layered medium with activated charcoal, which induced vegetative maturity, and detachable shoots during culture (Figure 3). Activated charcoal adsorbs toxic compounds secreted by plant tissues in tissue culture. It also retains some substances released during autoclaving of nutrient medium. It was proved by Fridborg et al. (1978) that activated charcoal adsorbs phenolic compounds. When nutrient media containing sucrose carbon source are autoclaved, 5-



hydroxymethylfurfural (HMF) substance that emerges increase acidity of the medium (Weatherhead et al. 1978).

Table 2. The amount of shoot formation in the media in 4 different compositions used in the shoot development stage

Type of medium	Treatments		Number of shoots / explant
	GA ₃ (mg/L)		
½×MS medium	0.00		5.67 ± 1.67 a
1×MS medium	0.00		6.02 ± 0.97 a
½×MS medium	0.30		5.23 ± 1.56 a
1×MS medium	0.30		7.10 ± 0.23 a
CV%			18.44

Kohlenbach , and Wernicke (1978), mentions that harmful effects can be eliminated by adsorbing activated charcoal. Activated carbon (or charcoal; AC) provides a dark medium in the basal part of the plant tissues under in vitro conditions, prevents the deterioration of auxins, and ensures that the development is balanced , and close to natural conditions; because plant growth regulators can lose their effectiveness under light (Nissen , and Sutter 1990). It is well established that activated charcoal prevents darkening and reabsorption of toxic substances by holding phenolic substances secreted by plant tissues, and inactivating enzyme activities such as polyphenol oxidase, and peroxidase (Tisserat 1979). They reported that the ethylene accumulated in the closed medium during the culture can also be adsorbed by the AC in the nutrient medium, thereby promoting a healthier growth of plants (Mensuali-Sooi et al. 1993). The results corroborate the findings of Deng et al. (2005), Wang et al. (2003), and (Ellialtıođlu and Yanmaz 1994), who recommend use of activated charcoal during vegetative maturity.

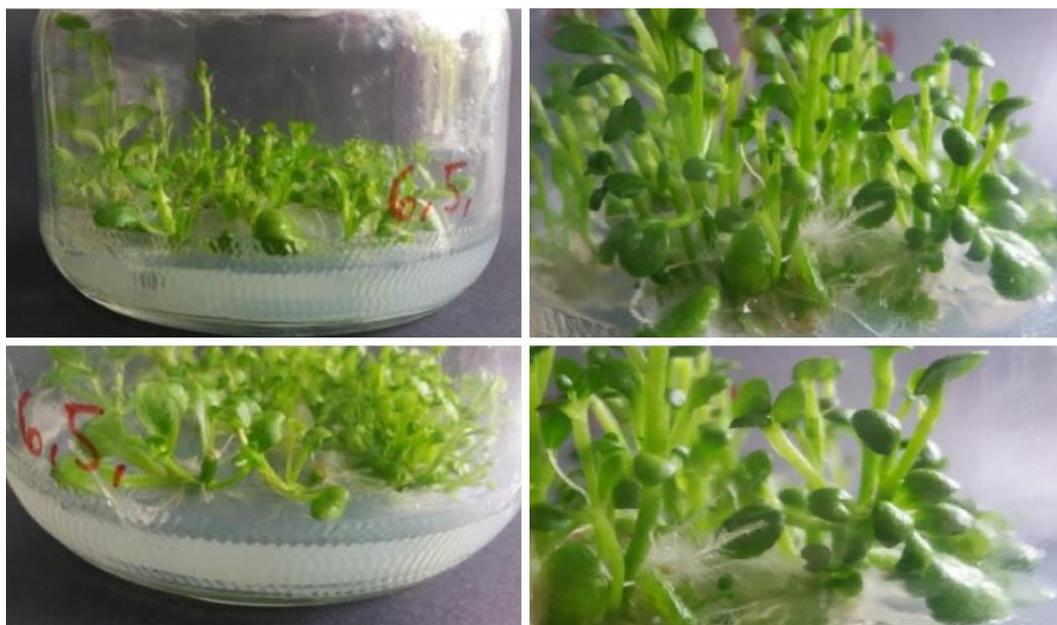


Figure 2. Development of *Kalanchoe* shoots in ½MS (left) , and full MS (right) nutrient media.



Figure 3. Development of Kalanchoe shoots in double-layer medium containing $\frac{1}{2}$ MS medium+ activated charcoal.

Shoot propagation stage

As can be seen from the table, and the figures, the transfer of in vitro grown shoots to media containing BAP has caused an explosion in terms of the proliferation of shoots. In Table 3, the average number of shoots taken from 10 explants was given.

Table 3. The amount of shoot formation in the media with 3 different compositions used in the shoot propagation stage.

Nutrient medium	Shoot formation / 10 explants (jar)	Shoot formation / explant
MS+ 0.3 mg/L GA ₃	291.90± 53.19 c	29.19±5.32
MS+ 0.3 mg/L GA ₃ +0.3 mg/L BAP	845.20± 242.08 a	84.52± 24.21
MS + 0.3 mg/L GA ₃ + 1.0 mg/L BAP	638.50± 269.18 b	63.85± 26.92
%CV	31.79	
Nutrient medium	**	

**The differences between groups with different letters in the column are statistically significant (P≤0.05)

However, when Figures 4 , and 5 are compared together, it is possible to see that both media contain dense shoots, but there is more mass shoot formation that is short, and inseparable in the media using 1.0 mg/L BAP. High doses of cytokinin's have generally been found to be unnecessary or even unfavorable for kalanchoe multiplication. The MS medium with + 0.3 mg/L GA₃ ranked third statistically different from the other two cultures, and gave 29.19±5.32 shoots per explant. Although the number of shoots is the least (but sufficient for micropropagation), it has established itself as the most preferable medium due to its state of development.



Figure 4. Axillary shoot formation in *in vitro* *Kalanchoe* cultures after 6 weeks of incubation in proliferation medium with MS + 0.3 mg/L GA₃ + 0.3 mg/L BAP composition.

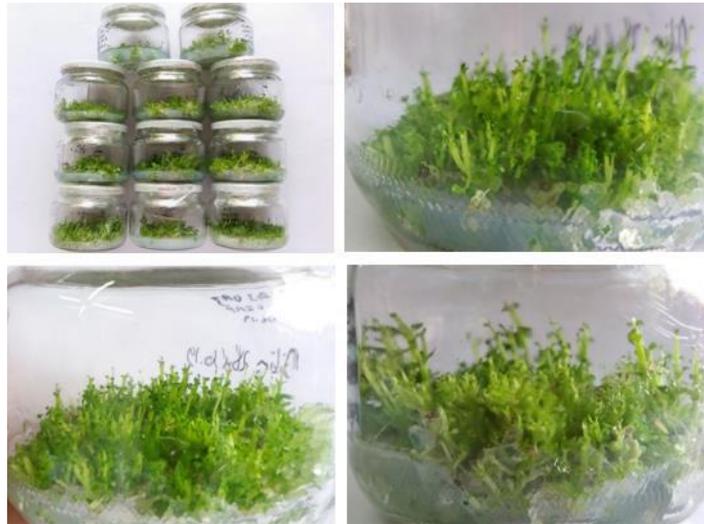


Figure 5. Axillary shoot formation in *in vitro* *Kalanchoe* cultures after 6 weeks of incubation in proliferation medium containing MS + 0.3 mg/L GA₃ + 1.0 mg/L BAP.

Hardening stage

At this stage, which includes the formation of dense axillary shoots, and the reduction of side branch formation, the existing shoots are thickened, vegetatively mature and made suitable for rooting; the composition of the previous treatment showed carry over effects during shoot proliferation. Accordingly, in the medium where 1 mg/L of BAP was used, the highest shoot number was obtained with 7.16 ± 0.41 per explant, but these were the shortest shoots (4.532 ± 0.051 cm). With the decrease of the BAP dose to 0.3 mg/L, the number of shoots formed slightly decreased (6.21 ± 0.21 shoots/explants), and their length was slightly longer (54.65 ± 1.24 mm) (Table 4). Benzyl amino purine (BAP) is one of the most widely used growth regulators for the formation of axillary shoots in tissue cultures.



Table 4. The carry over effects on in the amount of shoot formation , and shoot length in the hardening stage. (the data on the hardening media of the shoots separated according to their origin media).

The nutrient medium from which the shoots are supplied	Axillary shoot formation / shoot transferred to the hardening medium	Average shoot length (mm)
MS+ 0.3 mg/L GA ₃	4.62 ± 0.39 c	69.77±1.43 a
MS+ 0.3 mg/L GA ₃ +0.3 mg/L BAP	6.21± 0.21 b	54.65±1.24 b
MS + 0.3 mg/L GA ₃ + 1.0 mg/L BAP	7. 16± 0.41 a	45.32± 0.51 c
CV%	5.58	1.87
Nutrient medium	**	**

**The differences between groups with different letters in the column are statistically significant (P≤0.05)

It promotes division in plant cells, eliminates the effect of auxin to create apical dominance, and stimulates the development of lateral shoots from the basal part (Kumar , and Reddy 2011). Plant tissues grown in nutrient media accumulate substances in the medium, and they can still maintain their effect when transferred to the next medium. For this reason, shoots taken from a medium containing high doses of BAP continued shoot proliferation at a higher level, although BAP was not present in the setting medium. Those from low-dose BAP medium had less proliferation, while shoots from medium without cytokinin had the lowest number of shoots in the hardening medium. The longest shoots (69.77±1.43 mm) were obtained in ½×MS medium without adding BAP , and containing GA₃ only, which induced minimum number of shoots per explant (4.62 ± 0.39 shoots/explants) compared to the other two media. GA₃ (gibberellic acid) were added to in vitro nutrient media to elongate the internodes, and to ensure the development of meristem tissues or buds (Pierik 1997). In Table 4, The average shoot length was found to be maximum in the medium containing GA₃ only, with statistically significant differences. As shoot numbers is increased due to BAP, it was possible to grow in vitro shoots in a balanced, and healthy medium with activated charcoal. The differences emerged in the shoot development were balanced, and therefore eliminated after treatment with activated charcoal.

CONCLUSIONS

The results obtained from this study, are summarized below:

1. *K. blossfeldiana* is a species prone to propagation by tissue culture, and leaf explants are a convenient source of the explants.



2. Responses from *Kalanchoe* tissue culture may differ according to plant genotype. The differences that emerged in the early stages of culture, especially during organogenesis, and shoot propagation, disappeared with the equalization of endogenous hormone levels in the tissues in subcultures. For this reason, it has been concluded that the protocols developed , can be implemented without worrying about the somaclonal variations.
3. When the cytokinin , and auxin balance is well adjusted, both a sufficient number of shoot differentiation can be obtained as starting material, and shoots larger than 0.5 cm are easily separated from each other.
4. For explant superficial sterilization, 1.0-1.5% commercial bleach can be used by subjecting them to 12 minutes treatment followed by 3 times rinsing with sterile distilled water.
5. The use of 2,4-D was abandoned as no shoot regeneration was noted on the explants that were not treated with 2,4-D, and used as control treatment where shoot differentiation could not be achieved. It has been observed that PGR's are needed for in vitro regeneration.
6. It was concluded that MS medium in which 1.0 mg/L BAP and 1 or 0.5 mg/L NAA are used could be a good starting environment for the regeneration of new *Kalanchoe* shoots from leaf explants. Increasing the dose of BAP increases the number of shoots formed, but makes it difficult for them to separate from each other during the transfer phase, and they tend to develop in the form of bushes.
7. Addition of GA₃ to the medium did not make a remarkable difference on the induction of number of shoots, but promoted distinguishable healthy shoot growth. Therefore, 0.2 mg/L GA₃ supplementation may be recommended during the culturing of leaf explants.



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AMASYA İLİ MEYVE TOPTANCI HALİNDE KİRAZ ALIM VE SATIMI YAPAN İŞLETMELERİN YAPISI VE SORUNLARI

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ÖZET

Bu çalışmanın amacı; Amasya ili meyve toptancı halinde kiraz alım satımı yapan işletmelerin yapısı ve halde karşılaşılan sorunların neler olduğunu tespit etmektir. Bu amaca ulaşmak için ilk aşamada; Amasya ili meyve halinde faaliyet gösteren 32 kiraz komisyoncusu ile görüşülmüştür. Araştırmada kullanılan veriler toptancı halindeki kiraz alım satımı ile uğraşan işletmelerle anket yapılarak ve Hal Müdürlüğü ile yapılan görüşmelerle toplanmıştır. Verilerin değerlendirilmesinde ise IBM SPSS® programından yararlanılmıştır ayrıca verilerin faktörler bakımından karşılaştırma yapılması ve değerlendirmesinde yüzde hesabı, basit aritmetik ortalama, Tablo ve grafik gibi çeşitli tekniklerden yararlanılmıştır. Araştırma bölgesinde görüşülen komisyoncuların tamamı, toptancı halinde belediye tarafından kendilerine verilmiş olan işyerlerinde pazarlama faaliyetlerini sürdürmektedirler. Hal içerisinde üretici birliklerine ve herhangi bir kooperatife rastlanmamıştır. Ürünlerin hal içerisinde muhafaza edilmesi amacıyla soğuk hava depolarının hem hal içerisinde hem de il merkezinde kullanabilecekleri depoların mevcut olduğu tespit edilmiştir. Kiraz ticaretinde önemli faktörün, mevsim olduğu ortaya çıkmış ve ürünlerin o bölgede yetişiyor olması ürünün alım-satımında yoğunlaşmaya sebebiyet verdiği tespit edilmiştir. Ayrıca komisyoncular, hal dışı satışların sebebinin denetim yetersizliği ve yasal kesintilerden kaçınma olduğunu ifade etmektedirler. Toptancı haline mensup tüm işletmelere iş kazalarına karşın ilk yardım eğitimi öğrenme, teknoloji kullanımının artırılması, hal dışı satışların engellenmesi ve ticari faaliyetlerinin aksamaması için kooperatifleşme ayrıca yeni hal inşaatı önerilmektedir.

Anahtar kelimeler: Amasya, Kiraz, Komisyoncu, Meyve, Toptancı Hali, Tüketici, Üretici.



STRUCTURE AND PROBLEMS OF BUSINESSES BUYING AND SELLING CHERRY AS FRUIT WHOLESALE IN AMASYA

ABSTRACT

The aim of this study is to determine the structure of the businesses that buy and sell cherries in the form of fruit and vegetable wholesalers in Amasya province and what are the problems encountered in this situation. In the first stage to achieve this aim; Interviews were made with 32 cherry brokers operating in the fruit and vegetable sector in Amasya. All of the brokers interviewed in the research area carry out their marketing activities in the workplaces given to them by the municipality as a wholesaler. No producer associations or any cooperatives were found in the state. It has been determined that there are warehouses that can be used both in the market and in the city center in order to keep the products in the wholesale market. It has been revealed that the important factor in the cherry trade is the season, and it has been determined that the fact that the products are grown in that region causes concentration in the trading of the product. In addition, brokers state that the reason for out-of-wholesale market sales is lack of supervision and avoidance of legal cuts. IBM SPSS® program was used in the evaluation of the data, and various techniques such as percentage calculation, simple arithmetic average, charts and graphs were used in the comparison and evaluation of the data in terms of factors. It is recommended that all businesses belonging to the wholesale trade become cooperative and also build a new market in order to learn first aid training against work accidents, to increase the use of technology, to prevent non-market sales and to prevent commercial activities.

Keywords: Amasya, cherry, broker, fruit, wholesale market, consumer, producer



1.GİRİŞ

Türkiye, iklim özellikleri ve coğrafi yapısı açısından birçok tarım ürününün yetiştirildiği nadir ülkeler arasında yer almaktadır. Ülkemizde, çeşit zenginliğiyle yaygın bir biçimde bir çok ılıman iklim meyve türleri yetişmektedir. Kiraz, bu meyve türleri arasında önemli bir yer tutmaktadır (Özçağiran, 1974). En fazla üretimin, alım satımının ve ihracatın yapıldığı tarım ürünleri içerisinde bulunan, ülke ekonomisinde sağladığı katkı ile önemli bir yer edinen kiraz üretimi yıllar itibariyle artış göstermektedir. Amasya arazi yapısı, iklim özellikleri ve bitkisel çeşitliliğinin yüksek olması bakımından tarımsal potansiyeli oldukça büyük illerimizdendir. Bu potansiyel Amasya ilini, ülkemizin ve Karadeniz bölgesinin önemli kiraz üreticisi illerinden biri haline getirmekte ve alım satımının yüksek ekonomik rakamlara ulaşmasını sağlamaktadır.

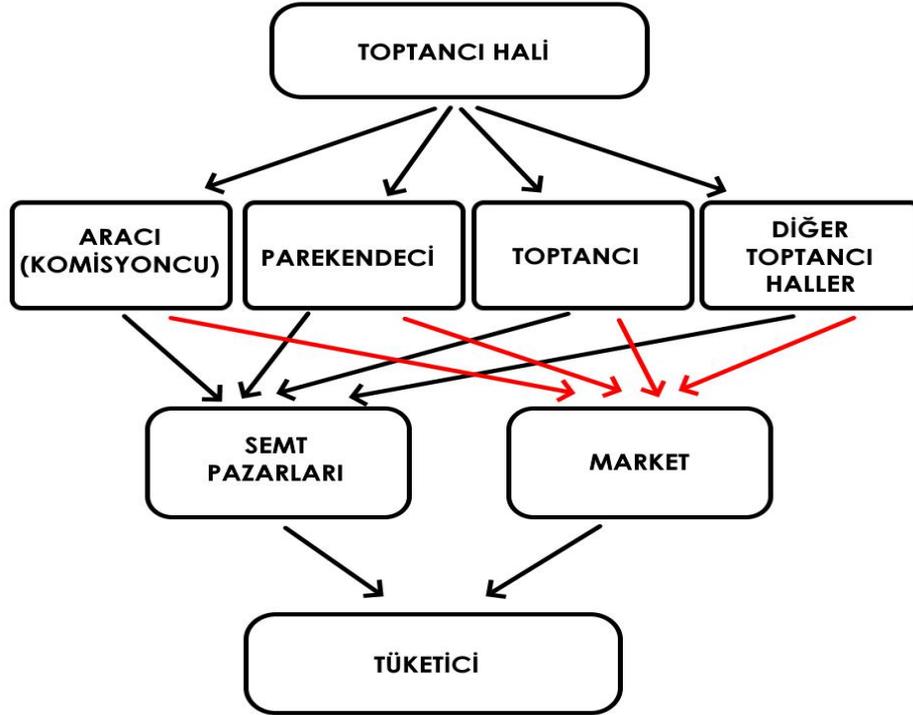
Tablo 1. Amasya İlinde Kiraz Üretimi ve Kiraz Rakamları (TÜİK, 2020)

Meyve Veren Yaşta Olan Ağaç Sayısı (Adet Sayısı)	857.679
Meyve Vermeyen Yaşta Olan Ağaç Sayısı (Adet Sayısı)	287.176
Toplu Meyve Bahçelerinin Alanı (Dekar)	26.280
Ortalama Verim (Kg/Meyve Veren Ağaç)	41
Üretim Miktarı (Ton)	34.926

Kiraz üretiminde ilk 10 il içerisinde olan Amasya ili son yıllarda üretim hacminde süreklilik sağlanamamasına ve dalgalanmalar yaşamasına karşın, ağaç başı ortalama 41 kilogram ve toplamda 34.926 ton kiraz üretimi ile bölgesi için en önemli kiraz pazarı konumundadır. Amasya ilinin tarım yapılan 230.998 hektar tarım arazisinin 26.280 dekarında kiraz üretimi yapılmaktadır. Bu arazilerde meyve veren yaşta ağaç sayısı 857.679 ve meyve vermeyen yaşta ağaç sayısı ise 287.176'dır. Bu ağaçlardan yıl ve iklim koşullarına bağlı değişiklikler olmakla birlikte son 5 yılın kiraz üretimi ortalamasına göre yıllık 34 bin ton kiraz üretilmektedir. Kiraz, raf ömrünün kısa olması, üretim bölgeleri, işlenebilme özellikleri ve üreticinin pazarlamada geleneksel alışkanlığı gibi birden fazla etmene bağlı olarak birçok farklı kanallardan pazarlanmaktadır. Toptancı haline gelen tarım ürünleri komisyoncu ve toptancılar başta olmak üzere diğer satış kanallarıyla çiftçiden alınmaktadır. Komisyoncu, perakendeci, toptancı ve diğer toptancı hallerinden gelen satıcılar, ürünlerini semt pazarlarından gelen satıcılar veya market temsilcilerine satmaktadır. Kiraz ticaretinde bir aracı olan toptancı hallerinin, toptan meyve alım satımında önemli bir yere sahiptir. Türkiye'de meyve pazarlanmasında, toptancı halleri ve bu hallerde faaliyet gösteren satıcılar, semtlerde bulunan pazarlara ve diğer satıcılara



mal temin eden komisyoncular, oldukça etkin bir biçimde görev almaktadır (Şekil 1). Toptancılar faaliyet buldukları bölgelerde tüketicilerin kiraz ihtiyaçlarını bilmekte, buna göre tüketici taleplerini sunmakta ve hal içerisindeki işyerlerinde bu faaliyetlerini sürdürmektedirler. Toptancı hallerinde de kiraz alım satımı Mayıs ve Haziran aylarında Amasya İlinde en önemli ekonomik faaliyeti haline gelmektedir. Sahip olduğu farklı ekolojik koşulları nedeniyle bölgedeki diğer illere istinaden daha erken dönemlerde ürün hasat edilmekte, iç ve dış piyasalarda ticareti yapılmaktadır. Meyvelerin alım satım durumu, o günkü şartlara göre değişiklik gösterebilir olmasına karşın meyve pazarlamasında toptancı hallerinin oldukça büyük bir önemi bulunmakta ve ürün pazarlamasının ilk basamağını oluşturmaktadır.



Şekil 1. Meyve Pazarlama Kanalları

Tarım ürünlerinin pazarlanmasında toptancı halleri üzerine birçok araştırma yapılmıştır (Demirbaş, 2000; Bayuk, 2000; Yılmaz ve Yılmaz, 2002; Turhanoğlu, 2003; Aydemir,2006; Kadanalı ve Dağdemir, 2013; Laledemir, 2014; Çoşkun ve Tunalıoğlu, 2015; Yurdakul, 2018; Can ve Engindeniz, 2018). Toptancı hallerinin işleyişindeki mevzuat hakkında da çalışmalar bulunmaktadır (Demirbaş, 2000; Gözener ve Sayılı, 2011; Adanacıoğlu ve Yercan, 2012;



Ölmez ve Demirörs, 2015; Yıldız ve Tunalıoğlu, 2020). Bu çalışmalarda toptancı halleri için geçerli olan mevzuatlar çeşitli yönleriyle irdelenmiştir. Türkiye’de toptancı hallerinin sorunlarının tespit edilmesi ve çözüm önerilerinin getirilmesi hakkında da çalışmalar yapılmıştır (Yılmaz, 2007; Civelek 2011; Kahraman, 2012; Yurdakul, 2014) Bu çalışmalarda toptancı hallerinin yapıları, işleyiş durumları, toptancı hallerinde karşılaşılan sorunların neler olduğu tespit edilmiş ve bu problemleri çözmek üzere çeşitli öneriler ortaya koyulmuştur. Toptancı halleri üzerine çok fazla çalışma olmasına rağmen Karadeniz bölgesinin tarım potansiyeli en yüksek illerinden Amasya ilinde böyle bir çalışmaya rastlanılmamıştır. Yapılan bu araştırmada, Amasya İli Meyve Toptancı Halinin yapısı, işleyişi, hal bölgesinde karşılaşılan sorunları ve bunlara ilişkin çözüm önerilerinin bulunması amaçlanmaktadır. Yapılan araştırmada elde edilen bulgu ve sonuçlar; üreticiler, komisyoncular ve tüketiciler için önemli yarar sağlayabilecektir.

2. MATERYAL VE METOT

2.1. MATERYAL

Araştırmanın ana materyalini Amasya toptancı halinde bulunan kiraz alım satımı yapan 32 işletmeden anket yoluyla toplanan veriler ile toptancılarla yapılan görüşmelerden edinilen veriler oluşturmaktadır. Araştırmada ayrıca Türkiye İstatistik Kurumu (TÜİK), Birleşmiş Milletler Tarım ve Gıda Örgütü (FAO) ve Amasya Belediyesi Hal Müdürlüğü verileri ile daha önce yapılmış araştırma sonuçları kullanılmıştır.

2.2. METOT

Araştırmada kullanılan metotları verilerin toplanma aşamasında kullanılan metotlar ve analiz aşamasında kullanılan metotlar olmak üzere iki alt başlıkta incelemek mümkündür.

2.2.1. VERİ TOPLAMA AŞAMASINDA KULLANILAN METOTLAR

Araştırmada kullanılan işletme düzeyindeki veriler toptancı halindeki kiraz alım satımı ile uğraşan 32 işletmeden yüz yüze doldurulan anketler ile toplanmıştır. İşletmelerden toplanan veriler 2020 yılına aittir. Araştırma toptancı halinin yapısı ve sorunları incelenmiştir. İncelenen toptancı halinin yapısı ortaya konulurken araçlar tarafından alım-satımı yapılan ürünler, kiraz üretimi, tedarik şekli, satış hacmi, satışların dağılımı, ulaşım şekilleri, muhafaza, soğutma değişkenleri ele alınmıştır. Sorunlarında ise komisyoncu sayısının ürünleri sunmada ve fiyattaki olumsuz etkileri, muhafaza depoları eksikliği, yaklaşma, yükleme, boşaltma peronları ihtiyacı, yapılan yasal kesintiler (KDV, stopaj vb.), vergi ve yeni hal yasası değişkenleri dikkate alınarak ortaya konmuştur. Toptancı halinin yapısı ve sorunlarını değerlendirmek amacıyla yapılan



görüşmeye Amasya İli Meyve Toptancı Hali Komisyoncular Derneği Başkanı ve Amasya Belediyesi Hal Müdürü katılmıştır.

2.2.2. VERİLERİN ANALİZİNDE KULLANILAN METOTLAR

Araştırmada, komisyonculuk faaliyeti gösteren işletmelerle yapılan anket çalışmasından edinilen bulgu ve bilgiler değerlendirilme yapılırken önce anketler üzerinde yapılması gereken hesaplamalar ve düzenlemeler yapılmış, sonra bu veriler bilgisayar ortamına aktarılmıştır. Verilerin değerlendirilme aşamasında ise IBM SPSS® programından yararlanılmıştır. Çalışma konusuyla alakalı ikincil verilerin ve yapılan anketler sonucunda ortaya çıkan birincil verilerin faktörler bakımından karşılaştırma yapılması ve değerlendirmesinde yüzde hesabı, basit aritmetik ortalama, Tablo ve grafik gibi çeşitli tekniklerden yararlanılmıştır. Anket sonuçlarından elde edilen veriler, şekiller ve Tablolar halinde sunulmuştur. İşletmeler üzerinden elde edilen veriler değerlendirilirken önce, Amasya ilinde meyve toptancı halinde faaliyet gösteren kiraz komisyoncularının kendi durumları ortaya koyulmuş, sonras işletme sahipleri bir bütün olarak değerlendirilmiştir. Ortaya çıkarılan sonuçlar ile yapısal durum ve sorunlar karşılaştırılmıştır. Komisyoncu hakkında genel bilgiler; aile nüfusu yaş grupları, cinsiyet ve eğitim durumları bakımından incelenmiştir. Nüfus miktarının belirlenmesinde, işletme sahipleri ve ailesiyle birlikte bulunan mevcut kişi sayısı dikkate alınmıştır. İşletme sahiplerinin eğitim düzeyi belirlenirken öğrenim süreleri yıl olarak dikkate alınmıştır.

3. BULGULAR VE TARTIŞMA

3.1. DEMOGRAFİK BİLGİLER

Tablo 2. Demografik Bilgiler

		Frekans	Yüzde (%)	Toplam Yüzde (%)
Eğitim seviyesi	İlkokul mezunu	5.0	15.6	15.6
	Ortaokul mezunu	2.0	6.3	21.9
	Lise mezunu	22.0	68.8	90.6
	Önlisans/Lisans	3.0	9.4	100.0
		Minimum	Maksimum	Ortalama
Yaş		27.0	59.0	42.0
Ailedeki kişi sayısı		2.0	12.0	5.2
Ailedeki komisyonculukla uğraşan kişi sayısı		1.0	7.0	2.0
Kendi adına kiraz ticareti ile uğraşma süresi (yıl)		0.4	40.0	19.8
Hal içinde kiraz ticaretiyle uğraşma süresi (yıl)		0.4	40.0	15.9
Hal dışında kiraz ticaretiyle uğraşma süresi (yıl)		2.0	12.0	5.2



İşletme sahipleri ile yapılan anket sonucunda ortalama yaş 42, minimum yaş değeri 27, maksimum yaş değeri 59 çıkmıştır. Daha önce yapılan çalışmalarda ise işletme sahiplerinin ortalama yaşları Tokat ilinde 47.9 (Gündüz ve ark., 2005), Tokat ilinde 45 yıl (Gözener ve Sayılı, 2011), Antalya ilinde 40 yıl (Yılmaz, 2008), İstanbul, Bursa, İzmir ve Antalya illerinde 41 yıl (Çetin,2009) olarak bulunmuştur. Bu işletme sahiplerinin %15.6'sı ilkokul, %6.3'ü ortaokul, %68.8'i lise mezunu, %9.4'ü yüksekokul/fakülte mezunudur. Türkiye'nin değişik illerinde tarım ürünleri ticareti alanında yapılan diğer çalışmalarda komisyoncuların eğitim düzeyi %53.8 ile ortaöğretim, (Çetin, 2009) %53 ile lise, (Gündüz ve ark., 2005) %40 ile lise olarak tespit edilmiştir. Bunun sonucunda eğitim seviyesi ve komisyonculuk mesleği arasında anlamlı bir ilişki bulunmadığı sonucuna varılmıştır. Aileler ortalama 5 kişiden oluşmakta ve bu ailelerde en az 2 kişi, en fazla ise 12 kişi bulunmaktadır. Ailelerde kiraz komisyonculuğu işiyle ortalama 2 kişi uğraşmaktadır. Aileler içerisinde en az 1, en fazla 7 kişi komisyonculuk işiyle ilgilenmektedirler. Kiraz ticaretiyle uğraşan işletme sahiplerinin ortalaması 19.875 yıl bulunmuş, işletme sahiplerinin en az 4 ay, en fazla 40 yıl kiraz ticareti yaptıklarının sonucuna varılmıştır. Ayrıca hal içerisinde kiraz ticaretiyle uğraşanların yıl ortalaması 15.906 bulunmuştur. İşletmeler, en az 4 ay ile en fazla 40 yıl, hal içerisinde kiraz ticaretini gerçekleştirdiklerinin sonucu elde edilmiştir. Hal dışında kiraz ticaretiyle ortalama 5 yıldır uğraşılmaktadır. İşletmelerden en az 2, en fazla 12 yıl, hal dışı kiraz alım satımı yapılmaktadır. Daha önce yapılmış çalışmada Tokat ili merkez ilçede toptancı halinde faaliyet gösteren komisyoncuların bu işte çalışma süreleri ortalama 25.07 yıl bulunmuş, halde faaliyette buldukları süre ise 19.04 yıl (Gözener ve Sayılı, 2011) olarak bulunmuştur. Bu hal dışı kiraz ticareti seyyar pazarlar, halk pazarları ve işletmelerin kendi marketleri üzerinden yapıldığının sonucuna varılmıştır.

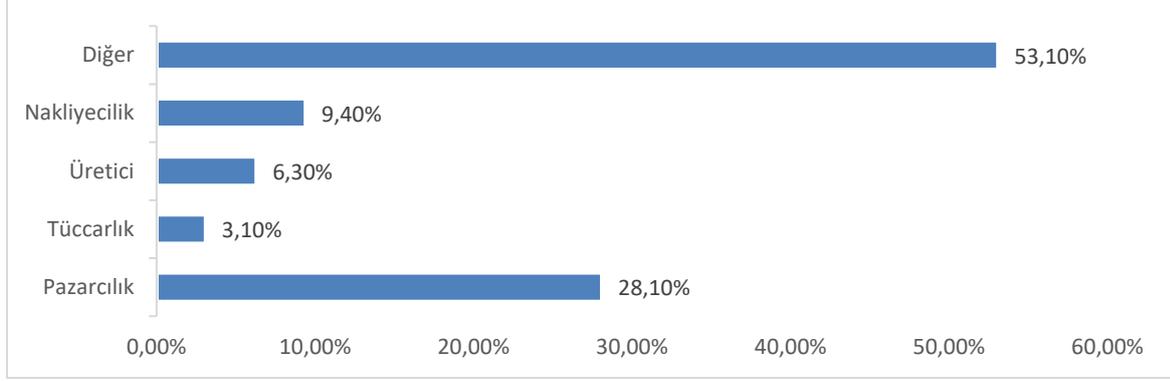
3.2. YAPISAL ÖZELLİKLER

Yapılan bu çalışmada toplanan bilgi ve verilere göre Amasya meyve halinde kiraz alım satımı ile uğraşan işletmeler arasında %12.5'i herhangi bir tarımsal kooperatife üye iken, %87.5'inin herhangi bir tarımsal kooperatife üyelikleri bulunmamaktadır. Türkiye'de Yaş Meyve-Sebze Pazarlamasında Toptancı Hallerinin Etkinliği, Karşılaşılan Sorunlar ve Çözüm Önerilerinin (Kahraman, 2012) incelendiği çalışmada İzmir ilinde işletmelerin %65'inin kooperatif üyeliği bulunmaktadır. Bu oranın %60'mı Tarım Kredi Kooperatifi ile Tariş oluştururken, %5'ini ise Tarımsal Kalkınma Kooperatifi oluşturmaktadır. İşletmelerin büyük çoğunluğunun herhangi bir tarımsal kooperatife üye olmaması oldukça dikkat çekicidir. Hal komisyoncularından %34.4'ü ticaret dışı gelir sağlarken, % 65.4'ünün ticaretten başka gelirinin olmadığı



gözlenmektedir. Komisyonculukla uğraşan kişilerin yarısından fazlasınının geçimini bu işten karşıladığı anlaşılmaktadır.

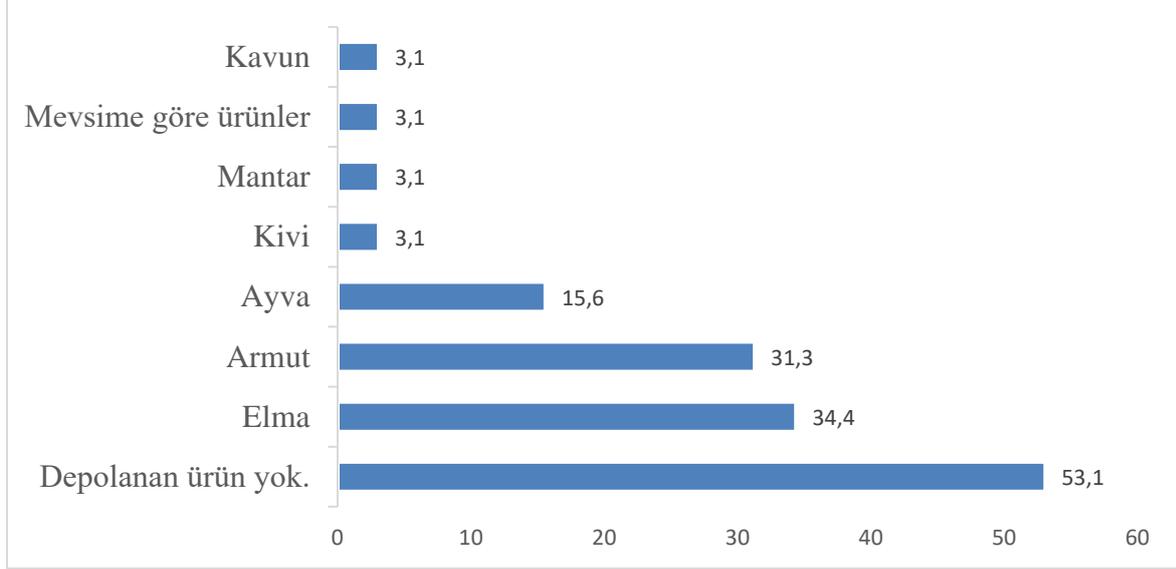
Şekil 2. İşletme Sahiplerinin Halde Çalışmadan Önceki Meslekleri



Halde çalışmadan önce işletme sahiplerinin % 28.1'i pazarcılık, %3.1'i tüccarlık, % 6.3 üreticilik, % 9.4'ü kişi nakliyecilik ile uğraştıklarını belirtmişlerdir. İşletmelerin içinden %53.1'i ise diğer cevabını vermiştir. Haldeki işletmeler arasında % 9.4'ü sadece sebze, %12.5'i meyve ve %78.1'i hem meyve hem sebze ticaretiyle uğraşmaktadırlar. Bu tablodan hal içerisinde sebze ve meyve ticaretinin %78.1 oranında birlikte yapıldığı görülmektedir. İşletmeler arasında hal içinde 81.3'ü kendi adına bu işi yürütürken, %18.7'si ise müvekkili adına kiraz ticaretiyle uğraşmaktadır. İşletmeler, tüketici ayırt etmezsiniz her türlü satışı yapmaktadır. Gerçek veya tüzel kişiler; sandık, kasa, çuval gibi o mala ait asgari miktarını talep etmek kaydıyla istedikleri ürünü satın alabilmektedirler. Tarım ürünlerinin pazarlanmasında toptancı hallerinin incelendiği (Can ve Engindeniz, 2018) çalışmada komisyoncuların sattıkları tarım ürünlerini satın alan tüketicilere bakıldığında 31 komisyoncu sayısı ile pazarcıların en başta yer aldığı görülmektedir. Pazarcıları, 18 komisyoncu ile süpermarketler, 11 komisyoncu ile bireysel tüketiciler ve 5 komisyoncu sayısı ile marketler takip etmektedir. İzmir ilinde yapılan diğer bir çalışmada (Kahraman, 2012) ise halden yapılan satışların yüzdesel dağılımı incelendiğinde %42'lik oranla pazarcılar ilk sırada almaktadır. %25 ile süpermarketler, %19 ile manavlar, %9 ile okul ve hastaneler, %5 oranı ile de yemek fabrikaları pay edinmektedir.



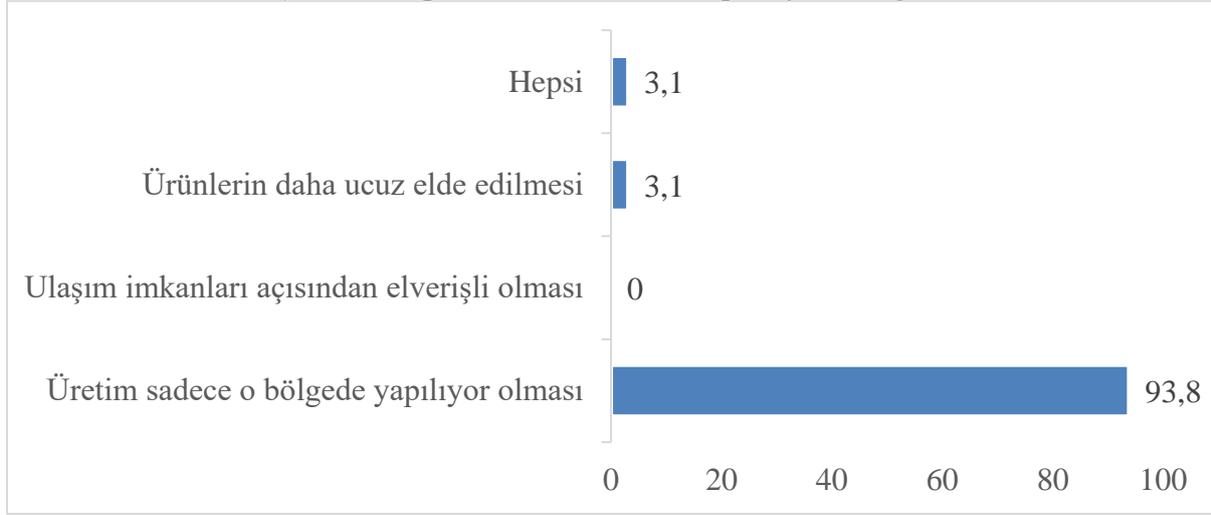
Şekil 3. Depolanan Tarımsal Ürünler



Görüşülen işletmelerden %53.1'i ürün depolamamaktadır. En çok depolanan ürünler sırasıyla %34.4 elma, %31.3 armut ve %15.6 oranında ayvadır. Kirazın ise raf süresinin az ve depolanma imkanının olmamasından dolayı depolanmadığının sonucuna varılmıştır. Depolama işleminde ise işletmelerin % 59.4'ü soğutma sistemli depo kullanırken, doğal depoları tercih edenlerin oranı ise %40.6'dır. Çoşkun ve Tunalıoğlu (2015) tarafından Aydın ilinde yapılan çalışmada komisyoncuların %72.1'sinin kendisine ait deposunun olmadığı sonucuna varılmış, ayrıca komisyoncuların %24.4'ü kendilerine ait soğuk hava deposuna sahip iken %4.7'sin ise normal bir depoya sahip olduğu belirlenmiştir. Can ve Engindeniz (2018) tarafından Kocaeli'nde yapılan başka bir çalışmada 2015 yılında yapılan yeni halin modern yapısı sayesinde çoğu işyerinde ürünlerini depolayabilecekleri soğuk hava depoları bulunduğu sonucuna varılmıştır. Kahraman (2012) tarafından yapılan araştırmada 9.864 işyerinden sadece 275 adet (%3) işyerinde soğuk hava deposu bulunduğu tespit edilmiştir.



Şekil 4. Bölgede Kiraz Ticaretine Yoğunlaşma Sebepleri



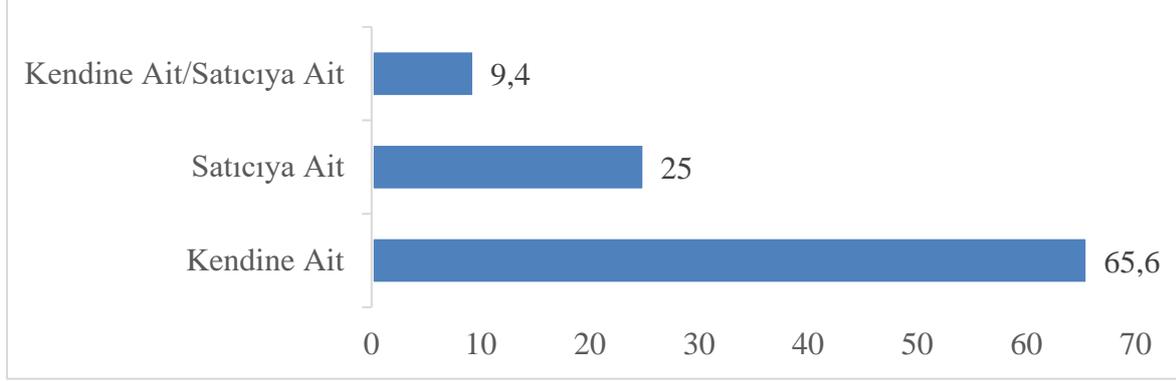
İşletmelerin kiraz ticaretini %93.8 gibi yüksek bir oran ile mevsime, %6.3 oranında ise fiyat, talep ve mevsime bağlı olarak ayarladıkları belirlenmiştir. İşletmelerin, 93.8'i üretimin sadece o bölgede yapılıyor olmasından, %3.1'i ürünlerin daha ucuz elde edilmesinden ve %3.1'ise bu sebeplerin hepsinden kaynaklı bu bölgede kiraz ticaretine yoğunlaştıklarının cevabının vermiştir. Görüşülen işletme sahiplerinin kiraz tedarik şekillerinin %78.1'i üreticilerden sağlarken %56.3'ü üretim bölgelerindeki toptancı hallerinden, %34.4'ü üretici ile toptancı halleri arasındaki aracılardan olduğu görülmektedir. Tokat ilinde bulunan toptancı halindeki komisyoncuların yeni hal yasası hakkındaki görüşlerinin incelendiği (Gözener ve Sayılı, 2011) çalışmada komisyoncuların satın aldıkları ürünleri; %67.39 ile üreticiden sağlarken, %43.38 ile tüccarlardan temin etmekte, %36.96 ile tarladan sağlarken ve %26.09 ile komisyoncular aracılığıyla temin ettiğinin sonucuna varılmıştır. Diğer çalışmalarda ise komisyoncuların ürünlerini; Trabzon ilinde %50'sinin üreticilerden, %30'unun komisyonculardan ve %20'sinin ise aracılardan (Bayuk, 2000); Tokat ilinde %35'inin üreticiden, %45'inin komisyonculardan ve %20'sinin ise hem üreticilerden hem de komisyonculardan (Gündüz ve ark., 2005); Antalya ilinde %84.6'sının üreticilerden ve %15.4'ünün ise komisyoncu, tüccar ve bahçeden (Yılmaz, 2008); Antalya, İstanbul, İzmir, Bursa ve Antalya illerinde %52'sinin tüccardan, %44'ünün üreticiden ve %4'ünün ise bahçeden (Çetin, 2009) ürünlerini temin ettiklerinin sonucuna varılmıştır. Ayrıca kiraz satış miktarının dönemsel dağılımı aylık devam etmektedir. Kiraz satışı dönemsel olarak Mayıs ayının ilk haftalarından ve Haziran ayının son haftalarına kadar devam etmektedir. Görüşülen işletmelerin tamamı tarım ürünlerini sağlamada kara yolunu kullanmaktadır. Bunun başlıca sebebi Amasya ilinin yer şekillerinden dolayı kara yolunun uygun olmasıdır. İşletmelere gelen kirazlar çeşitli meyve kasalarında gelmektedir. İşletmelerin



%25'ine karton meyve kasalarında, %75'ine ise plastik meyve kasalarında gelmektedir. Görüşülen işletmelerin hepsi, kendilerine yardımcı olan kuruluşların olmadığını söylemiştir. Böyle bir kuruluşun gerekli olup olmadığı sorulduğunda ise işletmelerin %59.4'ü evet yanıtını verip yardımcı kuruluşun gerekli olduğunu belirtirken, %40.6'sı hayır diyerek yardımcı kuruluşa gerek olmadığını yanıtını vermiştir. Bu sonuca göre yardımcı bir kuruluşa ihtiyaç duyanların sayısı fazla olsa bile, yardımcı bir kuruluşa ihtiyaç olmadığını düşünen işletmelerin sayısının da bir hayli fazla olduğunu görülmektedir. İşletmelerin %71.9'u pazarda ihtiyaç duyulan ürünleri sunmada haldeki komisyoncu sayısının yeterli olduklarını düşünürken, %28.1'i ise ürün sunmada komisyoncu sayısının fazla olduğunu belirtmektedirler. İşletmelerin %78.1'i haldeki komisyoncu sayısının fiyatları ucuzlaştırdığını düşünürken, %18.8'i pahalılaştırdığını düşünmektedir. İşletmelerin %3.1'i ise fiyatların arz-talep ilişkisine göre oluştuğunu, haldeki komisyoncu sayısının fiyatları etkilemediğini belirtmiştir. Can ve Engindeniz (2018) tarafından yapılan çalışmada ise komisyoncular tarafından satılan ürünlerde fiyatın oluşma şekli sorulduğunda %90.91 oranıyla talebe göre fiyatın belirlendiği tespit edilmiştir. İşletmelerin %37.5'i yaklaşıma, yükleme, boşaltma peronlarının ihtiyacı karşılama yeterli olduğunu söylerken, %62.5'i peronların yetersiz olduğunu belirtmişlerdir ve işletmelerin %78.1'i diğer tarımsal ürünler muhafaza ettiği depoya sahipken, %21.9'u herhangi bir muhafaza deposuna sahip değildir. Ayrıca kiraz, raf ömrü çok kısa bir meyve olduğundan depolarda en fazla 1 ile 1 buçuk gün bekletildiği sonucuna varılmıştır. Komisyonculuk ile uğraşan işletmelerden, hal içerisindeki sağlık koşullarının %28.1'i yeterli olduğunu düşünürken, %71.9'u yetersiz olduğunu belirtmiştir. İşletmelerin %84.4'ü haller ve diğer toptancı halleri ile haberleşme olanaklarının yeterli olduğunu düşünürken, %15.6 yetersiz olduğunu düşünmektedir. Bu işletmelerden %84.4'ü ücret karşılığında yararlanabileceği depoların mevcut olduğunu belirtirken, %15.6'sı ücret karşılığı yararlanacakları bir deponun bulunmadığını söylemiştir.

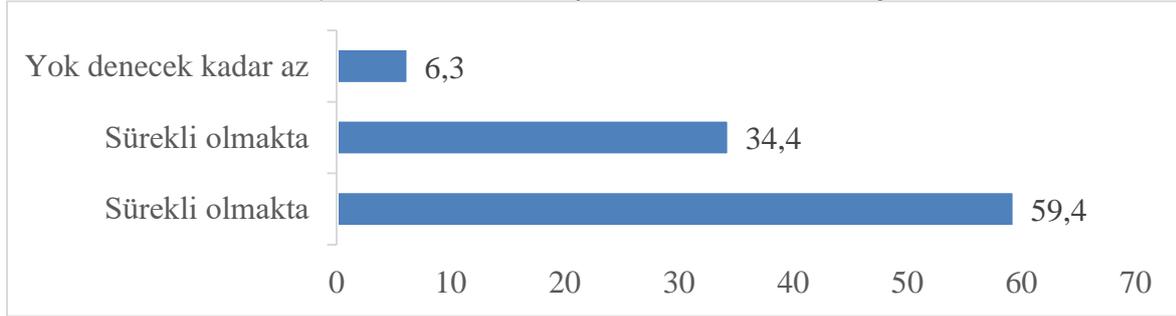


Şekil 5. Kiraz Ticaretinde Taşıma Giderleri



İşletmelerin %65.6'sı taşıma giderlerinin işletme sahiplerine ait olduğunu belirtirken, %25'i satıcıya ait olduğunu belirtmiş, işletmelerin %9.4'ü ise taşıma giderlerinin hem kendilerine hem de satıcıya ait olduğunu belirtmiştir.

Şekil 6. Yükleme- Boşaltma Sırasında Ürün Kaybı



İşletme sahiplerinin % 59.4'ü yükleme-boşaltma sırasında ürün kaybının sürekli olduğunu, % 34.4'ü bazen olduğunu, % 6.3 ise yok denecek kadar az olduğunu belirtmiştir. İşletmelerden %96.9'u hal içerisinde fiyat panosunun mevcut olduğunu belirtmişlerdir. İzmir ilinde yapılan (Kahraman, 2012) çalışmada 203 adet toptancı halinin %49'unda halen fiyat panosu bulunmadığı sonucuna ulaşılmıştır. İşletmelerin %50'si toptancı hallerinde yapılan yasal kesintilerin (KDV, Stopaj, vb) oranlarını orta düzeyde olduğunu düşünürken, %37.5'i yüksek olduğunu, %12.5'i çok yüksek olduğunu düşünmektedir. Ayrıca tüm işletmeler toptancı hali dışında kiraz satışı olduğunu belirtmektedir. İşletmelerin %75'i hal dışı satışlarının sebeplerinin denetim yetersizliğine bağlarken, %25'i yasal kesintilerden kaçınma olduğunu belirtmişlerdir. İşletmelerin %62.5'i yeni hal yasası hakkında bilgi sahibi olduğunu söylerken, %37.5'i herhangi bir bilgisinin olmadığını söylemiştir. Gözener ve Sayılı (2011) tarafından Tokat bölgesinde yapılan çalışmada ise toptancı halinde bulunan komisyoncuların %43.48'inin yeni yasadaki herhangi bir haberi olmadığını, %50.00'si ise kısmen haberlerinin olduğunu ve

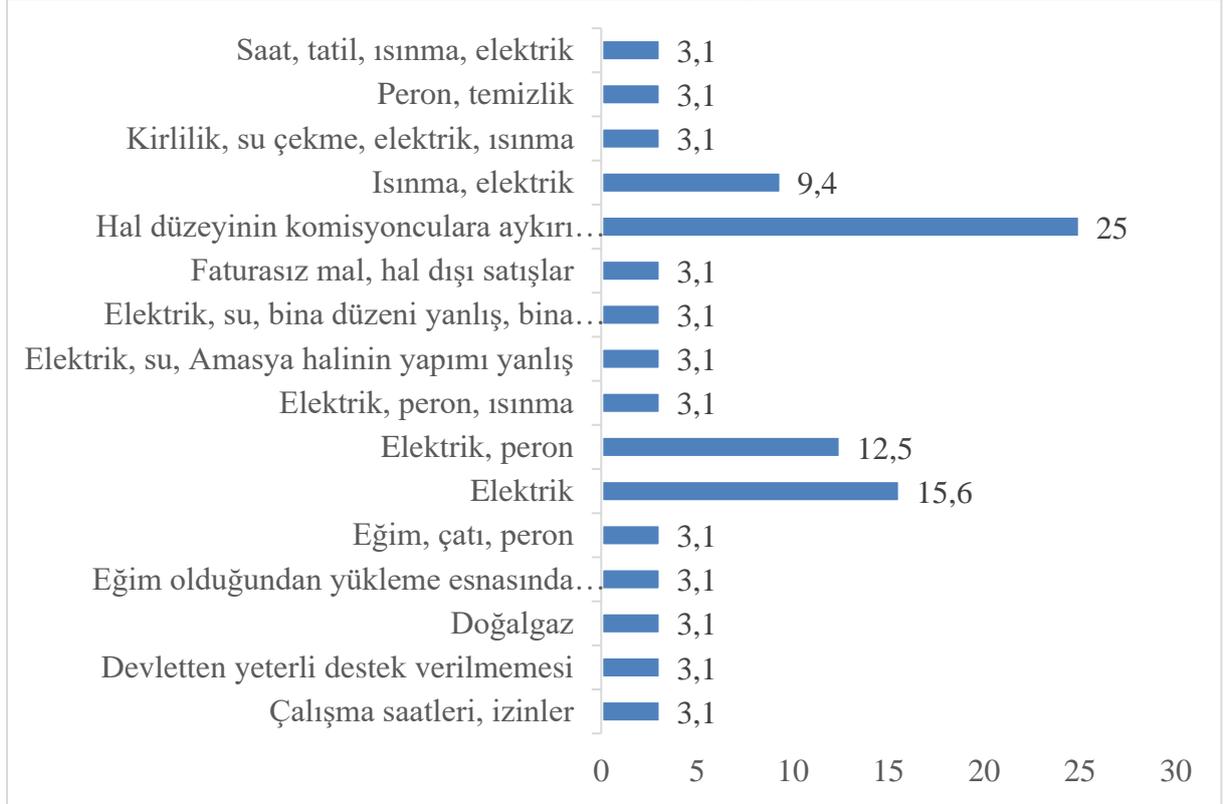


%6.52'sinin ise yeni hal yasası hakkında tam bir bilgiye sahip olduğunun sonucuna varılmıştır. Kahraman (2012) tarafından yapılan bir diğer çalışmada işletmecilere sorulan "Yeni Hal Yasası hakkında bilginiz var mı?" sorusuna verilen yanıtlara göre işletmelerin %11.60'ının yeni yasadaki haberleri bulunmaktadır ancak bu kişilere sorulan "Size göre yeni hal yasası sebze-meyve pazarlamasını etkiler mi?" sorusuna verilen yanıtlara göre bu kişilerin yasa ile ilgili net bir bilgiye sahip olmadığı tespit edilmiştir. İşletmelerin %53.1'i yeni yasanın toptan tarım ürünleri alım satım piyasasını etkileyeceğini düşünürken, %12.5'i bir etkilemenin olmayacağını belirtmişlerdir. İşletmelerin %34.4'ü ise herhangi bir bilgisi olmadığını söylemiştir. Ayrıca komisyoncuların %53.1'i yeni yasanın piyasayı olumsuz etkileyeceği görüşündedir. Toptancı halleri ile ilgili yapılan başka bir çalışmada (Gözener ve Sayılı, 2011) ise komisyoncuların %28.26'sı yeni yasanın ürün satışlarını veya ürün pazarlamasını %34.60 oranında etkileyeceğini belirtmiştir. Haldeki işletmelerin büyük çoğunluğu %93.8'i fiyatların pazarlık usulüne göre olduğundan bahsederken, %6.3'lük kısım ise diğer yollardan fiyatların oluştuğunu belirtmişlerdir. İşletmelerin %37.5'i meyve-sebzeye uygulanan komisyon sınırını yeterli bulurken, %50'si sınırının yetersiz olduğunu düşünmektedir. Komisyoncuların %12.5'i ise herhangi bir bilgilerinin olmadığını belirtmişlerdir. İşletmelerin % 81.3'ü de vergileri ağır bulmaktadır.

Görüşülen işletmelere yöneltilen toptancı haliyle ilgili diğer sorunlar sorusuna komisyoncuların büyük çoğunluğu elektrik sorununun olduğuna dikkat çekerken, bir diğer önemli sorunun doğal gaz hattının hal girişine kadar getirilip işletmelere bağlanmamasından dolayı yaşanan ısınma sorunu olduğunu belirtmişlerdir. Yükleme boşaltma peronlarının yetersiz olduğu ve eğimden dolayı yaşanan sıkıntılarında göz ardı edilemeyeceğini belirten komisyoncular, hal şeklinin ve çalışma saatlerinin de düzenli olmadığından duyulan şikayetlerini de belirtmişlerdir. Aydın ilinde yapılan (Coşkun ve Tunalıoğlu, 2012) çalışmada komisyoncuların %12.8'i faaliyette buldukları hal bölgesinde belediye üzerinden kaynaklı yaşanan sorunların varlığından söz ederken ederken, %22.1'i çevre düzenlemesi ile ilgili sorunlarını olduğunu, %10.5'i toptancı halinin yapısının küçük olduğunu, %10.5'i yeni hal yasanın sorun oluşturduğunu ifade etmektedirler. Diğer çalışmada ise (Kahraman, 2012) İzmir Büyükşehir Belediyesi Hali'nde yapılan anket sonuçlarından elde edilen bulgulara göre yeterli denetimin olmaması ve kaçak satışların engellenememesi en çok ifade edilen sorun olmuştur.



Şekil 7. Toptancı Hali İle İlgili Diğer Sorunlar



4. SONUÇ

Türkiye'nin 4 mevsim boyunca 7 bölgesinde devam eden bir meyve üretimine sahip olduğu bir gerçektir. Bu tarımsal organizasyonun en büyük değeri olan çiftçilerimizin yanında komisyoncularda önemli rol oynamaktadır. Meyve pazarlaması, ürünlerin toplanma aşamasından ambalajlara konulmasına, taşınma sürecinden depolanma işlemine ve tüketicilere ulaşmasına kadar geçen süreç ürünün değeri ve kalitesi açısından önem arz etmektedir. Haller ise bu sürecin mekan sahipliğini üstlenmektedirler. Türkiye'de tarım sektörü dağıtım kanalları içerisinde komisyoncuların her zaman önemli bir rolü olmaktadır. Komisyoncular ürünlerini başkalarına satmak ve kar elde etmek amacıyla çalışan kişi veya işletmeler olup, üretici ile tüketici arasında fayda sağlamaktadır. Toptancı halinde üreticiler, satıcılar, toplayıcılar, komisyoncular, toptancılar ve perakendeciler yer almakta ve burada genellikle toptancılar ile perakendeciler ağırlıklı konumda bulunmaktadır. Kiraz pazarlanmasında toptancı halleri oldukça önemli bir yere sahiptir. Üretici düzeyinde yapılan çalışmaların sonucuna göre, yaş sebze ve meyvelerin, çeşit ve türlerine göre, %13 ile %42'sinin toptancı halleri üzerinden pazarlandığı tespit edilmiştir. Ancak toptancı hallerinde ve sistem içerisinde bulunan diğer komisyonculara uygun depolama koşullarının bulunmamasından dolayı üretimin %30'unun



tüketicilere ulaşmadan kayba uğramaktadır. (Çetin, 2009). Amasya ilinde yapılan kiraz üretiminin önemli bir kısmı iç pazara yönelik olmasına rağmen pazarlama aşamasında çeşitli sorunlarla karşılaşmaktadır. Amasya ilinde kiraz fiyatlarının oluşumu, bir kısmının ambalajlanması ve diğer bölgelere dağıtımını gibi pazarlama hizmetleri toptancı halinde gerçekleştirilmekte, ancak hal yasasının uygulanmasında halen birçok sorunla karşılaşmaktadır. Denetim yetersizliğinin olması veya yasal kesintilerden kaçınma durumu hal dışı satışları da beraberinde getirmektedir. Amasya ilinde toptancı halinin yapısı ve sorunları araştırmak amacıyla Amasya ilinde bulunan toptancı halinde faaliyet gösteren 32 adet kiraz alım satımı yapan işletme ve Komisyoncular Derneği Başkanı ile Amasya Belediyesi Hal Müdürü karşılıklı görüşmeler yapılarak aşağıdaki sonuçlar elde edilmiştir:

İşletme sahiplerinin eğitim durumları incelendiğinde, en yüksek eğitim düzeyi yüksek okul veya fakülte mezunlarının az bir oranda bulunmasına karşın komisyoncuların en az ilköğretim mezunu olmaları kayda değer bir durumdur. Amasya toptancı hali komisyoncuların ürün alım satımını yaptıkları yer olup yapısı ise fiyatların arz ve talebe göre oluştuğu, komisyoncu sayısının da fiyat üzerinde etkili olduğu sonuçlarına varılmıştır. Komisyoncuların büyük bir çoğunluğunun herhangi bir tarımsal kooperatife üye olmadıkları ve kendilerine yardımcı bir kurum veyahut kuruluşun bulunmadığını belirtmişlerdir. Dolayısıyla, pazarlama faaliyetinde bulunan komisyoncuların yüksek oranda kendi tecrübeleri ile bu işi yaptıkları belirlenmiştir.

Araştırma bölgesinde görüşülen komisyoncuların tamamı, toptancı halinde belediye tarafından kendilerine verilmiş olan işyerlerinde pazarlama faaliyetlerini sürdürmektedirler. Araştırmanın yürütüldüğü toptancı halinde yükleme ve boşaltma peronlarının yetersizliği, teknik donanımın mevcut olmadığı ayrıca fiyat panosunun bulunduğunu ancak panonun çalıştırılmadığı tespit edilmiştir. Araştırma alanındaki toptancı hali fiziki alt yapı, hijyen ortamı sağlama ve sağlık koşulları bakımından yetersizlikler taşımaktadır. Amasya halinin zemini eğime sahip olduğu için birçok iş kazasının gerçekleştiği görüşülen komisyoncular tarafından belirtilmiştir. Toptan tarım ürünleri pazarlamasında toptancı halleri yasasının düzgünce işletildiği ve yeterli düzeyde denetim yapıldığında, vergi kaçışlarının, kayıt dışı ekonomik kayıpların ve fiyat dalgalanmalarının azalacağı ifade edilebilir. Bu sonuç tüketicilerin kaliteli ürün tüketimine katkıda bulunacağı gibi, ekonomideki kayıpları da azaltacaktır. Toptancı halinde bulunan komisyoncuların diğer tüm hallerle iletişim kurabildikleri ve alıcı ayırt etmeksizin ürün kalitesine göre birbirlerine mal alım ve satımı yaptıkları saptanmıştır. En büyük sorunun elektrik ve doğalgaz olduğunu belirten komisyoncular, ısınma sisteminin bulunmadığını, hal binasında su sızıntısının olduğunu, binanın çürümeye başladığını, can ve mallarının tehlikede



birakıldığını, peron ve garaj yetersizliğini, yasal kesintilerin fazlalığı ile %8 komisyon sınırını yetersiz buldukları ve kamudan bekledikleri hizmetleri göremedikleri tespit edilmiştir. Yapılan araştırma neticesinde bir çok yapısal soruna karşın işletme sahiplerine ilk öncelik olarak kooperatifleşme önerilmektedir. Böylece kalite arttırılıp maliyetler düşürülmeli, işbirliği ile daha güvenli bir çalışma ortamı sağlanmalı ve diğer toptancı halleriyle işbirliği yapılmalıdır. Acil sağlık durumları için ilk yardım eğitimleri alınmalı, fiziki alt yapının düzeltilmesi için çalışmalar yapılmalıdır. Teknoloji ve teknik donanımın geliştirilmesi için kurum ve kuruluşlar ile görüşülmeli gerekli hizmetler alınmalıdır. Ayrıca işletmelere yeni hal yasası hakkında gerekli bilgi hizmeti sağlanmalıdır. Endüstri ilişkilerinin geliştirilmesi, ücret ve sigorta konusunda iyi bir sistemin kurulması ve hal bazında iyi bir organizasyon yapısının oluşturulması önerilmektedir.



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VASE LIFE IN CUT FLOWERS

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ABSTRACT

The potential vase life of cut flowers is one of the most important quality factors, because it strongly affects consumer satisfaction and repeat of purchasing which influences the value of the cut flowers. The main issue with postharvest treatment of cut flowers is floral senescence. Senescence, which comes after physiological maturity and before the death of a cell, organ, or the entire plant, is the last stage of plant development. For flowers to be marketable, there must be a delay in floral senescence, and the flowers must be at sufficient quality. Chemicals have also been used to delay senescence and prevent chlorophyll degradation in cut flowers, with different degrees of success. Many cut flower species experience premature senescence as a result of bacteria buildup in vase water. The use of fresh keeping techniques is very important for preventing flower senescence and maintaining the quality of their decorative effect. It can be divided into chemical and physical approaches based on the various treatment methods. Chemical fresh keeping techniques are extensively employed and preferred due to their low cost, simplicity of usage, and visible results.

Keywords: Vase life, postharvest longevity, cut flowers



1. INTRODUCTION

Cut flowers have a short shelf life and quickly lose their aesthetic appeal (Saeed et al., 2014). In *Alstroemeria*, leaf yellowing is a significant issue, and the lack of indications of leaf senescence is a crucial quality trait (Mutui et al., 2006). Cut narcissus flowers suffer significantly from the problem of petal browning, which reduces their beauty, value, and vase life (Heidari Krush & Rastegar, 2022). Senescence is a significant issue with gerbera (*Gerbera jamesonii*) cut flowers as prevents them from being transported over long distances and from being marketed after that (Shabaniyan et al., 2018).

Senescence primarily occurs in higher plants as they get older and is brought on by particular phytohormones and environmental conditions. In actuality, senescence is a complicated and well orchestrated process (Su et al., 2019). One of the biggest issues with postharvest floral physiology is vascular system blockage by bacterial or air growth, which lowers water intake and obstructs xylem arteries, causing water stress (Elhindi, 2012). Postharvest senescence and browning of petals may result from a lack of energy, inability to remove ROS, cell membrane disintegration, increased electrolyte leakage, and malondialdehyde buildup (Aghdam et al., 2015; Salunkhe et al., 2012; He and Luo, 2007). The reduction in water intake and flower withering that results from microbial growth obstruction in stem conducting tissues shortens vase life. Therefore, a cut flower is frequently placed in a holding solution containing two main components, sugar and biocide. In floral stem and vase solution, sugar supplies a respiratory substrate while biocides lower the bacteria population. A variety of biocidal substances, such as silver nitrate, 8-HQC, disinfectants, aluminum sulfate, polymers, sodium benzoate, and 5-sulfosalicylic acid, extend vase life and preserve the quality of cut flowers. They inhibit xylem vessel occlusion by loosening bacterial cell walls, acidifying vase solution and inactivating enzymes involved in endogenous ethylene release. Additionally, they increase the activities of antioxidant enzymes and provide cell membrane stability, which improve the quality of cut flowers (Manzoor et al., 2021).

A variety of biotic and abiotic factors have an impact on how long flowers can last on the shelf. It can be enhanced by adding various preservatives. Thyme, Rosemary, Geranium, Mint, Eucalyptus, Ajowan, Savory, Coriander, Dill, and Artemisia are just a few of the aromatic herbs utilized to make the extracts from natural essential oils that are highly respected. In the case of *Lisianthus*, *Gerbera*, *Narcissus*, *Chrysanthemum*, *Alstroemeria*, and *Carnation* cut flowers vase life longevity, Thyme essential oil was evaluated, and positive results were recorded. According



to reports, artemisia, rosemary, coriander, and dill essential oils extended the vase life of cut carnations. The suggested essential oils for extending the vase life of cut Alstroemeria flowers are rosemary and peppermint. Due to their antibacterial properties and environmentally friendly nature of the extracts, the majority of research reported the efficacy of essential oils for floriculture as a noble substitute to various metal and chemical compounds (Banjaw et al., 2017).

The most common floricultural crops traded internationally include roses (*Rosa* spp.), carnations (*Dianthus caryophyllus*), gerberas (*Gerbera* spp.), chrysanthemums (*Chrysanthemum* spp.), gladioli (*Gladiolus* spp.), gypsophilas (*Gypsophila* spp.), nerines (*Nerine* spp.), orchids (*Orchidaceae*), liatris (*Liatris* spp.), achilleas (*Achillea* spp.), anthuriums (*Anthurium* spp.), tulips (*Tulipa* spp.), and lilies (*Lilium* spp.). Increases in the production of these flowers have increased global competition, with consumers now demanding a variety of specific and uniform flower colors and shapes.



Fig.1. *Nerine sarniensis*; colour forms from the wild (Duncan, 2008)

Floral senescence and petal abscission affect the cut flower quality and postharvest longevity. In ethylene-sensitive flowers, this is predominantly caused by ethylene synthesis in the floral organs (such as the petals and gynoecium) and microbial growth in the xylem arteries, whereas microbial growth is more important in ethylene-insensitive flowers. Several methods have been



put forth to enhance these postharvest characteristics, and many of them make use of chemicals to inhibit bacterial growth and ethylene production. However, due to its capacity to increase agricultural yields and lower post-harvest waste, the application of nanotechnology in the agricultural sector has grown during the past ten years. In particular, nano-silver particles have been used as ethylene inhibitors and antimicrobial agents in packaging to extend the vase life of horticultural products (fruits, vegetable and flowers) (Naing & Kim, 2020).

2. ETHYLENE INHIBITORS

The production of ethylene in the petals and the growth of microorganisms in the cut stems are the main factors influencing the postharvest quality and longevity of cut flowers (Li et al., 2017; Solgi et al., 2009). Even at low quantities, ethylene can cause petal senescence in ethylene-sensitive cut flowers including orchids, hibiscus, and carnations. The growth of microorganism in the xylem vessels, which can restrict the passage of water to the flower heads and result in early wilting of the petals, can diminish the uptake of water, which is also essential to the postharvest quality of cut flowers (Solgi et al., 2009). 1-Methylcyclopropene (1-MCP) is a ethylene inhibitor. It inhibits certain plants from producing ethylene hormone (Thompson & Bishop, 2016).

Due to its capacity to suppress ethylene generation and the growth and development of microbes, nano-silver particles are being utilized to increase the postharvest longevity and quality of cut flowers (Hassan et al., 2014). After coming into contact with the cut stems, nano-silver particles kill any bacteria present in the vase solution and the cut stem ends. They also penetrate the xylem and move to the flowers, where they suppress the ethylene biosynthesis genes to reduce ethylene production and increase antioxidant activity (Naing & Kim, 2020).

3. ANTIBIOTICS, ANTIMICROBIALS AND GERMICIDES

It is advised to add chemical preservatives to the holding solution to increase the cut flowers' vase life. Essentially, all storage solutions must have two ingredients: sugar and germicides. The germicides prevent clogging of the conducting tissues while controlling hazardous microorganisms, and the sugar provide a respiratory substrate. Sucrose has been discovered to be the sugar that is most frequently used to extend the vase life of cut flowers among all the different types of sugars (Asrar, 2012). Bacterial populations in vase water and the cut stem are restricted by antibiotic compounds (Gupta and Dubey 2018). Additionally, anti-microbial



substances keep flowers fresh by inhibiting the degradation of flavonoids, which are crucial for bloom coloration (Babarabie et al. 2018a).

Due to its fundamental carbon plane and functional groups that incorporate oxygen, graphene oxide has exceptional characteristics. In the investigation of cut roses (cv. Carola), graphene oxide's antimicrobial activity was used to increase vase life and enhance quality (He et al., 2018). According to the findings, cut roses grown with low doses of graphene oxide (0.1 mg/L) had better water relations, a longer vase life, and a greater diameter. The most common explanation for stem blockage that results in water stress and early wilting of cut flowers is microbial contamination at the base stem end. It was shown that graphene oxide functions as a germicide by successfully preventing microbial development at the cut stem end and enhancing water intake and water balance in cut roses.

A derivative of salicylic acid with a sulfur group, 5-sulfosalicylic acid also exhibits antimicrobial capabilities (Nasibi et al. 2014). In cut carnations (*Dianthus caryophyllus*), it greatly decreased anthocyanin leakage, chlorophyll degradation, and ACC oxidase activity (Kazemi and Ameri, 2012). In the cells of *Argyranthemum* (*Argyranthemum frutescens*) petals, 5-Sulfosalicylic acid and GA4+7 postpone protein deterioration and maintain membrane stability (Kazemi, 2012). *Gladiolus* (*Gladiolus grandiflorus*) florets open faster and have fewer unopened petals as a result (Khattab et al. 2018). Sulfosalicylic acid reduces bacterial growth and maintains membrane stability greater than three times better than control, preserving the quality of tuberose (*Polianthes tuberosa*) cut stem (Hajizadeh and Aliloo, 2014).

Due to its oxidizing capacity, ozone, an anti-microbial agent, has been widely used in many applications (food preservation, treatment of drinking water, etc.). Ozone breaks down into diatomic oxygen and free radicals like hydroxyl, hydroperoxyl, and superoxide when it is dissolved in water. These free radicals in a solution react quickly with all inorganic and organic substances. In a preservative solution, aqueous ozone dramatically reduces microbial development, increasing the bud opening percentage and vase life of hybrid orchids (*Dendrobium*) (Almasi et al., 2015). Due to the maximum xylem channel activity, CO₂ assimilation rate, and stomatal conductance, rose (*Rosa hybrida*) cut stems immersed in aqueous ozone showed a three-fold increase in vase life (Robinson et al., 2009).

At a sufficient dosage of 200–600 mg/l (Fonseca et al., 2017), 8-HQS (8-hydroxyquinoline sulfate) prevents the buildup of microorganisms in the xylem vessels and maintains the pace of water uptake. It lowers the pH of the vase solution and deactivates the vascular occlusion-causing enzymes (Adam and Eldeeb, 2021). When paired with sugars, 8-HQS works well to



slow down the breakdown of carbohydrates and chlorophyll in snapdragon (*Antirrhinum majus*) (Asrar, 2012). It enhances the carotenoids in the petals of gerberas (*Gerbera jamesonii*) and prevents stem bending in those plants (Jafarpour et al., 2015). Sweet pea (*Lathyrus odoratus*) treatment with sugar + 8-HQS enhances water intake, water balance, and increases vase life to 17 days (Elhindi, 2012). 8-HQS Improve the fresh weight, diameter, and vase life of chrysanthemum (*Chrysanthemum morifolium*) flowers as well as the bacterial colony in a preservation solution (Bajpay and Dwivedi, 2017). The combined action of calcium as a flow resistance reducer and 8-HQS as a biocide maintains turgidity in rose petals and leaves. Also, reduce loss in fresh weight with an increased percentage of opened flowers (Cortes et al. 2011). Titanium has a role in plant growth by increasing enzymes activity, chlorophyll content, improving plant biomass, and compensating for nitrogen insufficiency. Bacteriostatic and bactericidal effects are provided by titanium ion (Ti^{4+}). Since titanium ions have broad-spectrum anti-microbial activity, their modest quantity (8 mg/L) in a preservation solution containing cut stems of gerbera (*Gerbera jamesonii*) not only decreased the number of bacteria present, but also prevented a wide variety of bacterial taxa from reproducing (Li et al. 2019). A gentle biocide that inhibits bacterial growth in a preservation solution is sodium hypochlorite. When cut diffenbachia (*Diffenbachia maculate*) foliage is soaked in a preservation solution comprising sodium hypochlorite (NaOCL) and 1% sugar, bacterial growth in the solution is significantly reduced, leaf weight loss is decreased, and foliage color is preserved for a prolonged period of time (Sasikala et al. 2015). Combining sodium hypochlorite and 8-HQC increases the water intake by twofold in cut stems of lisianthus (*Eustoma grandiflorum*), extending the vase life (from 10 to 29 days) (Hutchinson et al., 2013). However, larger concentrations of sodium hypochlorite limit the uptake of water and sugar by cut roses (*Rosa hybrida*) (Muriithi and Ouma, 2011), and its 2% concentration in safflower (*Carthamus tinctorius*) causes yellowing of the leaves and stem whitening (Menegaes et al., 2019).



Fig. 2. The summertime vase life of newly cut gerberas was extended by titanium ions. Through June 23 the flowers were cultured in vases (Li et al., 2019).

In comparison to sodium hypochlorite, sodium dichloroisocyanurate (DICA) is a chlorine compound that releases chlorine slowly, is slightly poisonous, and has neither corrosive nor carcinogenic properties. Gladiolus (*Gladiolus grandiflorus*) vase life was extended by lowering water loss, delaying wilting, enhancing water balance, and raising the proportion of opened florets (Casares et al., 2017). When kept in a solution containing DICA and phosphate buffer, mokra orchid exhibits less microbial development and has a longer vase life (Buanong, 2018).

4. MIXED EFFECT COMPOUNDS

Because they effectively relax the cell, diminish the thickness of the cytoplasmic membrane, and condense DNA molecules, silver ions (Ag^+) destroy bacteria (Carrillo-Lopez et al. 2016). To suppress microbial development or aqueous microflora, commercially available floral preservatives include synthetic germicides like silver acetate ($AgC_2H_3O_2$) or silver nitrate



(AgNO₃) (Rahman et al. 2018). Silver nitrate boosts the fresh weight of *Polianthes tuberosa* spikes, the percentage of flowers that open, and the vase life by up to 18 days when combined with 5% sucrose (Selvaraj et al. 2014). However, this combination enhances water uptake rate, delays the withering flower rate in *Dendrobium* (Ajithkumar et al., 2013), and lowers carbohydrate and soluble sugar loss in orchids (Mattiuz et al. 2015). Because of a number of drawbacks, silver nitrate is used less frequently. In water, photo-oxidation of silver nitrate produces a number of insoluble chemicals. Following their precipitation, these substances combine with the chlorine in tap water to form insoluble silver chloride, which blackens the solution and kills stems. Additionally, silver is hazardous to a variety of species whether it is in ionic form or dissolved. Additionally, silver is a heavy metal that lingers in soil and water for a very long period (Begri et al. 2014).

By interacting with ethylene biosynthesis enzymes, copper reduces bacterial populations and blocks the functioning of the enzymes that result in physiological stem occlusion. It increases *Ophiopogon japonicas*' solution intake in relation to fresh weight and nearly doubles their vase life (Wijayabandara et al. 2018). Strap wattle (*Acacia holosericea*) can have its vase life increased by up to 1.9-fold by copper ions (Cu²⁺) in vase water (MohdRafdi et al. 2018). Copper sulfate improves petal water content and dry weight, slows anthocyanin and chlorophyll breakdown, and delays leaf yellowing in the rose (*Rosa hybrida*) (Hajizadeh et al. 2012).

Chitosan is a natural biopolymer used as an antioxidant and anti-microbial. The cell wall of fungi, cuticle of insects and crustacean's shells are rich sources of chitin. They function as anti-microbial agents against harmful bacteria, fungi, and molds. By enhancing membrane integrity and fresh weight, it successfully extends the vase life of cut carnations (*Dianthus caryophyllus*) to seven days (Solgi, 2018). It boosts glutathione in petals and glutathione reductase antioxidant enzyme activity (Jing and Li, 2015). The days necessary for gerbera (*Gerbera jamesonii*) petal color discoloration, petal shriveling, and flower drooping are postponed by a combination of chitosan and salicylic acid treatment (Mehraj et al., 2016). In rose petals, chitooligosaccharide, a degraded form of chitosan, reduces the levels of Malondialdehyde, hydrogen peroxide, and superoxide anion (*Rosa hybrida*).



Fig. 3. Appearance of cut peony ‘Albert Crousse’ (A) and ‘Ursynow’ (B) flowers placed into water and preservatives 10 days after harvest. 1) water, 2) 8-hydroxyquinoline citrate (8-HQC) + sucrose (S), 3) Floralife 300, 4) Chrysal sachet, 5) nanosilver (NS) + sucrose (S) (Rabiza-Swider et al., 2020).

5. ELECTRON TRANSFER OXIDIZING AGENTS

An additional antibacterial agent with potential for application in cut flower hydration solutions is chlorine dioxide (ClO₂) (Macnish et al., 2008). It is an oxidizing agent that only transfers one electron. It is regarded as a secure and reliable sterilant against bacteria, yeast, mold, and viruses. Even six days in an experiment, the ClO₂ treatment of clipped spikes of the gerbera (*Gerbera jamesonii*) exhibited no bacterial population in solution. Additionally, varying the percentage of ClO₂ can extend vase life to 22 days (Lee et al., 2014). Chlorine dioxide hydration of cut roses (*Rosa hybrida*) cv. Frisco enhances flower quality by encouraging petal opening and lowering the risk of diseases (*Botrytis* sp.) and bent neck problem (Mupandanyama et al. 2014). The combined effects of ClO₂ and sucrose prevent bacterial growth at the stem cut end, enhance water absorption, postpone leaf yellowing, and add four extra days to the vase life of roses (*Rosa hybrida*) (Lee and Kim, 2018).

6. ESSENTIAL OILS



Essential oils are safe and environmentally beneficial organic natural compounds. Because they include large amounts of phenolic chemicals (like eugenol, carvacrol, and thymol), essential oils have potent antibacterial activity against some infections (Bounatirou et al., 2007). Carvacrol was discovered to have antibacterial properties against some bacteria and fungus (Botelho et al., 2007, Martinez-Romero et al., 2007). Other essential oils that have been discovered to be useful against some bacteria and fungus include thymol, thyme oil, and zataria oil (Braga et al., 2008).

The use of carvacrol increased the vase life of gerbera flowers from 8.3 to 16 days (Solgi et al., 2009). At all concentrations, the vase life of cut flowers was improved by *Zataria multiflora* essential oil, however high concentrations of *Ferula assa-foetida* essential oil increased mortality percentage and decreased vase life. Some used essential oil treatments enhanced the cut gerbera flowers' relative fresh weight and vase solution uptake. The least stem color change was seen with *Ferula assa-foetida* and *Zataria multiflora* essential oils. Overall, the best treatments for preserving the quality of gerbera cut flowers during vase life were 200 mg L⁻¹ *Zataria multiflora* essential oil and 100 mg L⁻¹ *Ferula assa-foetida* essential oil (Mallahi et al., 2018).

Thyme essential oil has been shown to have beneficial effects when used to handle cut narcissus flowers, cut chrysanthemum flowers, and cut gerbera flowers after harvest (Bazaz et al., 2015; Sardoei et al., 2014; Amini et al., 2014). *Alstroemeria* cut flower lifespan was measured using a 4000 mg/L-1 thymol concentration (Babarabie et al., 2015). Thyme, lavender, savory, and ajowan essential oils increased the vase life of carnations (Kazemi & Ameri, 2012).

Lisianthus cut flower with Thyme at 50 ppm, *Zataria multiflora* 200 ppm, and *Echinophora platyloba* 100 ppm essential oils has been reported to have the longest vase life, petal water content, and relative water content.

When cut carnations were treated to extend their vase life after harvest, essential oils from coriander and dill proved successful (Shanan et al., 2010). According to Hashemabadi et al. (2015), the greatest vase life of cut carnation flowers was induced by 12% *Artemisia* and *Anethum* essential oils. The diameter of cut *Alstroemeria* flowers was considerably enlarged by rosemary essential oil (Babarabie et al., 2015). According to Babarabie et al. (2018b), rosemary and peppermint essential oils have a strong antimicrobial effect and lower the amount of microorganisms in the solution, improve the quality and freshness of flower color, and prevent discoloration and pigment loss in the petals of cut *Alstroemeria* flowers. Thyme, savory, and ajowan essential oils were used as an alternative to chemical preservatives and silver to



increase the vase life of cut gladiolus flowers (Mirdehghan & Aghamolaei, 2016). According to Hashemi et al. (2013), thymol, menthol, and eugenol can prolong the vase life of cut chrysanthemum flowers. Numerous studies have demonstrated that thyme essential oil prolongs the vase life and quality of cut gerbera flowers after harvest (Jafarpour et al., 2015).

According to Hashemabadi et al. (2015b), extracts of *Mentha pulegium* with preservative solution can increase the vase life of cut rose blossoms. To achieve the greatest results for gladiolus cut flower vase life, Rasul et al. (2011) demonstrated that the essential oils of ajowan and savory must be used in conjunction with silver thiosulphate. According to Hashemabadi et al., (2015a) and Dashtbay and Hashemabadi (2015) 10% geranium essential oil increased vase life of chrysanthemum cut flowers. Hashemabadi et al., (2013) found that 30% *Artemisia* essential oil and 200 mg/L-1 rifampin improved the quality of cut chrysanthemum flowers after harvest, whereas Hashemabadi et al., (2016) found that geranium essential oil improved postharvest vase life.

7. CONCLUSION

Cut flowers face the problem of short display life and lose their aesthetic value rapidly. The flexibility of the market at any given time is determined by the product's shelf life, especially for cut flowers. Cut flower vase life is limited due to physio-chemical mechanisms that influence senescence. Senescence in flowers is controlled by several interconnected physiological and biochemical mechanisms. These characteristics are significantly impacted by water loss and wilting while in transport. Lack of water and the resulting premature senescence cause cut flowers to be of poor quality and lose their market.

The blockage of stem conducting tissues by microorganisms found in vase solution is one of the key factors influencing floral vase life. By using biocides in preservative solutions, this can be avoided. To increase the vase life of cut flowers, it is necessary to utilize chemicals that are non-toxic and environmentally friendly. Essential oils are safe and environmentally beneficial organic natural compounds. Because they include large amounts of phenolic chemicals (like eugenol, carvacrol, and thymol), essential oils have potent antibacterial activity against some infections.



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KAYSERİ'DE EKİM NÖBETİ

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ÖZET

Tarımsal ürünlerin ekim deseni içerisindeki payını yetiştirilen ürünün ekonomik değeri ve üretim maliyeti belirlemektedir. Toprak verimliliğinin korunması için ekim nöbeti uygulanması bir zorunluluktur. Hava koşullarının neden olabileceği verim kayıpları ve taban fiyatlarda ortaya çıkabilecek gelir kaybını en aza indirmek için ekim nöbeti uygulanmaktadır. Farklı özelliklere sahip bitkilerin dahil olduğu ve iyi planlanmış ekim nöbeti sistemlerinde hastalık, zararlı ve yabancı ot kontrolü kolaylaşmakta, verim ve fiyat dalgalanmalarından doğacak riskler azalmakta işletmenin makine ve iş gücü yıl içerisinde daha düzenli kullanılmakta, erozyon azalmakta, toprağın azot ve organik madde içeriği artmakta, topraktaki besin maddeleri ve uygulanan gübreler daha etkin bir şekilde değerlendirilmektedir. Bu araştırmada ekim nöbetinin ne olduğu, ekim nöbetinin faydaları, ekim nöbetinin yaygınlaştırılmasında öncelikli konular, ekim nöbeti uygularken dikkat edilmesi gereken konular, ekim nöbetine girecek bitkilerde bilinmesi gereken özellikler, ön bitkinin verim ve kaliteye etkisi, ekim nöbeti uygularken karşılaşılabilecek zorluklara değinilerek Kayseri'de mevcut ürün deseni ve uygulanabilecek ekim nöbeti sistemlerine değinilecektir.

Anahtar Kelimeler: Ekim nöbeti (münavebe), rotasyon, ön bitki, kayseri



CROP ROTATION IN KAYSERI

ABSTRACT

The share of agricultural products in the planting pattern is determined by the economic value of the product and the cost of production. Crop rotation is a necessary application to maintain soil fertility. Crop rotation is applied in order to minimize income losses that may be caused by adverse weather conditions and low base crop prices. A well-defined plant rotation system with different plants may improve the resistance against pests and diseases, and it may ease the control of weeds, decrease the risks of yield and price fluctuations, reduce the risk of erosion, increase the nutrient content of soils and allows more proper machinery and labor use for producers and better use of fertilizers. In this research, the benefits of the crop rotation, the priority issues in the dissemination of the rotation, the issues to be considered while applying the rotation, the characteristics that should be known in the plants that will enter the rotation, the effect of the pre-plant on the yield and quality, the difficulties to be encountered while applying the rotation, crop pattern, applicable crop rotation systems and the current situation in Kayseri will be discussed.

Keywords: Crop rotation, rotation, front plant, kayseri



1. GİRİŞ

Tarla tarımının en önemli kültürel uygulamalarından birisi, ekim nöbeti veya rotasyondur. Herhangi bir yerde uygulanacak iyi seçilmiş etkili bir münavebe (ekim nöbeti) hastalık, zararlı ve yabancı ot yoğunluğunu azalttığı gibi, toprak canlılığını derinlemesine artırmak, yetiştirilen ürünlerin toprağın değişik katmanlarından aynı şekilde yararlanmak ve erozyonu önlemek gibi pek çok avantajları bulunmaktadır. Ekim nöbeti sistemleri toprak verimliliğinin korunmasına ilave olarak tarımsal üretimde, biyolojik ve ekonomik stabilitenin sağlanması açısından da önemlidir. Özellikle ABD gibi tarımı ileri ülkelerde bitki yetiştirilen alanların %80'inden fazlasında rotasyon uygulanmaktadır (Claassen ve ark., 2018). İngiltere'de pancar ekili alanların %90'ında pancar ekimi kışlık ya da yazlık bir tahıl takip etmektedir. Ekim nöbeti, yabancı ot kontrolünde birçok bitki için önemli bir yer tutmaktadır (Torun ve Uygur, 2019; Torun ve Özkil, 2021). Rotasyonda bitki sırasının farklılığı, değişik tarihlerde ekilme ve olgunlaşma, rekabet ve allelopatik özellikler yönünden farklılık gösteren bitkilerin kullanılmasıyla yabancı otların çoğalmaları önlenebilmektedir (Kara ve ark., 2011; Zimdahl, 2018; Çiğnitaş ve Kitiş, 2021). Ayrıca rotasyon uygulamaları organik madde, besin elementi elverişliliği, organik azot ve karbon, hacim ağırlığı (Edwards ve ark., 1992), agregat stabilitesi, organik madde ve erozyona mukavemet gibi (Öztaş ve ark., 1997) toprak özellikleri üzerinde de etkili olmaktadır. Ekim nöbeti, hastalık döngüleri (Maas ve Kotze, 1990), böcek popülasyonları (Brust ve King, 1994) ve nematod popülasyonlarını (Ferris ve ark., 1994) değiştirmek suretiyle de bitki verimini önemli ölçüde etkilemektedir. Tosun ve ark. (1987) Erzurum kıraç koşullarında fiğ ve korunganın ekim nöbetine girmesiyle nadas oranının oldukça aşağılara çekildiğini ve nadas yılında kuru ot üretildiğini tespit etmişlerdir. Bu çalışmada nadas-buğday klasik sistemi yerine fiğ-nadas-buğday, 3 yıl korunga-buğday-nadas-buğday ve 3 yıl korunga-nadas-buğday-nadas-buğday gibi sistemler buğday verimlerini önemli ölçüde artırdığından önerilmiş ve sistemler nadas-buğdaya göre sırasıyla 5,9 ve 8 kat daha karlı olmuşlardır. Ekim nöbeti sistemlerinde nitrat yıkanmasından kaynaklanan su kirliliği daha azdır. Zira ekim nöbetinde azot kullanım etkinliği düşük olan bitkinin azot ihtiyacının bir kısmı kalıntı azotu ile karşılanmakta hem de çevre-su kirliliği azalmaktadır. Kayseri'de tarım arazilerinde ürün deseni incelendiğinde Türkiye genelindeki aynı yanlışlıklar görülmektedir. Tarım arazilerinde toprak yapısını iyileştiren ve verimliliğin sürekliliğini sağlayan bir ekim nöbeti sistemi uygulanmamaktadır. Kayseri'de genellikle tahıl tarımına dayalı mono kültür tarım uygulanmaktadır. İlde bulunan 555.336 ha tarım arazisinin 369.512 hektarında tahıllar yetiştirilmekte, 130.707 ha alanda da nadas yapılmaktadır (Anonim, 2021). Tahıl + nadasın



tarla tarımındaki oranı %90.1 olmak üzere çok yüksektir. Toprağa katkısı olmayan bu sistem sonucunda da topraklar verimsizleşmekte, yağın yağış toprakta tutulamamakta ve ürün verimleri de düşük seviyede kalmaktadır. Kayseri’de tarım arazilerinin %23.5’lik kısmında nadas uygulanmaktadır (Anonim, 2021). Nadas ekolojik şartların getirdiği bir zorunluluk olup, topraklarımızdaki su ve besin elementi noksanlığından dolayı toprağın bazı yıllar ekilmeden boş bırakılmasıdır. İç Anadolu Bölgesinin diğer illerinde olduğu gibi bu İlde de nadas-tahıl ekim nöbeti sistemi uygulanmaktadır. Ancak toprakları organik maddece fakir ve yıllık yağış miktarı yetersiz olan bölgelerde nadası tamamen kaldırmak mümkün değildir. Geleneksel olarak uygulanan nadas-buğday sistemi nadasın yüksek olarak seyretmesine neden olmaktadır. Oysa uygun ekim nöbeti sistemleri uygulanarak nadas alanları oldukça düşük oranlara çekilebilir. Kıraç şartlarda nadas (N)-buğday (B) uygulaması yerine macar fiği (MF)-N-B uygulanarak nadas %50’den %33’e düşürülerek, buğdayın tane verimi %50 artırılmış ve MF’den 350–400 kg/da kuru ot alınarak kaba yem açığı giderilmiş olur (Tosun ve ark., 1987). Yine, Tosun ve ark. (1987) tarafından kıraç şartlarda; N-B yerine 4–5 yıl korunga (K) veya 5–6 yıl yonca (Y) ve peşine B-N-B ekim sistemi (K-K-K-K/K-B-N-B; Y-Y-Y-Y/Y-B-N-B), sulu şartlarda ise B-B, B-Pancar, B-Ayçiçeği uygulaması yerine MF-B/A/Pan/Ayç uygulanarak hem MF’den 1200-1500 kg/da kuru ot alınabileceği belirtilmektedir. Bu durumda buğdayın tane verimi %50 artırılmış olur. Hayvancılığı desteklemesi bakımından B-B yerine MF + silajlık mısır (SM) ekim nöbeti uygulanarak aynı yıl hem MF ve hem SM’den kaba yem alınabilir. Bu sayede hem kaba yem açığı kapatılmış olur hem de daha yüksek miktarda doğrudan gelir desteği alınmış olur. Meyveci ve ark. (2005) tarafından Orta Anadolu’da uzun süredir yürütülen farklı ekim nöbeti sistemlerinin denendiği araştırmanın 3 yıllık bölümünden elde edilen sonuçlar “nadas-tahıl-nadas-tahıl” ekim nöbeti sistemine en yakın hatta bunun üzerinde verim sağlayan “nadas-tahıl-yazlık mercimek-tahıl” ekim nöbeti sisteminin en karlı ekim nöbeti sistemi olduğu tespit edilmiştir.

2. EKİM NÖBETİNİN TANIMI

Ekim nöbeti; aynı tarla üzerinde farklı kültür bitkilerinin belirli sıra dahilinde birbirini takip edecek şekilde yetiştirilmesine denir (Örük ve ark., 2019; Büyüktavşan ve Naneli 2020). Ekim nöbeti, tarla tarımının organize edilmesinde üzerinde durulacak en önemli konulardan biridir. Ekim nöbetinde asıl amaç toprağın üretkenliğinin sürdürülebilmesi ve birim alandan elde edilen verimin artırılmasıdır (Tuğay, 1988; Sencar ve ark., 1994). Tarla tarımı organizasyonunun kilit noktası olan ekim nöbetindeki sorunları bilimsel açıdan ele alan çok sayıda çalışma bulunsa da, en önemli sorun bulguların çiftçiye ulaştırılamamasıdır. Bitkisel üretimle ilgili yapılan



uygulamaların yüksek oranda verime çevrilebilmesi ve arzulan tarımsal başarıya ulaşılabilmesinde doğal ve ekonomik şartlara uygun ve zarar vermeyen bir ekim nöbeti planının hayata geçirilmesi gerekir (Pratley, 1992; Kara ve ark., 2005). Tarla tarımı yapan bir işletmenin karlı bir üretim yapabilmesi için en az 3-5 yıl gibi bir sürede hangi üretim dallarında ne miktarda üretim yapılacağını planlaması gerekir. Bu husus sadece tarımsal işletmeler düzeyinde kalmayıp, ülke düzeyinde hangi ürünün, yıllara göre ne miktarda üretileceğinin bilinmesi, ülke kalkınmasını planlama yönünden de mutlak gereklidir.

2.1. Ekim nöbeti iki grup altında toplanır bu gruplar;

2.1.1. Sabit Ekim Nöbeti Sistemi: Bu ekim nöbeti sisteminde bitkiler düzenli bir sıra ile birbirini takip ederler ve belirli bir yılda ekim nöbeti tamamlanır. Örneğin ülkemizin sahil şeridinde uygulanabilecek Pamuk-Buğday-Mısır-Fiğ+Yulaf ya da Pamuk-Buğday-Mısır-Fiğ+Yulaf sıralamasında olduğu gibi.

2.1.2. Değişken Ekim Nöbeti Sistemi: Bu ekim nöbeti sisteminde bitkiler belirli bir sıra ile birbirini izler. Ancak yıllara göre değişkenlik gösterir.

3. EKİM NÖBETİNİN FAYDALARI ŞÖYLE SIRALANABİLİR

3.1. İşletmede muntazam bir iş bölümü sağlanır: Mevcut tarlalarda usulüne uygun olarak ekim nöbeti uygulanması halinde muntazam bir iş bölümü sağlanır. Örneğin; bir tarlada buğday varken, diğerinde şeker pancarı varsa, buğdayın hasadından sonra kalan boş zamanlarda şeker pancarı ziraatına devam edilir.

3.2. Rizikoyu ve zarar tehlikesini azaltır: Tarlalarda, ekim nöbeti ve işletme imkânlarına uygun olarak yıl içerisinde değişik bitkiler yer alacağından bu değişik ürünlerin don, kuraklık, dolu gibi iklim faktörlerinden görebilecekleri zarar miktarı da farklı olacaktır. Ayrıca ülkemizdeki fiyat politikaları nedeniyle bir ürünün pazarlanması ve satışında karşılaşılan sorunlar, diğer ürünlerin satışı ile telafi edilebilir.

3.3. Hastalık, zararlı böcek ve hayvanların kontrolünü sağlar: Toprakta geçen veya toprakta barınan bazı hastalık ve zararlıları devamlı aynı ürün yetiştirilen bölgelerde gittikçe artarak mücadeleyi zorlaştırır ve maddi külfetlere yol açarlar. Hâlbuki değişik ürünlerin bir münavebe planı içerisinde yetiştirilmesi ile bu zararlıların çoğalması önlenmiş olur. Çünkü bir ürün için zararlı olan bir hastalık veya zararlı başka bitkiye zarar vermeyebilir. Örneğin; tarlaya üst üste buğday ekilirse, buğdayda hastalık yapan mantarlar yıldan yıla çoğalırlar. Bu mantarlar diğer hububat ekilişlerinde ve yabancı otlarda yaşamını sürdürdüklerinden buğdayın arkasından arpa, çavdar ve yulaf ekilmemeli, toprak otlardan temizlenmelidir. Rhizoctonia kök ve



kökboğazi hastalığının hakim olduğu tarlalarda hububattan sonra patates, bezelye, fasulye ve bakla ekilmemelidir. Çünkü mantar bu bitkilerde de yaşamını sürdürmektedir.

3.4. Yabancı otların çoğalmasının önlenmesi: Herhangi bir kültür bitkisinde sorun oluşturan bir yabancı ot, diğer kültür bitkisinde bulunmayabilir. Bu nedenle münavebe kültür bitkisine bağlı olarak uygulanmaktadır ve yabancı otlarla mücadelede etkin yollardan biridir (Torun ve Uygur, 2019; Torun ve Özkil, 2021). Örneğin; hububat içerisinde sorun oluşturan yabancı yulaf (*avena fatua*) çapa bitkilerinin veya yonca gibi sık biçilen yem bitkilerinin ekilmesi ile birkaç yılda ortadan kalkmaktadır. Küskütte olduğu gibi bazı parazit bitkilerde tarlaya konukçularının 2-3 yıl ekilmemesi ile geniş ölçüde mücadele yapılabilir. Diğer taraftan bazı yabancı otların mücadelesinde etkili olan herbisitlerin uygulanabileceği kültür bitkisi ekilerek ilaçlama yapılabilir. Örneğin; patates içerisinde sorun oluşturan köygöçüren (*cirsium arvense*) ile mücadelede bir sonraki yıl ekilen hububata MCPA terkipli ilaçlar uygulanarak mücadele yapılabilir.

3.5. Toprakta organik maddenin artırılması: Topraklarda organik maddenin yeterli olması başta toprağın su tutma kapasitesini artırır. Toprakta makro ve mikro besin elementlerinin dengesini sağlar, toprağın havalanmasına yardımcı olur, toprak mikroorganizmalarının daha aktif çalışmasını sağlayarak ayrışma ve parçalanmanın hızını artırır. Kaymak tabakasının oluşmasını engelleyerek çıkış ve gelişmenin düzenli olmasına yardım eder. Bu nedenlerle topraktaki organik maddenin artırılması gerekir. Organik maddenin artırılmasında en önemli yöntem toprağa çiftlik gübresinin verilmesidir. Bununla beraber ekim nöbeti uygulamaları da toprakta organik madde miktarının artırılmasına yardımcı olur. Özellikle ilimiz toprakları gibi organik maddece fakir olan topraklarda uygulanacak ekim nöbeti içerisinde çayır-mera ve baklagil yem bitkileri ile yeşil gübre ve örtü bitkilerinin yer alması, toprağın organik madde miktarının ve su tutma kapasitesinin artırılmasına yardımcı olur. Baklagil bitkilerinin ekim nöbeti içerisinde yer alması ile baklagillerin toprakta fikse ettikleri azottan ve ayrıca tahıllara oranla yaklaşık 2 misli azot içeren toprakaltı organlarının diğer organizmalar tarafından parçalanması ile toprağa verilen azottan, baklagillerden sonra ekilecek olan bitkiler faydalanırlar. Ayrıca baklagiller toprağın biyolojik ve fiziksel yapısının iyileştirilmesine de yardımcı olurlar (Büyüktavşan ve Naneli 2020).

3.6. Toprağın derinliklerindeki besin elementlerinden faydalanmanın sağlanması: Her bitki topraktan eşit ölçülerde besin elementi kaldırmaz. Bazıları belirli besin maddelerini fazla kaldırarak diğer bazılarını çok az harcarlar. Bu durumda aynı bitkinin üst üste yetiştirilmesi o madde bakımından toprağın fazla zayıflamasına yol açar. Münavebeye kök yapısı,



adaptasyonları ve yetiştirme teknikleri birbirinden farklı olan bitkilerin alınması bu maddelerin dengeli harcanmasına yardımcı olur.

3.7. Gübrelerden daha çok fayda temin edilmesi ve gübre tasarrufu sağlanması: Organik çiftlik gübrelerinin veya ticaret gübrelerin münavebeye alınan bitkilere verilmesi ile bunlardan en iyi şekilde fayda sağlanır. Yeşil gübreleme yapılması ile organik madde miktarı artırılır. Böylece toprakta artan mikroorganizma faaliyeti gübrelerin daha faydalı olmasına yardımcı olur. Ayrıca daha sonra ekilen bitkiler için de toprakta kalan gübreler faydalı olur.

3.8. Erozyonun önlenmesi: Yem bitkilerinin münavebeye alınmasıyla erozyon olan bölgelerde iyi bir çim kapağı oluşturularak erozyon önlenmiş olur.

3.9. Verimin ve kalitenin artırılması: İyi bir ön bitki kendisinden sonra gelen bitkinin verim ve kalitesinin artmasına yardımcı olur (Kara ve ark., 2011).

3.10. Biyolojik dengenin korunması, çevre ve toprak kirliliğinin azaltılması: Bitkileri geliştirmek için kullanılan tarım ilaçları o kültür bitkisinin yetiştirilmesi için faydalı iken toprakta veya çevrede oluşturduğu kirlilik ve kalıntı biyolojik dengenin bozulmasına yol açabilmektedir. Tarım ilaçları kullanılmayarak ekim nöbeti uygulanması ile maliyeti ve ilaçlama masrafı azalacaktır.

3.11. Bitki salgılarının olumsuz etkisi kaybolur: Bitkiler köklerinden çeşitli maddeleri salgılar. Bitkilerin canlılara zehir etkisi yapabilecek bazı toksit maddeleri salgılamaları (mısır-amino asit, yulaf-scopoletin, keten-linoin, yağ bitkileri-fosfor asidi, şeker nişasta bitkileri-potasyum) yanında, ayrışma ve çürüme sonucunda ortaya çıkan toksit maddelerin toprağa karışması ile de bitki veriminde azalmalar görülür. İşte monokültür tarımın sakıncaları ve münavebenin sayılan bu faydaları nedeniyle uygun bir ekim nöbetinin planlanması ve bunun uygulanması gerekmektedir.

4. EKİM NÖBETİNİN YAYGINLAŞTIRILMASINDA ÖNCELİKLİ KONULAR

- ❖ Üretim planlamasının sağlanması,
- ❖ Üretimin kayıt altına alınması,
- ❖ Bitkisel ve hayvansal üretimin birlikte desteklenmesi,
- ❖ Arazi planlamasının yapılması,
- ❖ Tarım alanlarının amaç dışı kullanımını önlemek,
- ❖ Kuru ve sulu tarım sistemlerinin ilkelerini uygulamaktır.



5. EKİM NÖBETİ UYGULARKEN DİKKAT EDİLMESİ GEREKEN HUSUSLAR

- a) İklim şartları: Yıllık yağış miktarı, ilkbahar son don ve sonbahar ilk don tarihleri, sıcaklık, yağışın dağılımı, kışlık ekimin mümkün olup olmadığı gibi faktörler.
- b) Toprak yapısı: Toprağın pH derecesi, asit veya alkali olması, toprak yapısı kumlu, killi, humus toprak olması, organik madde miktarı gibi faktörler.
- c) Sulama imkânları: Sulamanın yapılabilmesi, suluda yüksek verim alınan bitkilerin münavebeye girmesini, toprakta organik maddelerin parçalanmasını, gübreden daha iyi yararlanmayı etkiler.
- d) Bitkilerin Uyuşumu: Bitki tür ve çeşitlerinin özellikleri: Bitkilerin topraktaki ilerleyebildikleri kök derinlikleri, bitkinin daha fazla kullandığı besin elementlerinin farklı olması, hububat, baklagil bitkisi olması gibi faktörler.
- f) Ulaşım, depolama ve pazarlama gibi ekonomik şartlar.

6. EKİM NÖBETİNE GİRECEK BİTKİLERİN BİLİNMESİ GEREKEN ÖZELLİKLERİ

- A- Bitkinin vejetasyon süresi
- B- Bitkinin morfolojisi (kök, yaprak, çiçek vb. özellikler)
- C- Bitkinin fizyolojisi (soğuğa, kurağa dayanıklılık, bitki besin maddesi ve su alımı vb.)
- D- Bitkinin toprakta bıraktığı kök ve bitki artıkları miktarı ve C/N oranı (Aydın ve Kılıç, 2020)
- E- Bitkinin salgıları
- F- Bitkinin yetiştirilme amacı
- G- Bitkinin pazar durumu

7. ÖN BİTKİ ETKİSİ NELERE BAĞLIDIR

- Genetik akrabalık ve morfolojik benzerliklere,
- Toprak ve iklim şartlarına,
- Kültür bitkilerinin vejetasyon sürelerinin uzunluğuna,
- Toprakta kalan kök ve hasat artıklarına,
- Toprağın su varlığının zorlanmasına,
- Organik ve mineral gübrelemeye,
- Toprak sağlığının korunmasına (fitopatolojik açıdan),
- Toprağın gölgeleme ve yabancı ot durumuna,
- Ön bitki verimine,
- Ön bitkinin allelopatik etkisine, (Zimdahl, 2018; Çiğnitaş ve Kitiş, 2021)
- Yetiştirme tekniği ile iş ekonomisinin özelliklerine bağlıdır.



8. ÖN BİTKİNİN VERİM ve KALİTEYE ETKİSİ

Tarla bitkilerinde farklı ön bitkilerin kendisinden sonra ekilen ürünlerin verim ve kalitesini etkiledikleri bilinmektedir (Kara ve ark., 2011). Kara ve ark. (2005) yaptıkları çalışmada buğday tanesindeki en yüksek protein oranını fiğ ve fasulyeden sonra ekilen buğdaydan elde edildiğini ve buğday için en uygun ön bitkilerin; fiğ, ayçiçeği, arpa ve şekerpancarı olduğunu belirtmiştir. Gül ve ark. (2008) baklagillerin ön bitki olarak kullanıldığı çalışmalarında baklagillerin mısır için çok iyi bir ön bitki olduğu ve mısırın kuru madde verimini artırdığı ve mısırın azot ihtiyacını azalttığını bildirmişlerdir. Uzun ve ark. (2005)'nin yaptıkları çalışmada kışlık ara ürün olarak baklagil yem bitkilerinin yetiştirilebileceği, bu ekimin kendisinden sonra gelecek mısır ekimi zamanını geciktirmeyeceği, mısır veriminin tek yıllık baklagil ekimlerinden sonra artışının az olmasına karşılık uzun yıllarda bu artışın daha belirgin olacağını bildirmişlerdir. Tisdale ve Nelson (1982), ekim nöbetinde adi fiğin yer almadığı durumda dekara 163 kg mısır verimi sağlanırken, bu verimin mısırdan önce adi fiğ ekili parsellerde 489 kg'a çıktığını tespit etmişlerdir. Anlarsal ve ark. (1996) Çukurova'da yaptıkları araştırmalarında, hiç azotlu gübre verilmeksizin, bakla bitkisinden sonra yetiştirilen mısırın tane verimini 689 kg/da olarak belirlemişlerdir. Denemede, ayrıca, azot dozlarının ortalaması olarak en yüksek tane verimini 1090 kg/da ile iskenderiye üçgülünden sonra ekilen mısır parselleri vermiştir. Kılıç ve ark. (1999)'nin Diyarbakır koşullarında yapmış oldukları çalışmada tane amaçlı mısır için en uygun ön bitkinin mercimek olduğu, mısırın koçan çapı, koçan uzunluğu, koçan ağırlığı, protein oranı ve tane veriminin arttığını bildirmişlerdir. Turgut ve ark. (1999)'nin Bursa koşullarında yapmış oldukları çalışmada tane mısır için en uygun ön bitkinin fasulye olduğu, mısırın koçan özelliklerinin farklı ön bitkilere göre değiştiğini ve tane veriminin arttığını bildirmişlerdir. Birçok araştırmacı baklagillerden sonra ekilen tahılların veriminde önemli artışlar olduğunu ve bu artışın ön bitki olarak kullanılan baklagil türüne göre değiştiğini ileri sürmüşlerdir. Buna mukabil bazı baklagillerden sonra art bitki olarak ekilen tahıllarda kardeş sayısını arttırdığı ve dolayısıyla tane iriliğinin azaldığı ifade edilmektedir (Forbes ve Watson, 1992; Aydın ve Tosun, 1993; Drury ve Tan, 1995; Kara ve ark., 2011).

9. EKİM NÖBETİ UYGULARKEN KARŞILAŞILAN ZORLUKLAR

9.1. Tarım alanlarında yüksek oranda tahıl (özellikle buğday) yetiştiriliyor olması:

Buğday tarımında ekim nöbeti, buğday kök hastalıkları, ekin kurdu (*zabrus*), buğday sineği gibi zararlılar ile mücadele ve toprakta verimin korunması için mutlaka her yıl veya en az iki yılda bir ayçiçeği, macar fiği, kanola, kavun, karpuz, soğan, fasulye, mısır gibi ürünlerle yapılmalıdır.



Tahıl-baklagil sisteminde nadas yerine geçebilecek baklagil bitkileri ise; kışlık mercimek, macar fiği, yazlık mercimek ve nohut olabilir.

Her yıl ekim sistemi içerisinde hububatın yer almasının sakıncaları;

- a) Ayın toprak derinliğindeki besin elementlerinin azalması,
- b) Farklı derinlikteki besin elementlerinden faydalanılamaması,
- c) O bitkiye has hastalık ve zararlıların artması,
- d) Yabancı otların çoğalması,
- e) Verim ve kalitenin düşmesine sebep olabilmektedir.

Bunların sonucu olarak toprak o bitki için uygun olmayan şartlar içerecektir. Bir kültür bitkisinin yetişmesine uygun olmayan bu tip topraklara yorgun toprak, bu olaya da “*toprak yorgunluğu*” denir. (Literatür bulalım)

9.2. Baklagillerin ekim nöbetinde fazla kullanılmaması: Ekim nöbetinde yer alacak ürünlerin seçiminde bölgenin iklim, toprak, sosyal ve ekonomik şartların göz önüne alınması gerekmektedir. Genel olarak yağışa dayalı kuru tarım alanlarında tahıl-baklagil ekim nöbeti sistemi ilk sıralarda yer almaktadır. Çiftçi etkili bir nadas uygulaması yapmıyorsa, zaten nadas süresince toprağı 14 ay gibi bir süre boş bırakmasının anlamı olmayacaktır. Bu dönemde ilave bir ürünle, ayrıca ek gelir de sağlamaktadır. Orta Anadolu Bölgesi’nde nadasın yerine daha çok baklagillerden nohut ve mercimek yazlık olarak ekilebilir. Son zamanlarda geliştirilen yeni çeşitlerle kışlık mercimek yetiştiriciliğı de şanslı görülmekte; bu ürünün nadas alanlarında geniş sahalarda ekilebileceğı düşünülmektedir.

Buğday bitkisinin gireceğı bazı münavebe modelleri şu şekilde olabilir:

1. Model: Ayçiçeğı + **Buğday** + Baklagil + Mısır
2. Model: Şeker Pancarı + Mısır + **Buğday** + Baklagil
3. Model: **Buğday** + Ayçiçeğı + Kavun-karpuz + Mısır
4. Model: Baklagil + **Buğday** + Ayçiçeğı + Mısır

Tahıl-baklagil ekim nöbeti aşağıda sıralanan sebeplerden dolayı tercih edilmelidir;

- Toprağı su ve rüzgar erozyonuna karşı korur,
- Yabancı ot ve zararlıları kontrol altına alır, (Baldwin, 2021)
- Boşta kalan işgücünü değerlendirir,
- Toprağın yapısını düzeltir.

Bu sistemde kuru tarım alanlarında nadas-tahıl sistemindeki nadas yerine baklagillerin sokulması suretiyle verimin artırılması hedeflenmektedir. Bu alanlarda nadas yerini alacak bitki sayısı sınırlıdır. Bu amaçla ilk akla gelenler tek yıllık baklagil bitkileri fiğ, yem bezelyesi,



mercimek ve nohut. Baklagiller derine inebilen kazık kökleri ve havadaki serbest azotu toprağa bağlamaları sonucunda toprağı azot ve organik madde yönünden zenginleştirmektedir. Tahıl-baklagil ekim nöbeti sisteminde önemli olan husus, nadas-buğday ekim sisteminden farklı bir yetiştirme tekniğinin uygulanacağını bilmektir.

9.3. Ekim nöbetine alınan yağ bitkilerin kullanımının yaygınlaştırılmaması: Gerek Orta Anadolu şartlarında, gerekse Geçit Bölgelerinde kuru şartlarda yağ bitkilerinin ekim nöbetine sokulduğu çalışmalar yapılmıştır. Ancak, bu bölgelerde yağ bitkileri ekiminin yaygınlaştırılması bir türlü mümkün olmamıştır. Bunun birçok sebepleri olmakla beraber, kuru şartlarda yağ bitkileri ile yapılan ekim nöbeti denemelerinde Orta Anadolu'nun hâkim ürünleri olan buğday ve pancarın verimleri azalırken, yağ bitkileri verimleri de çok fazla kârlı olamamıştır. Yapılan bu çalışmada ise hem yetiştirilen ana ürünler buğday ve pancar, hem de ekim nöbetine konulmak istenen ayçiçeği, soya, kolza, aspir ve mısır ihtiyaç duyduklarında sulanmıştır. Sulama yöntemi olarak damla ve yağmurlama sulama metodu uygulanmıştır. Denemelerde buğday, aspir ve kolza ekimleri kışık olarak tava yapılmış ve her üç yılda da çıkışlar başarılı olmuştur. Pancar, ayçiçeği, mısır ve soya ekimleri ise ilkbaharda ve yazlık olarak tava yapılmış ve bunların tarla çıkışları da fevkalade düzgün seyretmiştir. Ancak aspir ve kolza bitkileri yeterli kar yağışı olmadığı için her üç yıl da kıştan zarar görmüş ve ekimler ilkbaharda tekrarlanmıştır. Alınan neticeler göstermektedir ki, yıllar ana ürünler buğday ve pancar verimlerine, hem de yağ bitkileri ayçiçeği, soya, kolza, aspir ve mısır verimlerine etkili olmuştur. Her yıl da buğday ve pancar için en uygun ön bitkiler sırasıyla soya ve kolza olmuş, sonra da ayçiçeği, mısır veya mısır-ayçiçeği ve aspir olarak sıralanmıştır. Olaya ekonomik açıdan bakıldığında da yukarıdaki durum teyit edilmektedir. Sulu şartlarda Orta Anadolu'da kârlı bir üretim için buğday ve pancara en uygun yağ bitkileri soya ve kolza olduğu söylenebilir. Sonra ayçiçeği ve mısır, en sonda da aspir gelmektedir (Er ve ark. 2011). Bu şekildeki araştırmaların sayısı ve sürekliliği de arttırılmalıdır.

9.4. Nadası zorunlu kılan sebeplerin olması: Bölgeden bölgeye değişmekle birlikte; toprak, iklim, sosyal ve ekonomik şartlar göz önüne alınarak; yağışın yetersiz ve toprağın fakir olduğu yerlerde yeterli ürün alınabilmesi için bazen araya bir nadasın konulması tavsiye edilmektedir. Bu amaçla iki, üç ve dört yıllık ekim nöbeti sistemleri ortaya çıkmıştır. Bölgedeki baklagilin önemi ve yetiştirilebilme imkânına bağlı olarak değişik ekim nöbeti sistemleri önerilebilir.



10. KAYSERİ'DE ÜRÜN DESENİ

İlde yetiştirilen başlıca ürünler; buğday, arpa, yulaf, şeker pancarı, patates, kolza, ayçiçeği, mısır, yonca, korunga, karpuz, kavun, fasulye, nohut ve mercimektir.

11. ÜLKEMİZDE EKİM NÖBETİ UYGULAMALARI ve BAZI ÖRNEKLER

Ekim nöbeti uygulamalarına başlarken, mevcut tarım arazisi, kontrolleri kolay birbirine eşit büyük parçalara (tarlalara) ayrılır. İşletmenin büyüklüğüne göre parça sayısı ve büyüklüğü değişir. Ülkemizde çok farklı ekolojik bölgeler bulunduğu için standart olarak uygulanabilecek ekim nöbeti örnekleri yoktur. Ancak belirli çevre koşulları benzerlik gösteren bölgelerde uygulanabilecek ekim nöbeti örnekleri vardır:

Doğal yağışların az olduğu (kurak-yarı kurak) bölgelerimizde "bir yıl ekim bir yıl nadas" uygulamasıyla nadasın azaltılması amaçlanmaktadır. Korunga-Nadas-Buğday, Buğday-Nadas-Mercimek, Buğday-Baklagil, Arpa-Baklagil gibi ekim nöbetleri uygulanabilir.

Sulama olanağının bulunmadığı, doğal yağışların yeterli olduğu nadasın uygulanmadığı bölgelerimizde Buğday ve Arpa ile Kolza, Ayçiçeği, Haşhaş, Kavun, Karpuz, Tütün ve Aspir ile ikili ekim nöbetleri uygulanabilir.

Sıcaklık toplamının bir yılda iki ürün almaya yetmediği, fakat sulama olanağının bulunduğu bölgelerde daha fazla ürün yetiştirme olanağı mevcuttur. tahıl, pancar, patates, pamuk, susam, yerfıstığı, fasulye, yonca, haşhaş uygulamaları ile patates-pancar, patates-bezelye, mısır-pancar, mısır bezelye, pancar-haşhaş, baklagil-haşhaş, mısır-fasulye, pamuk-baklagil, pamuk-yonca gibi ikili ekim nöbeti uygulamaları yapılabilir. Ayrıca;

Sulanan yerlerde

- Buğday –silajlık mısır - fiğ + tahıl – şeker pancarı – kolza
- Yonca – yonca – yonca – yonca – yonca – mısır – şeker pancarı
- Fiğ + tahıl – ayçiçeği – kuru fasulye – buğday – fiğ + tahıl – mısır
- Arpa – silajlık mısır – kolza – fiğ + tahıl – patates
- Yonca – yonca – yonca – yonca – yonca – buğday – kolza – fiğ + tahıl – mısır
- Soya – fiğ + tahıl – mısır – patates gibi sistemlerde uygulanmaktadır.
-

Sulanamayan yerlerde

- ✓ Korunga – korunga – korunga – buğday – kolza – nadas
- ✓ Tohumluk fiğ – buğday – nadas
- ✓ Korunga – korunga – korunga – buğday – nohut
- ✓ Nohut – buğday – nadas



- ✓ Arpa – tohumluk fiğ – nadas
- ✓ Mercimek – buğday – nadas
- ✓ Korunga – korunga – korunga – buğday – kolza – arpa

12. KAYSERİ’DE UYGULANAN ve UYGULANABİLECEK EKİM NÖBETLERİ

Kayseri’de kıraç şartlarda buğday, arpa, nohut, mercimek, korunga ve adi ve macar fiği yetiştiriciliği yapılmaktadır. Nadasa yüksek oranda yer verilerek nadastan sonra genellikle buğday ve arpa ekilmektedir. Buğday ve arpadan yaklaşık 200 ve 300 kg tane verimi alınmaktadır. Yem bitkisi olarak kıraç şartlarda adi fiğ ekilmektedir. Adi fiğ ekildiğinde yağışın yeterli olmadığı yıllarda 4 parmak büyüyen adi fiğ hayvanlara otlatılmaktadır. Yağışın yeterli olduğu yıllarda ise 400 kg/da kuru ot verimi alınabilmektedir. Yıllık yağışın 450 mm’nin altına düştüğü yerlerde nadası tamamen kaldırmak mümkün görülmemektedir (Tosun ve ark., 1987 ve 1996; Olgun ve ark., 2007). Bu şartlarda Kayseri ve benzer ekolojilerde kıraç şartlarda mutlaka nadasa ve ekim sisteminde de yem bitkilerine yer vermek gereklidir. Bu olumsuz şartları düzeltmenin tek yolu buralarda yağış azlığına dayanıklı, yabancı otlarla mücadele edebilen, toprağı organik maddece ve bitki besin elementlerince zenginleştiren, yağın yağışın toprakta tutulmasını sağlayan tek veya çok yıllık bir baklagil yem bitkisinin ekim sistemine girmesidir (Tosun ve ark., 1996; Olgun ve ark., 2007).

Tablo 1. Kayseri’de kıraç şartlarda uygulanan ekim nöbeti sistemleri

Uygulanan Ekim Nöbeti Sistemi
Adi fiğ-Nadas
Buğday-Nadas-Çavdar
Buğday-Nadas-Buğday
Buğday-Arpa-Nadas-Buğday
Buğday-Arpa-Nadas-Buğday
Buğday-Nadas-Buğday-Patates-Buğday
Nadas-Buğday
Nadas-Arpa
Nadas-Nadas-Buğday
Nadas-Buğday
Nadas-Nadas-Buğday

Kayseri’de Kıraç Şartlarda Uygulanabilecek En Uygun Ekim Nöbeti Sistemleri

Üçlü Ekim Nöbeti Sistemleri

1. Macar Fiği-Nadas-Buğday
4. Nohut-Nadas-Çavdar
2. Macar Fiği-Nadas-Arpa
5. Macar Fiği-Nadas-Tritikale



3. Macar Fiği-Nadas-Aspir
6. Nohut-Nadas-Tritikale
7. Nadas-Tahıl-Nadas-Tahıl (Meyveci ve ark., 2005)
8. Nadas-Buğday-Ayçiçeği-Buğday (Meyveci ve ark., 2005)
9. Nadas-Buğday-Yazlık Mercimek-Buğday (Meyveci ve ark., 2005)

Dörtlü Ekim Nöbeti Sistemleri

1. Macar Fiği-Arpa-Nadas-Buğday
3. Macar Fiği- Buğday-Nadas-Aspir
2. Macar Fiği-Arpa-Nadas-Aspir
4. Macar Fiği-Buğday-Nadas-Tritikale

Beşli Ekim Nöbeti Sistemleri

1. Macar Fiği-Nadas-Arpa-Nadas-Buğday
4. M. Fiği-Nadas-Tritikale-Nadas-Buğday
2. Macar Fiği-Nadas-Arpa-Nadas- Aspir
5. M. Fiği-Nadas-Buğday-Nadas-Çavdar
3. Macar Fiği-Nadas-Buğday-Nadas-Aspir
6. M. Fiği-Nadas-Buğday-Nadas-Tritikale

Dokuzlu Ekim Nöbeti Sistemleri

1. Korunga-Korunga-Korunga-Korunga/Korunga-Nadas-Buğday-Nadas-Buğday
2. Korunga-Korunga-Korunga-Korunga/Korunga-Nadas-Buğday-Nadas-Arpa
3. Korunga-Korunga-Korunga-Korunga/Korunga-Nadas- Aspir -Nadas-Buğday

Onbirli Ekim Nöbeti Sistemleri

1. Yonca-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Nadas-Buğday-Nadas-Arpa
2. Yonca-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Nadas-Buğday- Nadas-Buğday
3. Yonca-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Nadas-Buğday- Nadas-Aspir
4. Yonca-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Nadas-Buğday- Nadas-B
5. (Korunga+Kılçiksız Brom+Otlak Ayırığı)-K+KB+OA-K+KB+OA-K+KB+OA-K+KB+OA-K+KB+OA-N-B-N-A/B/As/Ka
6. (Yonca+Kılçiksız Brom+Otlak Ayırığı)-Y+KB+OA-Y+KB+OA-Y+KB+OA-Y+KB+OA-Y+KB+OA-Y+KB+OA-N-B-N-A/B/As/Ka

Kayseri’de sulu şartlarda I. ve II. sınıf arazilerde buğday, arpa, pancar, patates, ayçiçeği, dane ve silajlık mısır, adi fiğ, macar fiği, fasulye ve yonca bitkileri ekilmektedir. Fasulye-



arpa/buğday-fasulye-arpa/buğday ekiminin yanında yoncanın hasadından sonra 2–3 yıl buğday, arpa, pancar, patates ve fasulye bitkileri sıraya ekilmektedir.

Tablo 2. Kayseri’de sulu şartlarda uygulanan ekim nöbeti sistemleri

Uygulanan Ekim Nöbeti Sistemi
Buğday-Pancar-Arpa-Arpa-Pancar
Patates-Fasulye-Lahana-Lahana-Pancar
Arpa-Buğday-Pancar-Buğday
Arpa-Buğday-Arpa-Buğday-Pancar
Arpa-Arpa-Pancar-Arpa-Arpa
Buğday-Pancar-Buğday-Pancar
Korunga-Korunga-Korunga-Korunga-Buğday
Buğday-Buğday-Buğday-Buğday-Buğday
Yonca-Yonca-Yonca-Yonca-Yonca-Yonca-Buğday-Pancar
Fasulye-Arpa-Fasulye-Arpa
Buğday-Nadas-Buğday-Nadas
Buğday-Nadas-Arpa-Nadas
Arpa-Nadas-Arpa-Nadas-Patates
Nadas-Buğday-Nadas-Pancar-Buğday
Buğday-Nadas-Buğday-Pancar
Nadas-Buğday-Pancar-Buğday-Arpa

Kayseri’de Sulu Şartlarda Uygulanabilecek En Uygun Ekim Nöbeti Sistemleri

İkili Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Pancar/Patates/Ayçiçeği/Arpa/Buğday/Silajlık Mısır/Kolza

Üçlü Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Arpa/Buğday-Silajlık Mısır/Kolza/Pancar/Patates/Ayçiçeği

Dörtlü Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Arpa-Buğday-Silajlık Mısır/Kolza/Pancar/Patates/Ayçiçeği

Sekizli Ekim Nöbeti Sistemleri

1. (Çayır Üçgülü+Kılçiksız Brom)-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-Silajlık Mısır/ Buğday-Arpa/Pancar/Patates/Ayçiçeği

Dokuzlu Ekim Nöbeti Sistemleri

1. (ÇÜ+KB)-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-ÇÜ+KB-Silajlık Mısır-Buğday-Arpa/Pancar/Patates/Ayçiçeği

Onlu Ekim Nöbeti Sistemleri

1. (Yonca+A)-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Silajlık Mısır/Buğday-Arpa/Pancar/ Patates/Ayçiçeği/Silajlık Mısır-Arpa/Pancar/ Patates/Ayçiçeği/Silajlık Mısır



2. (Yonca+Kılıksız Brom)-Y+KB-Y+KB-Y+KB-Y+KB-Y+KB-Y+KB-Silajlık Mısır-
Buğday/Arpa/Pancar/Patates/Ayçiçeği- Buğday/Arpa/Pancar/Patates/Ayçiçeği

Onbirli Ekim Nöbeti Sistemleri

1. (Yonca+A)-Yonca-Yonca-Yonca-Yonca-Yonca/Yonca-Silajlık Mısır/Buğday-Arpa-
Pancar/ Patates/Ayçiçeği/Silajlık Mısır-Pancar/ Patates/Ayçiçeği/Silajlık Mısır

2. (Y+KB)-Y+KB-Y+KB-Y+KB-Y+KB-Y+KB-Y+KB-Silajlık Mısır-Buğday-
Arpa/Pancar/Patates/Ayçiçeği- Arpa/Pancar/Patates/Ayçiçeği

13. SONUÇ

Tüm bu bilgiler ışığında ekim nöbetinden elde edilecek faydalar aşağıda sıralanmıştır.

1. Nadasa bırakılan arazi miktarı azalacak,
2. Yem bitkileri ekim oranı artacak,
3. Yem bitkileri ekim alanı artışına bağlı olarak üretilen kaba yem miktarı da artacaktır,
4. Nadasın azalması ve yem bitkilerinin ekim oranının artması erozyonu azaltacaktır,
5. Yağan düşük yağışın toprakta tutulması sağlanacaktır,
6. Toprakların mikro organizma faaliyeti artacaktır,
7. Toprakların organik madde oranı yükselecektir,
8. Ekilen bitkilerden birim alana daha fazla verimin elde edilmesi sağlanacaktır,
9. Endüstri bitkileri ekim oranı artacaktır,
10. Yemelik dane baklagiller ekim oranı artacaktır,



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ÖZET

Ekim nöbeti; aynı tarlada belirli bitkilerin (nadas dâhil), belirli bir sıra dâhilinde birbiri ardından yetiştirilmesi ve uygulanmasıdır. Bir tarlaya ekilen herhangi bir üründen sonra gelen ürün veya vejetasyon süresi içerisinde o tarlaya uygulanan işlemlerin sırasıdır. Bir tarlada aynı familyaya ait, özellikleri birbirine önemli ölçüde benzeyen bitkilerin birbiri ardından yetiştirilmesi mono kültür olarak bilinmektedir. Toprağı yılın aynı zamanlarında, aynı yönde, aynı derilikte kullanan; benzer hastalık, yabancı ot ve zararlılara sahip olan bitkilerin arka arkaya yetiştirilmesi bir taraftan toprak yapısını bozarken, diğer taraftan hastalık, zararlı ve yabancı ot varlığının artmasına sebep olmaktadır. Bunların sonucu olarak ta toprağın verimliliği önemli ölçüde azalmaktadır. Bu çalışmada ekim nöbetinin ne olduğu, ekim nöbetinin faydaları, ekim nöbetinin yaygınlaştırılmasında öncelikli konular, ekim nöbeti uygularken dikkat edilmesi gereken konular, ekim nöbetine gelecek bitkilerde bilinmesi gereken özellikler, ön bitkinin verim ve kaliteye etkisi, ekim nöbeti uygularken karşılaşılabilecek zorluklara değinilecek; Sivas'ta mevcut ürün deseni ve uygulanabilecek ekim nöbeti sistemleri hakkında bilgi verilecektir.

Anahtar Kelimeler: Ekim nöbeti (münavebe), rotasyon, ön bitki, Sivas



CROP ROTATION IN SIVAS

ABSTRACT

Plant rotation; is the cultivation and application of certain plants (including fallow) in the same field one after the other in a certain order. It is the sequence of operations applied to that field during the growing period after harvesting a planted crop in a field. The cultivation of plants in the same plant family one after the other in a field is known as monoculture. Cultivation of the soil at the same time of the year, in the same direction, at the same depth, disrupts the soil structure and the successive cultivation of plants with having similar diseases, weeds and pests increases diseases, pests and weeds. As a result, the fertility of the soil is significantly reduced. In this study, the benefits of the crop rotation, the priority issues in spreading the rotation, the issues to be considered while applying the rotation, the characteristics that should be known in the crops that will enter the rotation, the effect of the pre-plant on the yield and quality, the difficulties to be encountered while applying the rotation will be discussed. The information about the current crop pattern in Sivas and the crop rotation systems that can be applied in Sivas will be given.

Keywords: Plant rotation, foreplant, sivas



1. GİRİŞ

Ekim nöbeti veya münavebe tarla tarımının en önemli kültürel uygulamalarından birisidir. Bir bölgede uygulanacak iyi seçilmiş etkili bir ekim nöbeti; hastalık, zararlı ve yabancı ot yoğunluğunu azalttığı gibi, toprak canlılığını derinlemesine artırmak, yetiştirilen ürünlerin toprağın değişik katmanlarından aynı şekilde yararlanmak ve erozyonu önlemek gibi pek çok avantajları bulunmaktadır. Bunlar toprağın fiziksel ve kimyasal yapısını iyileştirmekte ve üretkenliğini artırmaktadır. Orta Anadolu ve Geçit Bölgelerinde olduğu gibi, dünyanın pek çok ülkesinde ve özellikle kurak ve yarı kurak bölgelerinde monokültür tarım yaygın olarak uygulanmaktadır. Rotasyon sistemleri toprak verimliliğinin korunmasına ilave olarak tarımsal üretimde, biyolojik ve ekonomik stabilitenin sağlanması açısından da önemlidir. Özellikle Amerika Birleşik Devletleri gibi tarımı ileri ülkelerde bitki yetiştirilen alanların %80'inden fazlasında rotasyon uygulanmaktadır (Daberkow ve Gill, 1989). İngiltere'de pancar ekili alanların %90'ında pancar ekimi kışlık ya da yazlık bir tahılı takip etmektedir. Ekim nöbeti, yabancı ot kontrolünde birçok bitki için önemli bir yer tutmaktadır. Rotasyonda bitki sırasının farklılığı, değişik tarihlerde ekilme ve olgunlaşma, rekabet ve allelopatik özellikler yönünden farklılık gösteren bitkilerin kullanılmasıyla yabancı otların çoğalmaları önlenmektedir (Liebman ve Dyck, 1993; Çiğnitaş ve Kitiş, 2021). Ayrıca rotasyon uygulamaları organik madde, besin elementi elverişliliği, organik azot ve karbon, hacim ağırlığı (Edwards ve ark., 1992), agregat stabilitesi (Öztaş ve ark., 1997), organik madde ve erozyona mukavemet gibi toprak özellikleri üzerinde de etkili olmaktadır. Ekim nöbeti, hastalık döngüleri (Maas ve Kotze, 1990), böcek popülasyonları (Brust ve King, 1994) ve nematod popülasyonlarını (Ferris ve ark., 1994) değiştirmek suretiyle de bitki verimini önemli ölçüde etkilemektedir. Tosun ve ark. (1987) Erzurum kıraç koşullarında fiğ ve korunganın ekim nöbetine girmesiyle nadas oranının oldukça aşağılara çekildiğini ve nadas yılında kuru ot üretildiğini tespit etmişlerdir. Bu çalışmada nadas-buğday klasik sistemi yerine fiğ-nadas-buğday, 3 yıl korunga-buğday-nadas-buğday ve 3 yıl korunga-nadas-buğday-nadas-buğday gibi sistemler buğday verimlerini önemli ölçüde artırdığından önerilmiş ve sistemler nadas-buğdaya göre sırasıyla 5,9 ve 8 kat daha karlı olmuşlardır. Ekim nöbeti sistemlerinde nitrat yıkanmasından kaynaklanan su kirliliği daha azdır. Zira ekim nöbetinde azot kullanım etkinliği düşük olan bitkinin azot ihtiyacının bir kısmı kalıntı azotu ile karşılanmakta hem de çevre-su kirliliği azalmaktadır. Sivas'ta tarım arazilerinde ürün deseni incelendiğinde Türkiye genelindeki aynı yanlılıklar görülmektedir. Tarım arazilerinde toprak yapısını iyileştiren ve verimliliğin sürekliliğini sağlayan bir ekim nöbeti sistemi uygulanmamaktadır. Sivas'ta 1.106.085 hektar tarım arazisi olup, bu alanın



393.180 hektarında tahıl yetiştirilmekte ve 293.679 ha alanda da nadas yapılmaktadır (Anonim, 2018). Sivas'ta genellikle tahıl tarımına dayalı mono kültür tarım uygulanmaktadır. Tahıl + nadasın tarla tarımındaki oranı %62.1 olmak üzere çok yüksektir. Toprağa katkısı olmayan bu sistem sonucunda da topraklar verimsizleşmekte, yağın yağış toprakta tutulamamakta ve ürün verimleri de düşük seviyede kalmaktadır. Sivas'ta tarım arazilerinin %27'lik kısmında nadas uygulanmaktadır (Anonim, 2018). Nadas ekolojik şartların getirdiği bir zorunluluk olup, topraklarımızdaki su ve besin elementi noksanlığından dolayı toprağın bazı yıllar ekilmeden boş bırakılmasıdır. İç Anadolu Bölgesinin diğer illerinde olduğu gibi bu İlde de nadas-tahıl ekim nöbeti sistemi uygulanmaktadır. Bu sistem tarım alanlarımızın verimli kullanılması ve sürdürülebilirliği açısından en kötü sistemlerden birisidir. Fakat nadasın tarla alanlarının %27'nı kaplamasında uygulanan ekim nöbeti sisteminin de payı vardır. Geleneksel olarak uygulanan nadas-buğday sistemi nadasın yüksek olarak seyretmesine neden olmaktadır. Oysa uygun ekim nöbeti sistemleri uygulanarak nadas alanları oldukça düşük oranlara çekilebilir. Kırac şartlarda nadas (N)-buğday (B) uygulaması yerine macar fiği (MF)-N-B uygulanarak nadas %50'den %33'e düşürülerek, buğdayın tane verimi %50 artırılmış ve MF'den 350-400 kg/da kuru ot alınarak kaba yem açığı giderilmiş olur (Tosun ve ark., 1987). Yine, Tosun ve ark. (1987) tarafından kırac şartlarda; N-B yerine 4-5 yıl korunga (K) veya 5-6 yıl yonca (Y) ve peşine B-N-B ekim sistemi (K-K-K-K/K-B-N-B; Y-Y-Y-Y/Y-B-N-B), sulu şartlarda ise B-B, B-Pancar, B-Ayçiçeği uygulaması yerine MF-B/A/Pan/Ayç uygulanarak hem MF'den 1200-1500 kg/da kuru ot alınabileceği belirtilmektedir. Bu durumda buğdayın tane verimi %50 artırılmış olur. Hayvancılığı desteklemesi bakımından B-B yerine MF + silajlık mısır (SM) ekim nöbeti uygulanarak aynı yıl hem MF ve hem SM'dan kaba yem alınabilir. Bu sayede hem kaba yem açığı kapatılmış olur hem de daha yüksek miktarda doğrudan gelir desteği alınmış olur. Meyveci ve ark. (2005) tarafından Orta Anadolu'da uzun süredir yürütülen farklı ekim nöbeti sistemlerinin denendiği araştırmanın 3 yıllık bölümünden elde edilen sonuçlar "nadas-tahıl-nadas-tahıl" ekim nöbeti sistemine en yakın hatta bunun üzerinde verim sağlayan "nadas-tahıl-yazlık mercimek-tahıl" ekim nöbeti sisteminin en karlı ekim nöbeti sistemi olduğunu göstermiştir.

2. EKİM NÖBETİ NEDİR

Ekim nöbeti; aynı tarla üzerinde farklı kültür bitkilerinin belirli sıra dahilinde birbirini takip edecek şekilde yetiştirilmesine denir (Büyüktavşan ve Naneli 2020). Ekim nöbeti, tarla tarımının organize edilmesinde üzerinde durulacak en önemli konulardan biridir. Ekim nöbetinde asıl amaç toprağın üretkenliğinin sürdürülebilmesi ve birim alandan elde edilen



verimin artırılmasıdır (Tuğay, 1988; Sencar ve ark., 1994). Tarla tarımı organizasyonunun kilit noktası olan ekim nöbetindeki sorunları bilimsel açıdan ele alan çok sayıda çalışma bulunsa da, en önemli sorun bulguların çiftçiye ulaştırılamamasıdır. Bitkisel üretimle ilgili yapılan uygulamaların yüksek oranda verime çevrilebilmesi ve arzulanan tarımsal başarıya ulaşılabilmesinde doğal ve ekonomik şartlara uygun ve zarar vermeyen bir ekim nöbeti planının hayata geçirilmesi gerekir (Kara ve ark., 2005; Kara ve ark., 2011). Tarla tarımı yapan bir işletmenin karlı bir üretim yapabilmesi için en az 3-5 yıl gibi bir sürede hangi üretim dallarında ne miktarda üretim yapılacağını planlaması gerekir. Bu husus sadece tarımsal işletmeler düzeyinde kalmayıp, ülke düzeyinde hangi ürünün, yıllara göre ne miktarda üretileceğinin bilinmesi, ülke kalkınmasını planlama yönünden de mutlak gereklidir.

3. EKİM NÖBETİNİN FAYDALARI

Ekim nöbeti tüm yönleri ile değerlendirildiğinde faydaları aşağıdaki gibi sıralanabilir.

1. İşletmede muntazam bir iş bölümü sağlanır
2. Rizikoyu ve zarar tehlikesini azaltır
3. Hastalık, zararlı böcek ve hayvanların kontrolünü sağlar
4. Yabancı otların çoğalmasının önlenmesi
5. Toprakta organik maddenin artırılması
6. Toprağın derinliklerindeki besin elementlerinden faydalanmanın sağlanması
7. Gübrelerden daha çok fayda temin edilmesi ve gübre tasarrufu sağlanması
8. Erozyonun önlenmesi
9. Verimin ve kalitenin artırılması
10. Biyolojik dengenin korunması, çevre ve toprak kirliliğinin azaltılması
11. Bitki salgılarının olumsuz etkisi kaybolur

4. EKİM NÖBETİNİN YAYGINLAŞTIRILMASI İÇİN NELER YAPILABİLİR

Ekim nöbetinin yaygınlaştırılması ve çeşitlendirilmesi noktasında öncelikli konular aşağıda verilmiştir.

1. Üretim planlamasının sağlanması,
2. Üretimin kayıt altına alınması,
3. Bitkisel ve hayvansal üretimin birlikte desteklenmesi,
4. Arazi planlamasının yapılması,
5. Tarım alanlarının amaç dışı kullanımını önlemek,
6. Kuru ve sulu tarım sistemlerinin ilkelerini uygulamaktır.



5. EKİM NÖBETİ UYGULARKEN DİKKAT EDİLMESİ GEREKEN HUSUSLAR

a) İklim şartları: Yıllık yağış miktarı, ilkbahar son don ve sonbahar ilk don tarihleri, sıcaklık, yağışın dağılımı, kışlık ekimin mümkün olup olmadığı gibi faktörler.

b) Toprak yapısı: Toprağın pH derecesi, asit veya alkali olması, toprak yapısı kumlu, killi, humus toprak olması, organik madde miktarı gibi faktörler.

c) Sulama imkânları: Sulamanın yapılabilmesi, suluda yüksek verim alınan bitkilerin münavebeye girmesini, toprakta organik maddelerin parçalanmasını, gübreden daha iyi yararlanmayı etkiler.

d) Bitkilerin Uyuşumu: Bitki tür ve çeşitlerinin özellikleri: Bitkilerin topraktaki ilerleyebildikleri kök derinlikleri, bitkinin daha fazla kullandığı besin elementlerinin farklı olması, hububat, baklagil bitkisi olması gibi faktörler.

Bazı değişik bitki türlerinin arka arkaya yetiştirilmesi sakıncalıdır. Ekim nöbetinde birinci yıl yetiştirilen bitkiye "ön bitki" ikinci yıl yetiştirilen bitkiye "art bitki" denir (Kara ve ark., 2011). Bazı bitkiler uzun yıllar arka arkaya monokültür şeklinde yetiştirildiklerinde verimlerini büyük ölçüde düşürürler. Kendine katlanmayan bitkilerin arka arkaya yetiştirilmeleri sakıncalıdır. Bazı bitkiler monokültür yetiştirildiğinde verim azalışı dar sınırlar içinde kalır. Böyle bitkilere kendine katlanmaz bitkiler denir. Kendine katlanmayan bitkilerin arka arkaya yetiştirilmeleri sakıncalıdır. Bazı bitkiler monokültür yetiştirildiğinde verim azalışı dar sınırlar içinde kalır. Böyle bitkilere kendine katlanan bitkiler denir. Bir kısım bitkilerde bu iki uç arasında yer alır. Kendine katlanmayan bir bitkinin aynı araziye ikinci kez gelebilmesi için aradan geçmesi gereken süreye "ekim molası" denir (Kara ve ark., 2011). Yapılan birçok araştırmaların toplu sonuçlarına göre bazı önemli tarım bitkilerinin kendine katlanma durumları aşağıda verilmiştir.

Kendi ardına ekilmesi sakıncasız olan bitkiler: Çavdar, Mısır, Bakla, Soya Fasulyesi, Darı, Kenevir, Tütün, Pamuk, Çeltik.

Kendine katlanma derecesi değişen bitkiler: Fasulye, Acı Bakla (Lüpen), Arpa Buğday.

Kendine katlanmayan bitkilerin ekim molaları: Keten 6 yıl, Yonca 5 yıl, Pancar 4-5 yıl, Yulaf 3-4 yıl, Bezelye 4 yıl, Turp 3 yıl, Kolza 3 yıl, Ayçiçeği 3-5 yıl, Soğan-Lahana-Patates 3-4 yıl.

e) Yabancı ot, hastalık ve zararlıların yayılma durumu: Eğer bir tarlada belirli yabancı otlar, hastalık veya zararlılar yoğun ise bunların mücadele eşliğinin altında tutulabileceği bitkilerin münavebeye alınması gerekir (Blackshaw ve ark., 1994; Torun ve Uygur, 2019).

f) Ekonomik şartlar (ulaşım, depolama ve pazarlama durumları vb.).



6. EKİM NÖBETİNE GİRECEK BİTKİLERİN ÖZELLİKLERİ

Ekim nöbeti planlaması önemli olduğu kadar ekim nöbetindeki fayda ve başarı ekim nöbetinde kullanılan bitkilerin özelliklerinin bilinmesine de bağlıdır.

Bu özellikler şunlardır;

1. Bitkinin vejetasyon süresi
2. Bitkinin morfolojisi (kök, yaprak, çiçek vb. özellikler)
3. Bitkinin fizyolojisi (soğuğa, kurağa dayanıklılık, bitki besin maddesi ve su alımı vb.)
4. Bitkinin toprakta bıraktığı kök ve bitki artıkları miktarı ve C/N oranı (Aydın ve Kılıç, 2020)
5. Bitkinin salgıları
6. Bitkinin yetiştirilme amacı
7. Bitkinin pazarı var mıdır

7. ÖN BİTKİ ETKİSİ NELERE BAĞLIDIR

- a) Genetik akrabalık ve morfolojik benzerlik
- b) Toprak ve iklim şartlarına
- c) Kültür bitkilerinin vejetasyon sürelerinin uzunluğuna
- d) Toprakta kalan kök ve hasat artıklarına
- e) Toprağın su varlığının zorlanmasına
- f) Organik ve mineral gübrelemeye
- g) Toprak sağlığının korunmasına (fitopatolojik açıdan)
- h) Toprağın gölgeleme ve yabancı ot durumuna
- i) Ön bitki verimine
- j) Yetiştirme tekniği ile iş ekonomisinin özelliklerine bağlıdır.
- k) Ön bitkinin allelopatik etkisi (Çiğnitaş ve Kitiş, 2021)

8. ÖN BİTKİNİN VERİM ve KALİTEYE ETKİSİ

Tarla bitkilerinde farklı ön bitkilerin kendisinden sonra ekilen ürünlerin verim ve kalitesini etkilemektedir (Pratley, 1992). Kara ve ark. (2005) yaptıkları çalışmada buğday tanesindeki en yüksek protein oranını fiğ ve fasulyeden sonra ekilen buğdaydan elde edildiğini ve buğday için en uygun ön bitkilerin; fiğ, ayçiçeği, arpa ve şekerpancarı olduğunu belirtmiştir. Gül ve ark. (2008) baklagillerin ön bitki olarak kullanıldığı çalışmalarında baklagillerin mısır için çok iyi bir ön bitki olduğu ve mısırın kuru madde verimini artırdığı ve mısırın azot ihtiyacını azalttığını bildirmişlerdir. Uzun ve ark. (2005)'nin yaptıkları çalışmada kışlık ara ürün olarak baklagil yem bitkilerinin yetiştirilebileceği, bu ekimin kendisinden sonra gelecek mısır ekimi zamanını



geciktirmeyeceği, mısır veriminin tek yıllık baklagil ekimlerinden sonra artışının az olmasına karşılık uzun yıllarda bu artışın daha belirgin olacağını bildirmişlerdir. Tisdale ve Nelson (1982), ekim nöbetinde adi fiğın yer almadığı durumda dekara 163 kg mısır verimi sağlanırken, bu verimin mısırdan önce adi fiğ ekili parsellerde 489 kg'a çıktığını tespit etmişlerdir. Anlarsal ve ark. (1996) Çukurova'da yaptıkları araştırmalarında, hiç azotlu gübre verilmeksizin, bakla bitkisinden sonra yetiştirilen mısırın tane verimini 689 kg/da olarak belirlemişlerdir. Denemede, ayrıca, azot dozlarının ortalaması olarak en yüksek tane verimini 1090 kg/da ile iskenderiye üçgülünden sonra ekilen mısır parselleri vermiştir. Kılıç ve ark. (1999)'nın Diyarbakır koşullarında yapmış oldukları çalışmada tane amaçlı mısır için en uygun ön bitkinin mercimek olduğu, mısırın koçan çapı, koçan uzunluğu, koçan ağırlığı, protein oranı ve tane veriminin arttığını bildirmişlerdir. Turgut ve ark. (1999)'nin Bursa koşullarında yapmış oldukları çalışmada tane mısır için en uygun ön bitkinin fasulye olduğu, mısırın koçan özelliklerinin farklı ön bitkilere göre değiştiğini ve tane veriminin arttığını bildirmişlerdir. Birçok araştırmacı baklagillerden sonra ekilen tahılların veriminde önemli artışlar olduğunu ve bu artışın ön bitki olarak kullanılan baklagil türüne göre değiştiğini ileri sürmüşlerdir. Buna mukabil bazı baklagillerden sonra art bitki olarak ekilen tahıllarda kardeş sayısını arttırdığı ve dolayısıyla tane iriliğinin azaldığı ifade edilmektedir (Forbes ve Watson, 1992; Aydın ve Tosun, 1993; Drury ve Tan, 1995).

9. EKİM NÖBETİ UYGUMASINDA ORTAYA ÇIKAN ZORLUKLAR

1- Tarım alanlarında yüksek oranda tahıl (özellikle buğday) yetiştiriliyor olması: Buğday tarımında ekim nöbeti, buğday kök hastalıkları, ekin kurdu (*zabrus*), buğday sineği gibi zararlılar ile mücadele ve toprakta verimin korunması için mutlaka her yıl veya en az iki yılda bir ayçiçeği, macar fiği, kanola, kavun, karpuz, soğan, fasulye, mısır gibi ürünlerle yapılmalıdır. Tahıl-baklagil sisteminde nadas yerine geçebilecek baklagil bitkileri ise; kışlık mercimek, macar fiği, yazlık mercimek ve nohut olabilir.

Her yıl ekim sistemi içerisinde hububatın yer almasının sakıncaları;

- a) Ayın toprak derinliğindeki besin elementlerinin azalması,
- b) Farklı derinlikteki besin elementlerinden faydalanılamaması,
- c) O bitkiye has hastalık ve zararlıların artması, (Blackshaw ve ark., 1994)
- d) Yabancı otların çoğalması,
- e) Verim ve kalitenin düşmesine sebep olabilmektedir.



Bunların sonucu olarak toprak o bitki için uygun olmayan şartlar içerecektir. Bir kültür bitkisinin yetişmesine uygun olmayan bu tip topraklara yorgun toprak, bu olaya da toprak yorgunluğu denir.

2- Baklagillerin ekim nöbetinde fazla kullanılmaması: Ekim nöbetinde yer alacak ürünlerin seçiminde bölgenin iklim, toprak, sosyal ve ekonomik şartların göz önüne alınması gerekmektedir. Genel olarak yağışa dayalı kuru tarım alanlarında tahıl-baklagil ekim nöbeti seçenekleri tercih sıralamasında ilk sıralarda yer almaktadır. Çiftçi etkili bir nadas uygulaması yapmıyorsa, zaten nadas süresince toprağı 14 ay gibi bir süre boş bırakmasının anlamı olmayacaktır. Bu dönemde ilave bir ürünle, ayrıca ek gelir de sağlamaktadır. Orta Anadolu Bölgesi'nde nadasın yerine daha çok baklagillerden nohut ve mercimek yazlık olarak ekilmelidir. Son zamanlarda geliştirilen yeni çeşitlerle kışlık mercimek yetiştiriciliği de şanslı görülmekte; bu ürünün nadas alanlarında geniş sahalarda ekilebileceği düşünülmektedir.

Tahıl-baklagil ekim nöbeti modelleri şu sebeplerden dolayı tercih edilmelidir;

1. Toprağı su ve rüzgar erozyonuna karşı korur,
2. Yabancı ot ve zararlıları kontrol altına alır,
3. Boşta kalan işgücünü değerlendirir,
4. Toprağın yapısını düzeltir.

Bu sistemde kuru tarım alanlarında nadas-tahıl sistemindeki nadas yerine baklagillerin sokulması suretiyle verimin artırılması hedeflenmektedir. Bu alanlarda nadas yerini alacak bitki sayısı sınırlıdır. Bu amaçla ilk akla gelenler tek yıllık baklagil bitkileri fiğ, yem bezelyesi, mercimek ve nohuttur. Baklagiller derine inebilen kazık kökleri ve havadaki serbest azotu toprağa bağlamaları sonucunda toprağı azot ve organik madde yönünden zenginleştirmektedir. Tahıl-baklagil ekim nöbeti sisteminde önemli olan husus, nadas-buğday ekim sisteminden farklı bir yetiştirme tekniğinin uygulanacağını bilmektir.

3- Ekim nöbetine alınan yağ bitkilerin kullanımının yaygınlaştırılmaması: Gerek Orta Anadolu şartlarında, gerekse Geçit Bölgelerinde kuru şartlarda yağ bitkilerinin ekim nöbetine sokulduğu çalışmalar yapılmıştır. Ancak, bu bölgelerde yağ bitkileri ekiminin yaygınlaştırılması bir türlü mümkün olmamıştır. Bunun birçok sebepleri olmakla beraber, kuru şartlarda yağ bitkileri ile yapılan ekim nöbeti denemelerinde Orta Anadolu'nun hâkim ürünleri olan buğday ve pancarın verimleri azalırken, yağ bitkileri verimleri de çok fazla kârlı olamamıştır. Yapılan bu çalışmada ise hem yetiştirilen ana ürünler buğday ve pancar, hem de ekim nöbetine konulmak istenen ayçiçeği, soya, kolza, aspir ve mısır ihtiyaç duyduklarında sulanmıştır. Sulama yöntemi olarak damla ve yağmurlama sulama metodu uygulanmıştır.



Denemelerde buğday, aspir ve kolza ekimleri kışlık olarak tava yapılmış ve her üç yılda da çıkışlar başarılı olmuştur. Pancar, ayçiçeği, mısır ve soya ekimleri ise ilkbaharda ve yazlık olarak tava yapılmış ve bunların tarla çıkışları da fevkalade düzgün seyretmiştir. Ancak aspir ve kolza bitkileri yeterli kar yağışı olmadığı için her üç yıl da kıştan zarar görmüş ve ekimler ilkbaharda tekrarlanmıştır. Alınan neticeler göstermektedir ki, yıllar ana ürünler buğday ve pancar verimlerine, hem de yağ bitkileri ayçiçeği, soya, kolza, aspir ve mısır verimlerine etkili olmuştur. Her yıl da buğday ve pancar için en uygun ön bitkiler sırasıyla soya ve kolza olmuş, sonra da ayçiçeği, mısır veya mısır-ayçiçeği ve aspir olarak sıralanmıştır. Olaya ekonomik açıdan bakıldığında da yukarıdaki durum teyit edilmektedir. Sulu şartlarda Orta Anadolu'da kârlı bir üretim için buğday ve pancara en uygun yağ bitkileri soya ve kolza olduğu söylenebilir. Sonra ayçiçeği ve mısır, en sonda da aspir gelmektedir (Er ve ark. 2011). Bu şekildeki araştırmaların sayısı ve sürekliliği de arttırılmalıdır.

4- Nadası zorunlu kılan sebeplerin olması: Bölgeden bölgeye değişmekle birlikte; toprak, iklim, sosyal ve ekonomik şartlar göz önüne alınarak; yağışın yetersiz ve toprağın fakir olduğu yerlerde yeterli ürün alınabilmesi için bazen araya bir nadasın konulması tavsiye edilmektedir. Bu amaçla iki, üç ve dört yıllık ekim nöbeti sistemleri ortaya çıkmıştır. Bölgedeki baklagilin önemi ve yetiştirilebilme imkânına bağlı olarak değişik ekim nöbeti sistemleri önerilebilir.

- ✓ Buğday / arpa - fiğ – nadas,
- ✓ Buğday / arpa - mercimek – nadas,
- ✓ Buğday / arpa - nohut – nadas,
- ✓ Buğday / arpa - nadas - buğday – mercimek,
- ✓ Buğday / arpa - nadas - buğday – nohut

10. SİVAS'TA ÜRÜN DESENİ

İlde yetiştirilen başlıca ürünler; buğday, arpa, yulaf, şeker pancarı, patates, kolza, ayçiçeği, mısır, yonca, korunga, karpuz, kavun, fasulye, nohut ve mercimektir.

11. TÜRKİYE'DE EKİM NÖBETİ UYGULAMALARINDAN ÖRNEKLER

Ekim nöbeti uygulamalarına başlarken, mevcut tarım arazisi, kontrolleri kolay birbirine eşit büyük parçalara (tarlalara) ayrılır. İşletmenin büyüklüğüne göre parça sayısı ve büyüklüğü değişir. Ülkemizde çok farklı ekolojik bölgeler bulunduğu için standart olarak uygulanabilecek ekim nöbeti örnekleri yoktur. Ancak belirli çevre koşulları benzerlik gösteren bölgelerde uygulanabilecek ekim nöbeti örnekleri vardır:



Doğal yağışların az olduğu (kurak-yarı kurak) bölgelerimizde "bir yıl ekim bir yıl nadas" uygulamasıyla nadasın azaltılması amaçlanmaktadır. Korunga-Nadas-Buğday, Buğday-Nadas-Mercimek, Buğday-Baklagil, Arpa-Baklagil gibi ekim nöbetleri uygulanabilir.

Sulama olanağının bulunmadığı, doğal yağışların yeterli olduğu nadasın uygulanmadığı bölgelerimizde Buğday ve Arpa ile Kolza, Ayçiçeği, Haşhaş, Kavun, Karpuz, Tütün ve Aspir ile ikili ekim nöbetleri uygulanabilir.

Sıcaklık toplamının bir yılda iki ürün almaya yetmediği, fakat sulama olanağının bulunduğu bölgelerde daha fazla ürün yetiştirme olanağı mevcuttur. Tahıl, pancar, patates, pamuk, susam, yerbıstığı, fasulye, yonca, haşhaş uygulamaları ile patates-pancar, patates-bezelye, mısır-pancar, mısır bezelye, pancar-haşhaş, baklagil-haşhaş, mısır-fasulye, pamuk-baklagil, pamuk-yonca gibi ikili ekim nöbeti uygulamaları yapılabilir. Ayrıca, aşağıdaki ekim nöbetleri de sıklıkla uygulanmaktadır.

Sulanabilen alanlarda

- Buğday –silajlık mısır - fiğ + tahıl – şeker pancarı – kolza
- Yonca – yonca – yonca – yonca – yonca – mısır – şeker pancarı
- Fiğ + tahıl – ayçiçeği – kuru fasulye – buğday – fiğ + tahıl – mısır
- Arpa – silajlık mısır – kolza – fiğ + tahıl – patates
- Yonca – yonca – yonca – yonca – yonca – buğday – kolza – fiğ + tahıl – mısır
- Soya – fiğ + tahıl – mısır – patates

Sulanamayan alanlarda

- ✓ Korunga – korunga – korunga – buğday – kolza – nadas
- ✓ Tohumluk fiğ – buğday – nadas
- ✓ Korunga – korunga – korunga – buğday – nohut
- ✓ Nohut – buğday – nadas
- ✓ Arpa – tohumluk fiğ – nadas
- ✓ Mercimek – buğday – nadas
- ✓ Korunga – korunga – korunga – buğday – kolza – arpa

12. SİVAS'TA UYGULANAN ve UYGULANABİLECEK EKİM NÖBETLERİ

Sivas'ta kıraç şartlarda buğday, arpa, nohut, mercimek, korunga ve adi ve macar fiği yetiştiriciliği yapılmaktadır. Nadasa yüksek oranda yer verilerek nadastan sonra genellikle buğday ve arpa ekilmektedir. Buğday ve arpadan yaklaşık 200 ve 300 kg tane verimi alınmaktadır. Yem bitkisi olarak kıraç şartlarda adi fiğ ekilmektedir. Adi fiğ ekildiğinde yağışın yeterli olmadığı yıllarda 4 parmak büyüyen adi fiğ hayvanlara otlatılmaktadır. Yağışın yeterli



olduğu yıllarda ise 400 kg/da kuru ot verimi alınabilmektedir. Yıllık yağışın 450 mm'nin altına düştüğü yerlerde nadası tamamen kaldırmak mümkün görülmemektedir (Tosun ve ark., 1987; Olgun ve ark., 2007). Bu şartlarda Sivas ve benzer ekolojilerde kıraç şartlarda mutlaka nadasa ve ekim sisteminde de yem bitkilerine yer vermek gereklidir (Bulut, 2023). Bu olumsuz şartları düzeltmenin tek yolu buralarda yağış azlığına dayanıklı, yabancı otlarla mücadele edebilen, toprağı organik maddece ve bitki besin elementlerince zenginleştiren, yağın yağışın toprakta tutulmasını sağlayan tek veya çok yıllık bir baklagil yem bitkisinin ekim sistemine girmesidir (Tosun ve ark., 1996; Olgun ve ark., 2007).

Tablo 1. Sivas'ta kıraç şartlarda uygulanan ekim nöbeti sistemleri

Uygulanan Ekim Nöbeti Sistemi
Adi fiğ-Nadas
Buğday-Nadas-Çavdar
Buğday-Nadas-Buğday
Buğday-Arpa-Nadas-Buğday
Buğday-Arpa-Nadas-Buğday
Buğday-Nadas-Buğday-Patates-Buğday
Nadas-Buğday
Nadas-Arpa
Nadas-Nadas-Buğday
Nadas-Buğday
Nadas-Nadas-Buğday

Sivas'ta Kıraç Şartlarda Uygulanabilecek En Uygun Ekim Nöbeti Sistemleri

Üçlü Ekim Nöbeti Sistemleri

1. Macar Fiği-Nadas-Buğday
4. Nohut-Nadas-Çavdar
2. Macar Fiği-Nadas-Arpa
5. Macar Fiği-Nadas-Tritikale
3. Macar Fiği-Nadas-Aspir
6. Nohut-Nadas-Tritikale

Dörtlü Ekim Nöbeti Sistemleri

1. Macar Fiği-Arpa-Nadas-Buğday
3. Macar Fiği- Buğday-Nadas-Aspir
2. Macar Fiği-Arpa-Nadas-Aspir
4. Macar Fiği-Buğday-Nadas-Tritik

Beşli Ekim Nöbeti Sistemleri

1. Macar Fiği-Nadas-Arpa-Nadas-Buğday



4. M. Fiği-Nadas-Tritikale-Nadas-Buğday
2. Macar Fiği-Nadas-Arpa-Nadas- Aspir
5. M. Fiği-Nadas-Buğday-Nadas-Çavdar
3. Macar Fiği-Nadas-Buğday-Nadas-Aspir
6. M. Fiği-Nadas-Buğday-Nadas-Tritikale

Sivas'ta sulu şartlarda I. ve II. sınıf arazilerde buğday, arpa, pancar, patates, ayçiçeği, dane ve silajlık mısır, adi fiğ, macar fiği, fasulye ve yonca bitkileri ekilmektedir. Fasulye-arpa/buğday-fasulye-arpa/buğday ekiminin yanında yoncanın hasadından sonra 2–3 yıl buğday, arpa, pancar, patates ve fasulye bitkileri sıraya ekilmektedir.

Tablo 2. Sivas'ta sulu şartlarda uygulanan ekim nöbeti sistemleri

Uygulanan Ekim Nöbeti Sistemi
Buğday-Pancar-Arpa-Arpa-Pancar
Patates-Fasulye-Lahana-Lahana-Pancar
Arpa-Buğday-Pancar-Buğday
Arpa-Buğday-Arpa-Buğday-Pancar
Arpa-Arpa-Pancar-Arpa-Arpa
Buğday-Pancar-Buğday-Pancar
Korunga-Korunga-Korunga-Korunga-Buğday
Buğday-Buğday-Buğday-Buğday-Buğday
Yonca-Yonca-Yonca-Yonca-Yonca-Yonca-Buğday-Pancar
Fasulye-Arpa-Fasulye-Arpa
Buğday-Nadas-Buğday-Nadas
Buğday-Nadas-Arpa-Nadas
Arpa-Nadas-Arpa-Nadas-Patates
Nadas-Buğday-Nadas-Pancar-Buğday
Buğday-Nadas-Buğday-Pancar
Nadas-Buğday-Pancar-Buğday-Arpa

Sivas'ta Sulu Şartlarda Uygulanabilecek En Uygun Ekim Nöbeti Sistemleri

İkili Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Pancar/Patates/Ayçiçeği/Arpa/Buğday/Silajlık Mısır/Kolza

Üçlü Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Arpa/Buğday-Silajlık Mısır/Kolza/Pancar/Patates/Ayçiçeği

Dörtlü Ekim Nöbeti Sistemleri

1. Macar Fiği+Tahıl-Arpa-Buğday-Silajlık Mısır/Kolza/Pancar/Patates/Ayçiçeği



13. SONUÇ

Bu derleme çalışmada ekim nöbetinin ne olduğu, ekim nöbetinin yaygınlaştırılmasında öncelikli konular, ekim nöbeti uygularken dikkat edilmesi gereken konular, ekim nöbetine girecek bitkilerde bilinmesi gereken özellikler, ön bitkinin verim ve kaliteye etkisi, ekim nöbeti uygularken karşılaşılabilecek zorluklara değinilmiş ve ekim nöbetinin kısa ve uzun vadede pek çok faydalar sağladığı görülmektedir.

Sonuç olarak; pek çok faydası olan ve devlet desteklerinden yararlanabilmek için Sivas çiftçilerinin örnekleri verilen ekim nöbeti sistemlerini uygulamaları bitkisel üretimdeki sürdürülebilirlik, çevre sağlığı, kaliteli ve yüksek verimli üretim açısından çok önemli olduğu gözükmektedir.



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ÖZET

Bugün Tavukçuluk sektörü, et ve yumurta üretimi ile ilgili olarak oldukça uzmanlaşmıştır. Et üretimi için her iki cinsiyete ait civcivler kullanılmakta, ancak yumurta üretimi yarka civcivlerine dayanmaktadır. Civciv kuluçkahanelerinde, yumurtacı erkek tavuklar atık olarak kabul edilmekte ve genellikle yumurtadan çıktıktan hemen sonra itlaf edilmektedir. Bu uygulamaya yönelik etik tartışmalara ve sert eleştirilere rağmen, hala yaygın olarak uygulanmaktadır. Yumurtacı erkeklerin itlafının önüne geçilmesi için olası alternatiflerden biri, bunların et üretimi için kullanılması olabilir. Cinsiyet belirleme kuluçka öncesi ve sonrasında yapılabilmektedir. Son yıllarda, erkek tavukların öldürülmesini önlemek için üç farklı yaklaşım geliştirilmiştir: in ovo cinsiyet tayini, et üretimi için yumurtacı erkeklerin yetiştirilmesi ve kombine verimli ırkların kullanılmasıdır. Bu derleme, erkek yumurtacı civcivlerin itlafını önlemek için bazı alternatifler hakkında mevcut bilgileri özetlemeyi ve bu civcivlerin yüksek kaliteli et ürünleri üretiminde olası kullanımlarını ortaya çıkarmasını amaçlamaktadır.

Anahtar Kelimeler: Tavuk, hayvan etiği, ayıklama, yumurtacı erkek civciv, et üretimi



CURRENT APPROACHES TO AVOID THE CULLING OF LAYER MALE CHICKS

ABSTRACT

Today the poultry sector is highly specialized relating to meat and egg production. Chicks of both sexes are used for meat production, but egg production is based upon pullet chicks. In chick hatcheries, male layer-type chickens are considered to be waste and usually killed immediately just after hatching. Despite the ethical debates and the sharp criticism against this practice, it is still widely applied. One of the possible alternatives to avoid the culling of layer cockerels might be their use for meat production. Sex determination in chicks can be done before or after hatching. In recent years, three different approaches to avoid killing of male chickens have been developed—the in ovo sex determination, the rearing of male layers for meat production and the use of dual-purpose breeds. This review aims to summarise the existing knowledge about some alternatives to avoid killing of male layer-type chickens and to reveal the possible use of these birds for production of high quality meat products.

Keywords: Poultry, animal ethics, culling, layer chick, meat production



1. INTRODUCTION

There is positive relationship between reproduction and fattening performance in chickens has led to specialised hybrids for egg and meat production. In broiler hybrids, both male and female sexes are used for meat production. However, male layer chickens are not suitable for economic fattening purposes and they are usually killed by maceration or carbon dioxide, in the hatcheries, at a day-old.

Some of these chicks are used at zoological gardens as food for reptiles, game-predators and predatory mammals (Klein et al., 2003). However, the vast majority of them are subjected to euthanasia, which generates mass pro-tests of animal welfare organizations (Ellendorff and Klein, 2003). According to defenders of animal rights, a viable alternative to euthanasia is to use male layer-type chicks for meat production. However, poultry breeders and producers share the opinion that layer chickens cannot be used for this purpose due to a worse value of the raw material and higher feed consumption per unit of the final product, as compared with broilers

As many as 300 million chicks are killed in the United States every year, and more than 6 billion total are killed around the world. It's a disturbing and wasteful practice, and it has its roots in the warped economics of chicken production. This practice has been sharply criticized for years and, as a result, the European Union has started banning the culling of male chicks; with France and Germany being the first to stop this practice as of 2022. This makes it necessary to explore alternative uses of male layer-type chickens, such as adopting appropriate rearing strategies for these birds so that they are raised for meat production.

There are already studies proving that male layer type chickens have better quality characteristics as compared to male broilers; however, this depends on the age of slaughter and on rearing systems (Gerken et al., 2003; Lichovníková et al., 2009).

In the following, current developments to avoid the killing of male chickens are reviewed with special focus on the concept of rearing male layer hybrids for meat in scientific projects, and in agricultural practice.

2. MATERIAL AND METHOD

The material of this review was obtained by compiling the studies conducted by various researchers in terms of the years to avoid the killing of laying male chicks.



3. DISCUSSION

Three approaches are generally applied to avoid culling: in ovo sex determination (Krautwald-Junghanns et al., 2018; Fioranelli et al., 2019; Reithmayer et al., 2021), use of dual-purpose crossings (Damme et al., 2015; Lambertz et al., 2018; Reithmayer et al., 2019; Baldinger & Bussemas, 2021), or use the male layertype chickens for meat (Damme & Ristic, 2003; König et al., 2010; 2012; Popova et al., 2017; Murawska et al., 2019; Giesberg&Kemper, 2018).

In recent years, due to the sharp criticism against the culling of male layers, several studies in Europe have been carried out to investigate the awareness of the population regarding alternatives for male layer-type chickens and their preferred ones (Leenstra et al., 2011; Giersberg & Kemper, 2018; Gremmen et al., 2018; Reithmayer & Musshoff, 2019; De Haas et al., 2021). De Haas et al. (2021), summarized the results of 7 studies and showed that people prefer in ovo sex determination, followed by the use of dual purpose breeds.

Rearing male layertype chickens for meat was either not determined or the least preferred.

There are three different approaches to avoid the killing of male chickens recommended by the researchers:

In-ovo sex determination:

By the means of endocrinological or optical methods, the sex of the chick embryo is determined, at a preferably early phase of incubation (Krautwald-Junghanns et al., 2018). Eggs identified as “male” can thus be separated and further processed. The resulting high-quality proteins could be used, for instance, in the pet food or chemical industry. The system detects the embryo’s sex with 98% accuracy, at the fourth day of incubation (Giersberg and Kemper, 2018).

Recent studies show that in-ovo gender determination of incubated eggs can provide a beneficial substitute for the large-scale culling of male chicks in layer hen production. However, the technology raises ethical concerns relating to the sensitivity of the embryo, the use of screened-out eggs and the accuracy of in-ovo screening. In-ovo technology enables male chicks to be identified within the egg during the incubation period. Recent developments show that this technology is expected to be ready for market on a large scale in most countries where the technology allows this and where animal welfare is a priority. Looking at the methods in a nutshell, the first is a method that determines gender at day 4 of incubation with a spectroscopic analysis of extra-embryonic blood vessels. The second method analyses the estradiol content of the allantoic fluid on day 9 of incubation. The third option sets out to analyse the gender through magnetic resonance – offering the ability to sex eggs from the first day of incubation (Brockötter, 2021).



Rearing dual-purpose breeds:

The aim of keeping dual-purpose breeds is that both sexes gain economic value both egg and meat as well. However, due to the negative correlation between reproduction and fattening traits, dual-purpose chickens cannot achieve the production performances of specialised hybrids. In addition, neither the commercial nor the traditional dual-purpose chickens are currently available on a large scale (Giesberg&Kemper, 2018)

The use of modern chicken genotypes with high egg or meat performance results in the ethically unacceptable practice of culling day-old male layer chicks because of their inefficient fattening performance. Dual-purpose genotypes with a balanced performance profile for both eggs and meat are one option to avoid this practice (Baldinger&Bussemas, 2021)

Fattening of male layers:

In recent years, several scientific projects on the production performance of male layer hybrids (Damme % Ristic, 2003; Koenig et al. 2012), and on the processing and marketing of the carcasses (Upmann et al, 2017), were carried out. Furthermore, male layers were studied in alternative housing systems, such as mobile houses (Kaufmann et al, 2011), or in control groups in investigations on the behaviour of dual-purpose breeds (Giersberg &Kemper, 2011). In a research conducted by Muraswka (2007) to compare the slaughter quality of layer-type cockerels and broilers reared under identical conditions. It was found that at six weeks of age the mean body weights and carcass weights of layer-type cockerels were 3.9-fold and 4.6-fold lower, compared with broilers (666 g vs. 2577 g and 412 g vs. 1897 g respectively). The values of most slaughter quality indices were less desirable in layer cockerels - lower carcass dressing percentage, lower breast content of a carcass, lower meat percentage in a carcass. Only the percentage of fat with skin in a carcass was more desirable in layer-type chickens than in broilers.

The review written by Popova et al. (2022) focused on male layer-type chickens, particularly on carcass characteristics and meat quality in terms of sensory traits, and chemical, and fatty acid composition. These parameters were presented in a very limited number of studies and often in comparison to commercial or slow growing broilers, indigenous breeds, dual purpose breeds, and crossbreeds. Age was also considered as a factor affecting meat quality traits. Male layer-type chickens produced lean carcasses with lower deposition of meat, especially on breast, and low abdominal fat content. The sensory characteristics, and chemical, and fatty acid profile of the meat of male layer-type chickens did not show disadvantage when compared to the other



chicken genotypes or breeds, with its overall acceptability being the same and even higher. The results of the studies suggest that, instead of being culled, male layer-type chickens might be used as a source of high quality meat. However, further research is needed on different rearing strategies or dietary manipulations to develop best rearing practice for this type of birds, so that their meat is popular not only to a small market niche but to wide circles of consumers

4. CONCLUSION

According to the three methods to avoid culling male layer chick, it was concluded that any of methods are not suitable completely. First approach; In-ovo sex determination even seem the best methods, however it is difficult to apply widely in sector. Second methods which is keeping dual-purpose breeds recommended by researchers also does not work due to the negative correlation between reproduction and fattening traits. The third approach, fattening of layer male would not have an opportunity to compete neither the commercial nor the traditional dual-purpose chickens. Fattening of the layer male chicken can be raise under organic farm conditions due the market price is higher than the conventional production.



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FUTURE OF ARTIFICIAL INTELLIGENCE (AI) IN THE PHARMACEUTICAL INDUSTRY

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ABSTRACT

Artificial intelligence (AI) having the high ability to evaluate comprehensive information present behind the data, which makes it indispensable tools not even in engineering but also played an very crucial role in the pharma sector too. In the last decade, artificial intelligence (AI) has played a revolutionary role by minimizing human effort and allowing for the achievement of objectives in a short amount of time. In case of Drug Discovery and Development the AI accelerates the entire process, upscaling and enhancing decision making in pharmacy (medicinal chemistry, pharmacology, pharmacokinetics, formulation development and toxicology) and in molecular and cell biology. Apart from it AI also upsurge many start-up companies specialized in this field. One of the best examples is Google Deepmind which has made a gargantuan leap in solving one of biology's grandest challenges in determining a protein's 3D shape from its amino-acid sequence. We also discuss crosstalk between the tools and techniques utilized in AI, ongoing challenges, and ways to overcome them, along with the future of AI in the pharmaceutical industry.

Keywords: Artificial intelligence, google deepmind, drug discovery and development, pharma sector



INTRODUCTION

Artificial intelligence (AI) is one core branch of Computer Science having the high ability to evaluate comprehensive information present behind the data, which makes it indispensable tools and has percolated to all the arenas of science and technology, from core engineering to medicines. In pharma sector it improve the design techniques and required time of the drugs as compared to the conventional methods. Apart from it AI also plays a major role in the target proteins. Thus we can say that Ai is used in the each step of the drug designing and development procedures, which not even decreases the health hazards but also reduces the cost. Bow a day's various pharmaceutical companies have teamed up with AI companies for faster progress in the field of drug development, along with the healthcare system. Currently, top pharmaceutical companies including Roche, Pfizer, Merck, AstraZeneca, GSK¹, Sanofi, AbbVie, Bristol-Myers Squibb, and Johnson & Johnson have already collaborated with or acquired AI technologies and collaborating with AI vendors and leveraging AI technology in their manufacturing processes for research and development and overall drug discovery. As per the literature nearly 62 percent of healthcare organizations are thinking of investing in AI in the near future, and 72 percent of companies believe AI will be crucial to how they do business in the future. In this study we covers various aspects of AI in drug design and its role in pandemic.

DEEPMIND

In 1994, scientists showed interest in protein folding formed CASP (Critical Assessment of protein Structure Prediction). This allows researchers to share progress on the protein-folding problem. Apart from it this community also organizes a biennial challenge for research groups to test the accuracy of their predictions against real experimental data. Proteins are the intricate machines, made up of amino acids (building blocks of life). Currently, there are 200 million known proteins and still counting every year, each has a unique 3D shape which determines the working of it in the living organisms. Amino acids sequences are assembled according to the genetic instructions of an organism's DNA. The exact structure of a protein remains an expensive and often time consuming process and till now scientists have only been able to study the exact 3D structure of a tiny fraction of the proteins. Attraction and repulsion forces present between the different types of amino acids caused the string to fold, make them intricate curls, loops, and pleats. From the last several decades, scientists have been trying to find a method to reliably determine a protein's structure just from its sequence of amino acids. This grand scientific challenge is known as the protein-folding problem². In 2018 AlphaFold placed first



in the protein structure prediction challenge and in 2020, with the help of latest version of AlphaFold, reached a level of accuracy considered to solve the protein structure prediction problem. AlphaFold is AI based program developed by DeepMind (subsidiary of Alphabet) designed for the predictions of protein structure, currently it has two versions.

AI IN PHARMA SECTOR

AI and machine learning play a critical role in the pharmaceutical industry. But the best use cases for these technologies are drug discovery, drug manufacturing, diagnostic assistance, and optimizing medical treatment processes, according to industry stakeholders. The consortium aims to break down the divide between machine learning research at MIT and drug discovery research by bringing researchers and industry together to identify and address the most significant problems. GSK also entered into a collaboration with Cloud Pharmaceuticals to accelerate the discovery of novel drug candidates. And in April 2020, GSK and Vir Biotechnology partnered to enhance COVID-19 drug discovery through CRISPR and AI. And most recently, Abbott launched a coronary imaging platform powered by artificial intelligence. The platform can detect the severity of calcium-based blockages and measure vessel diameter to boost the precision of decision-making during coronary stenting procedures. In drug development and production, AI provides various opportunities to improve processes. For example, AI can perform quality control, reduce materials waste, improve production reuse, and perform predictive maintenance. Machine learning can help forecast and prevent over-demand and under-demand, as well as fix supply chain problems and failures in the production line³.

When a patient is diagnosed, physicians look at their symptoms, diagnostic tests, historic data, and other factors. Based on this information, the physician will provide the patient with personalized treatment options. AI and machine learning can significantly help with diagnostic assistance by providing a more data-driven approach to patient categorization. Over the years, FDA has approved dozens of AI platforms for personalized patient care. Some of the platforms were used for remote patient monitoring, while others identified brain bleeding on a CT scan or recognized abnormal heart rhythms on an Apple Watch. During a medical treatment process, it's easier to predict an outcome than to suggest a solution to change that outcome.

AI can help optimize the medical treatment process through mobile apps with health measurement and remote monitoring capabilities. The personalized data from the apps can help to improve research and development, as well as treatment efficacy. The tech can also help with the repurposing of new drugs, especially during the COVID-19 pandemic⁴. AI and machine



learning algorithms are able to identify molecules that may have failed in clinical trials and predict how the same compounds could be applied to target other diseases.

THE FUTURE OF AI IN THE PHARMA INDUSTRY

The recent surge in activity in deploying AI capabilities in the pharmaceutical industry shows no sign of slowing down. According to recent research, about 50 percent of global healthcare companies plan to implement AI strategies and broadly adopt the technology by 2025. Specifically, global pharmaceutical and drug development companies will invest more in discovering new drugs for chronic and oncology diseases.

Chronic diseases are the leading causes of death in the US. Therefore, organizations are increasingly leveraging AI to improve chronic disease management, drive down costs, and enhance patient health. Some of the major chronic diseases that AI will tackle in the future include chronic kidney disease, diabetes, cancer, and idiopathic pulmonary fibrosis.

AI will also shape the future of pharmaceuticals by improving candidate selection processes for clinical trials. By quickly analyzing patients and identifying the best patients for a given trial, AI helps ensure uptake by providing trial opportunities to the most suitable candidates. The tech also helps to remove elements that may hinder clinical trials, reducing the need to compensate for those factors with a large trial group. Organizations will also continue to leverage AI to better screen and diagnose patients⁵. Experts can use AI to extract more valuable information from data that already exists, including in MRI images and mammograms. AI and machine learning will continue to help further drug discovery and manufacturing. And as AI tools become more accessible over the years, they will become part of the natural process within pharmaceutical and manufacturing. The future will be AI-enabled.



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KOYURUCU KÜLTÜR İÇEREN SOS İLE MARİNASYONUN TAVUK KANAT ETLERİNDE PATOJENLER VE RAF ÖMRÜ ÜZERİNE ETKİSİ*

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ÖZET

Son yıllarda tüketicilerin sağlıklı ve doğal ürünlere yönelik taleplerinin artması, gıda üretim proseslerinde doğal katkı maddelerinin kullanımını ön plana çıkarmıştır. Bu çalışmanın amacı, her evde bulunan baharat ve bileşiklerle hazırlanmış ev yapımı soslara biyokoruyucu kültürler (*Lactilactabacillus curvatus*, *Lactobacillus sakei* ve *Lactiplantibacillus plantarum*) ilave edilmesinin tavuk kanadında *Salmonella* spp., *Listeria monocytogenes* ve *Pseudomonas* spp. üzerine etkisinin belirlenmesidir. Çalışmada, *Salmonella* spp. ve *L. monocytogenes* ile kontamine edilen tavuk kanat etleri içerisinde yaklaşık 6.3-7.0 log₁₀ kob/g *L. plantarum*, *L. sakei* ve *L. curvatus* içeren ev yapımı sos ile marine edilmiş ve 4°C (soğuk ortam) ile 8°C (soğuk zincirin kırıldığı ortam)'de muhafazaya alınmıştır. Ev yapımı sos içerisine ilave edilen *L. plantarum*, *L. sakei* ve *L. curvatus*'un hem 4°C hem de 8°C'de canlılıklarını korudukları ve gelişim gösterebildikleri görüldü. İçerisinde koruyucu kültür içerip içermemesine bakılmaksızın soslama işleminin tavuk kanat etlerinde *Salmonella* spp. ve *L. monocytogenes* sayısını önemli ölçüde azalttığı (P<0.05), ürünün raf ömrünü uzattığı tespit edildi (P<0.05). Sos içerisine ayrı ayrı veya miks halinde koruyucu laktik asit bakterisi (*L. plantarum*, *L. sakei* ve *L. curvatus*) ilave edilmesi hem 4°C'de hem de 8°C'de muhafaza edilen kanat etlerinde *Salmonella* ve *L. monocytogenes* üzerine ilave bir azaltma etkisi yapmasına rağmen bu etkinin istatistiksel olarak önemli olmadığı görüldü (P>0.05). Koruyucu kültür içermeyen sos ile marine edilen kanat etlerinde *Pseudomonas* spp., sayısının kontrol grubuna göre önemli oranda düşük olduğu ve marinasyon işleminin ürünün raf ömrünü 4°C'de 12 güne, 8°C'de ise 8 güne kadar uzattığı tespit edildi. Sonuç olarak, her evde bulunan baharat ve bileşiklerle hazırlanan ev yapımı sos ile marine edilen tavuk kanat etlerinde *Salmonella* spp. ve *L. monocytogenes* sayısının önemli seviyede azaldığı, ürünün raf ömrünün marine edilmemiş kontrol grubuna göre uzadığı kanaatine varıldı. Ancak, sos içerisine teker teker veya miks halinde *L. plantarum*, *L. sakei* ve *L. curvatus* ilave edilmesinin *Salmonella* spp., *L. monocytogenes* ve *Pseudomonas* spp.'ye karşı biyokoruyucu etkisinin sınırlı olduğu görüldü.

Anahtar Kelimeler: Biyokoruyucu kültür, *Salmonella* spp., *L. monocytogenes*, Marinasyon, Tavuk kanat eti



THE EFFECT OF MARINATION WITH A SAUCE WITH PROTECTIVE CULTURE ON PATHOGENS AND SHELF LIFE OF CHICKEN WINGS

ABSTRACT

In recent years, the increase in consumer demand for healthy and natural products has highlighted the use of natural additives in food production processes. The aim of this study was to determine the effect of adding bioprotective cultures (*Latilactabacillus curvatus*, *Lactobacillus sakei* and *Lactiplantibacillus plantarum*) to homemade sauces prepared with spices and compounds available in every house on *Salmonella* spp., *Listeria monocytogenes* and *Pseudomonas* spp. in chicken wings. In the study, chicken wing meats contaminated with *Salmonella* spp. and *L. monocytogenes* were marinated in a homemade sauce containing approximately 6.3-7.0 log₁₀ CFU/g *L. plantarum*, *L. sakei* and *L. curvatus* and stored at 4°C (cold chain) and 8°C (broken cold chain). It was observed that *L. plantarum*, *L. sakei* and *L. curvatus* added to the homemade sauce maintained their viability and were able to grow at both 4°C and 8°C. Regardless of whether it contains protective culture or not, it was determined that the marination treatment significantly reduced the number of *Salmonella* spp. and *L. monocytogenes* in chicken wing meat (P<0.05) and extended the shelf life of the product (P<0.05). Although the addition of protective lactic acid bacteria (*L. plantarum*, *L. sakei* and *L. curvatus*) to the sauce, separately or in a mix, had an additional reducing effect on *Salmonella* spp. and *L. monocytogenes* in wing meats stored at both 4°C and 8°C, this effect was not statistically significant (P>0.05). It was determined that the number of *Pseudomonas* spp. was significantly lower in the wing meat marinated with sauce without protective culture compared to the control group and the marinating process extended the shelf life of the product up to 12 days at 4°C and up to 8 days at 8°C. As a result, it was concluded that the number of *Salmonella* spp. and *L. monocytogenes* decreased significantly in chicken wing meat marinated with homemade sauce prepared with spices and compounds available in every house, and the shelf life of the product was extended compared to the unmarinated control group. However, the bioprotective effect of adding *L. plantarum*, *L. sakei* and *L. curvatus* to the sauce, individually or as a mixture, was limited against *Salmonella* spp., *L. monocytogenes* and *Pseudomonas* spp..
Keywords: Bioprotective culture, *Salmonella* spp., *L. monocytogenes*, Marination, Chicken wing



1. GİRİŞ

Dünya nüfusunun artması, iklim değişikliğinin tarım ve hayvancılık üzerindeki olumsuz etkisi ve küresel salgın hastalıklar nedeniyle gıda kaynakları yetersiz kalmaktadır. Bu durum, sahip olduğumuz kaynakların daha iyi değerlendirilmesi konusunda yapılan çalışmaları ve dünya çapında gıda güvenliği ve yeni koruma teknolojileri gibi konuların önemini artırmaktadır. Kanatlı eti, düşük fiyatı ve besin değeri nedeniyle dünya çapında birçok hane için sağlıklı ve kolay erişilebilir bir seçenektir (Meneses ve Teixeira, 2022). Gıda kaynaklı birçok hastalık, kanatlı eti tüketimi ile ilişkilidir. Sağlıklı hayvanların etleri steril kabul edilse de bunların fermente edilmiş ve işlenmiş ürünleri, patojen ve bozulmaya neden olan mikroorganizmaların büyümesi için mükemmel bir ortam oluşturmaktadır (Castellano ve ark., 2017). Taze ve dondurulmuş et ve et ürünlerinde *Salmonella* spp., *L. monocytogenes* en çok endişe duyulan patojenler arasında bulunmaktadır (Mor-Mur ve Yuste, 2010).

AB'de salmonelloz, gıda kaynaklı salgınların birincil nedenidir (EFSA, 2021). *Salmonella* Typhimurium ve *S. Enteritidis*, gıda kaynaklı salmonellozun ana nedeni olarak kabul edilmektedir (Meneses ve Teixeira, 2022). Gıda kaynaklı patojenlerden bir diğeri ubikuter bir bakteri olan *Listeria monocytogenes*'dir. Listeriosis, hastalığına sebep olmaktadır. Enterik olmayan *L. monocytogenes* (menenjit veya meningoensefalit, septisemi) buzdolabı koşullarında dahi çoğalabildiğinden önemli bir halk sağlığı sorunudur (Mor-Mur ve Yuste, 2010).

Hem sağlıklı yaşam üzerine yapılan araştırmalar hem de pandemi süreci tüketicileri beslenmelerine dikkat etmeye sevk etmekte ve bu nedenle kimyasal gıda koruyucu katkı maddeleri yerine doğal, zararsız koruyucuların kullanımını talep etmelerine yol açmaktadır. Tüketici bilincinin artmasıyla birlikte gıda koruyucu olarak kimyasal bileşikler yerine doğal zararsız koruyucuların kullanılmasına yönelik araştırmalar da artmaktadır (Des Field ve ark., 2018; İncili ve ark., 2020). Bu durum "Temiz Etiket" olarak adlandırılan yeni biyokoruyucu bakteri kültürlerinin geliştirilmesini ve ticarileştirilmesini teşvik etmektedir (Souza ve ark., 2022).

Gıdaların muhafazasında kullanılan fermantasyon yönteminde laktik asit bakterilerinin (LAB) fonksiyonu anlaşıldıktan sonra, çeşitli fermente gıdalardan laktik asit bakterileri izole edilmiş ve etki mekanizmaları incelenmiştir. Çalışmalar, laktik asit bakterilerinin ürettiği oldukları organik asitler, hidrojen peroksit, reuterin, nisin, pediosin gibi maddelerin doğal gıda koruyucusu olarak gelecek vaat ettiklerini bildirmektedir (Milillo ve ark., 2013; Beristain-Bauza ve ark., 2016; Mohamad ve ark., 2018; Arrijoja-Bretón ve ark., 2020; Ma ve ark., 2020).



Doğal gıda işleme yöntemleri arasında gittikçe dikkat çeken bir alan olan laktik asit bakterileri ile biyokoruma (biopreservation, bioprotection) yöntemi pek çok gıda türünde denenmektedir (Hoyle ve ark., 2009; Costa ve ark., 2018; Delcarlo ve ark., 2019; Danielski ve ark., 2020; İncili ve ark., 2022). Marine edilmiş sığır ve domuz etlerinin raf ömrünü uzatmak için probiyotik suşların kullanıldığı bir çalışmada depolama sırasında mezofilik ve psikrotrofik bozulma bakterilerini baskıladığını gösterilmiştir (Mutegi ve Patimakorn, 2020). Gomez ve ark., (2021) çevreden izole ettikleri bazı *Enterococcus* izolatlarının sığır kıymalarında *Listeria monocytogenes*'in sayısını azaltmada etkili olduğu görülmüştür (Hoyle ve ark., 2009). Beristain-Bauza ve ark., (2017)'nin yaptığı bir çalışmada *Lactobacillus sakei*'nin bazı suşlarının taze ete inoküle edilen *Listeria monocytogenes*'i de 2 log azalttığı tespit edilmiştir. Bilimsel yayınlar arasında, bazı gıda patojenlerine karşı antibakteriyal etki göstermeleri ve ürünün raf ömrünü artırmak amacıyla laktik asit bakterilerinin kullanıldığı pek çok çalışma bulunmakta ve aynı amaçlarla çeşitli bitkisel ve doğal ekstraktların kullanıldığı pek çok marinyasyon çalışmasına da rastlanılmaktadır. Ancak, yapılan literatür taramasında, kanatlı etlerinde marinyasyon uygulaması ve laktik asit bakteri ilavesinin birlikte kullanılması halinde nasıl bir etki gösterdiklerine dair çalışmaya rastlanılmamıştır. Bu çalışmanın amacı, içerisine koruyucu kültür (*L. curvatus*, *L. sakei* ve *L. plantarum*) ilave edilen ev yapımı sos ile yapılan marinyasyon işleminin, 4°C ve 8°C'de muhafaza edilen tavuk kanat etlerinde *Salmonella* spp., *L. monocytogenes* ve raf ömrü üzerine etkilerini araştırmaktır.

2.MATERYAL VE YÖNTEM

2.1 Çalışmada Kullanılan Laktik Asit Bakterileri ve Patojen Bakterilerin Hazırlanması

Çalışmada kullanılmak üzere *Latilactabacillus curvatus* (Bactoform™ B-LC-48, Chr. Hansen), *L. sakei* (Bactoform™ B-FM, Chr. Hansen) ve *L. plantarum* (DSMZ 16627, Bioferm) bakterileri 10 ml De Man Rogosa and Sharpe Broth (MRS Broth) besiyeri içeren steril falkon tüplerinde 30°C'de 18-20 saat geliştirildi. İnkübasyon sonunda bakteri kültürü içeren MRS Broth'lar soğutmalı santrifüjde santrifüj edilerek, bakteri peletleri 2-3 ml steril %0.1'lik peptonlu suda çözdürüldü. Çözdürmenin ardından tüpler steril %0.1'lik peptonlu su ile 10 ml'ye tamamlandı.

Çalışmada kullanılmak üzere üç adet *Salmonella* suşu (*S. Typhimurium* ATCC 14028 ve NCTC 12416, *S. Enteritidis* ATCC 13076) ve üç adet *L. monocytogenes* suşu (ATCC 7644, 13932 ve N 7144) 10 ml Tryptic Soy Broth (TSB) besiyeri içeren laboratuvar tüplerinde 37°C'de 18-20 saat geliştirildi. *Salmonella* ve *Listeria monocytogenes*'e ait üç bakterinin de çözdürülmüş



peletleri ayrı ayrı birer tüpte birleştirilerek tüpler steril % 0.1'lik peptonlu su ile 10 ml'ye tamamlandı.

2.2 Sosun ve Marine Tavuk Kanat Etlerinin Hazırlanması

Çalışmada İncili ve ark., (2020) tarafından bildirilen sos formülasyonu modifiye edilerek kullanıldı. Kullanılan sos bileşenlerinin her evde rahatlıkla bulunabilen, içerisinde kimyasal bir koruyucu bulundurmayan ve genel olarak pek çok kişinin et marinasyonu deyince aklına gelen malzemelerden oluşmasına dikkat edildi (Tablo 1). Hazırlanan sos 1 kg kanat eti için 250 g olacak şekilde kullanıldı.

Tablo 1: Tavuk kanat eti için kullanılan sos (marinat)'un bileşen ve % oranları.

Bileşen	Oran (%)
<i>Domates salçası</i>	15
<i>Biber salçası</i>	2
<i>Limon suyu (taze sıkılmış)</i>	7
<i>Kırmızı pul biber</i>	1.5
<i>Karabiber (toz)</i>	0.5
<i>Kimyon</i>	0.75
<i>Kekik</i>	1
<i>Sarımsak (ezilmiş)</i>	2
<i>Şeker</i>	0.25
<i>Tuz</i>	3
<i>Su</i>	67

2.3. Tavuk Kanat Eti Gruplarının Hazırlanışı

Çalışmada, yerel bir markanın 1'er kg'lık kanat etleri piyasaya sunuldukları ilk gün orijinal ambalajları içerisinde marketlerden alınarak soğuk zincirde laboratuvara getirildi., Kanat etleri aşağıdaki şekilde 6 gruba ayrıldı: 1- Kanat Kontrol, 2- Kanat Soslu Kontrol, 3- Kanat Sos+*L. plantarum*, 4- Kanat Sos+*L. sakei*, 5- Kanat Sos+*L. curvatus*, 6- Kanat Sos+Laktik asit bakteri miksi grubu. Kanat kontrol grubunda kanat etleri hiçbir işlem yapılmadan, kanat soslu grupta kanat etleri hazırlanan sos ile marine edilerek, Kanat sos+laktik asit bakteri içeren grupta ise, sos içerisine 10^7 /g civarında olacak şekilde ilgili laktik asit bakterileri inokule edildikten sonra kanat etleri marine edilmiş ve tüm gruplar 4 ve 8°C'de muhafazaya alınmışlardır.

2.4 Mikrobiyolojik Analizler

4 ve 8°C'de muhafaza edilen kanat etlerinin mikrobiyolojik analizleri depolamanın 0, 4, 8, 12, 14 ve 17. günlerinde gerçekleştirildi. Her analiz günü herbir gruptan ikişer örnek analize alındı.



Kanat eti steril stomacher poşetine konuldu ve üzerine 100 mL %0.1 peptonlu su ilave edilerek poşetler 2 dakika çalkalandı. Örneklerde *Pseudomonas* spp., analizi için *Pseudomonas* Selective Supplement içeren *Pseudomonas* CFC Agar (Merck, Darmstadt, Germany) ve 25°C’de 48 saatlik inkübasyon, Laktik asit bakteri sayımı için MRS agar (Merck, Darmstadt, Germany) ve 30°C’de 48 saatlik inkübasyon, *L. monocytogenes* sayımı için Oxford *Listeria* Selective Agar (Merck, Darmstadt, Germany) ve 35°C’de 48 saatlik inkübasyon, *Salmonella* spp. sayımları için XLT4 Agar (Merck, Darmstadt, Germany) ve 35°C’de 24-48 saatlik inkübasyon süreleri kullanılmıştır.

2.4.2 pH Analizleri

pH analizi için Dijital pH metre (HI 11310, Hanna Instruments, USA)’nin probu direk homojenat içerisine daldırılarak ölçümler gerçekleştirildi.

2.4.3 İstatistiksel Analizler

Çalışma üç tekrar yapılarak tamamlanmış ve tüm istatistiksel analizler SPSS 22 (IBM SPSS, USA) paket programı kullanılarak varyans analizine (ANOVA) tabi tutulmuştur. İstatistiksel anlamlılık düzeyi $P < 0.05$ olarak kabul edilmiştir.

3. SONUÇ VE TARTIŞMA

Tüketicilere yönelik et ve et ürünlerinin güvenliği ve kalitesi ile ilgili tavsiyelerden biri de bu tip ürünleri soğuk ortamda muhafaza etmeleridir. Ancak, et ve et ürünlerinin yaklaşık %20-30’unun mikrobiyal bozulma sebebiyle tüketilmeden atıldığı bildirilmektedir. Yapılan çalışmalar pek çok evde, gerek buzdolaplarının kapaklarının çok sık açılıp kapanması gerekse buzdolaplarının verimli çalışmaması gibi sebeplerden dolayı soğuk zincir (1-4°C)’in kırıldığını ve buzdolabı sıcaklıklarının 6-8°C’lere hatta daha üzerine çıkabildiğini göstermektedir (Laguerre ve ark., 2002; Azevedo ve ark., 2005; Garrido ve ark., 2010). Bunun yanı sıra özellikle yaz aylarında piknik ortamlarında, market alışverişi sonrası eve veya tüketim noktasına varıncaya kadar geçen süre içerisinde et ve et ürünlerinde soğuk zincirin kırılması mümkündür. Soğuk zincirin ihlal edildiği durumlarda tavuk eti ürünlerinde ürün tüketilemeyecek derecede bozulmakta, gıda güvenliği ve halk sağlığı açısından potansiyel bir tehlike ortaya çıkabilmektedir. Marinasyon işleminin kanat etlerinde *Salmonella* spp. ve *L. monocytogenes* sayısını önemli ölçüde azalttığı ($P < 0.05$) saptanmıştır. *Pseudomonas* spp., sayısının ise kontrol grubuna göre önemli oranda düşük olduğu marinasyon işleminin ürünün raf ömrünü uzattığı tespit edilmiştir. Marinasyon işleminin sağladığı bu antimikrobiyal etkinin marinasyon içerisinde bulunan limon suyu (sitrik asit), sarımsak, baharatlar gibi antimikrobiyal

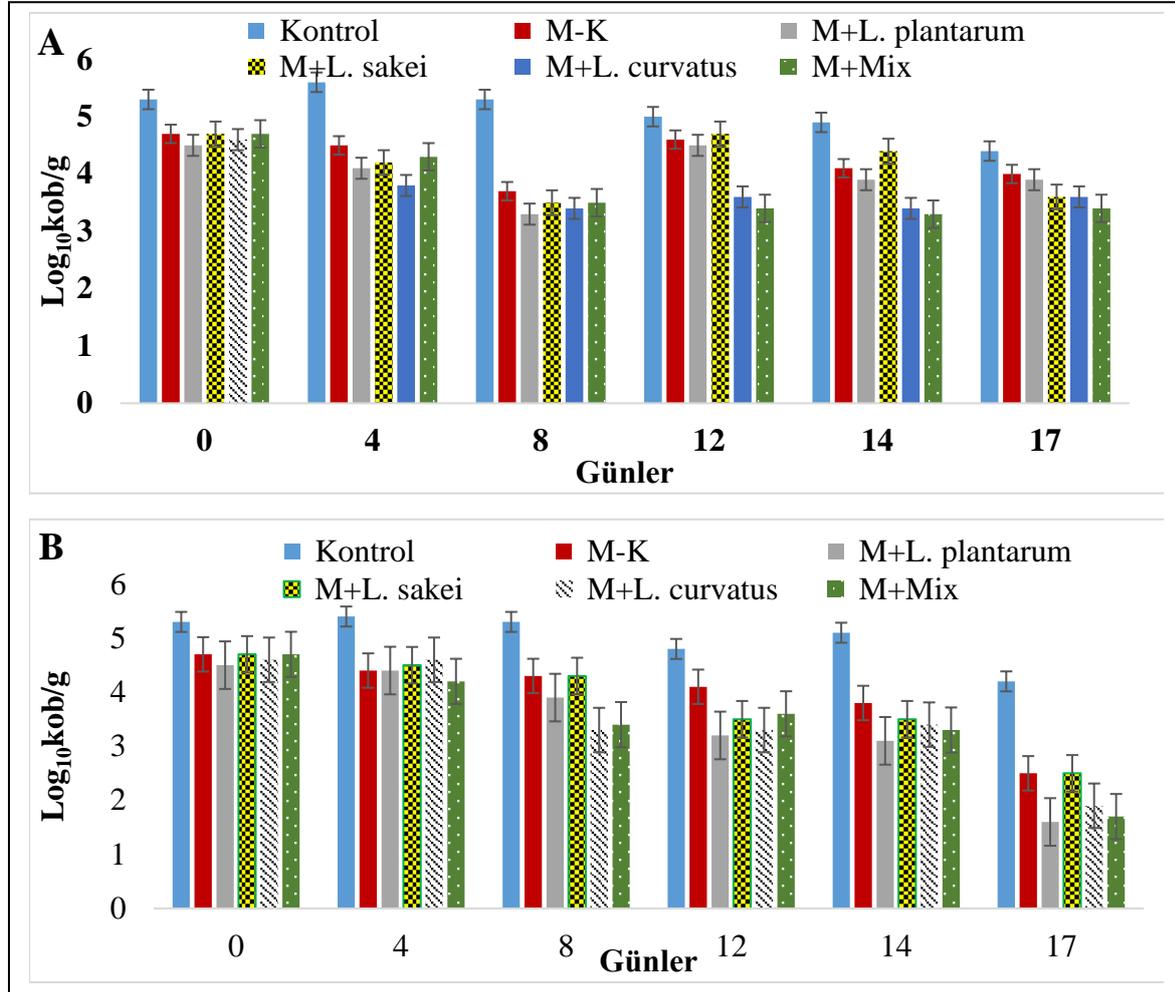


bileşikler ve düşük pH'dan kaynaklanmış olabileceği düşünülmektedir (Benkeebli, 2004; Eldin ve ark., 2020).

Marine edilen kanat grupları 0. günden itibaren kontrole göre daha düşük *Salmonella* spp. düzeyine sahip olmuştur ($P<0.05$) (Şekil 1), bunun sebebini hazırlanılan sos ortamının limon suyunun etkisiyle pH 4.0'den düşük olması açıklayabilir. Ayrıca marine sosunda bulunan sarımsak sistein sülfoksit gibi maddeler içerir ve bu bileşikler sebze zarar gördüğünde antimikrobiyal etki gösteren tiyosülfinat bileşiklerine dönüşmektedir (Benkeebli, 2004). 4°C'de muhafaza edilen marine kontrol (M-K) grubunda marinyasyonun etkisi ile özellikle 4. ve 8. günlerde önemli azalma görülmüştür ($P<0.05$). 12. ve 14. günlerde ise M+*L. curvatus* ve M+Mix marine gruplarında M-K'ya nazaran istatistiksel fark saptanmıştır ($P<0.05$). Diğer günlerde ise biyokoruyucu kültür eklenen marine gruplarda *Salmonella* sayısının istatistiksel olarak olmasa da sayısal olarak düşük değere sahip olduğu tespit edilmiştir *Salmonella* spp.'nin minimum üreme sıcaklığı 5.2°C olduğundan 8°C'de muhafaza edilen kontrol grubunda 4°C'de muhafaza edilene kıyasla daha hızlı bir artış söz konusu olmuştur. 8°C'de özellikle 4. günde marine gruplarda kontrole nazaran anlamlı bir azalma tespit edilmiştir ($P<0.05$). İstatistiksel bir fark olmasa da sayısal olarak LAB gruplarında kontrol gruplarına göre azalma olduğu saptanmıştır. *L. acidophilus*, *L. crispatus*, *P. acidilactici* ve *L. lactis* suşlarından oluşan laktik asit bakteri karışımının 10^6 , 10^7 ve 10^8 log₁₀kob/g dozlarında kıymaya inokule edildiği bir çalışmada, her üç dozdaki inokulasyon seviyesinin de 5°C'de 5 gün muhafaza edilen kıymalarda *Salmonella* sayısını 6 log₁₀kob/g azalttığı bildirilmiştir (Hoyle ve ark., 2009). Biyokoruyucu LAB'den her zaman benzer sonuçlar almak mümkün olmayabilir, bahsedilen çalışma sos içerisinde olmadığından bizim çalışmamızdaki değerlerle farklı olabileceği düşünülmektedir. Pathania ve ark., (2010), *S. Typhimurium* sayısının 24 saat boyunca 4°C'de teriyaki sosunda 5.65 log₁₀kob/g'dan 0.9 log₁₀kob/g'a düştüğünü kaydetmiştir. Thanissery ve Smith (2014), %6 NaCl ve %3 sodyum tripolifosfat ile marine edilmiş tavuk göğüs eti ve kanat örneklerinde *S. Enteritidis* sayısındaki azalma düzeylerinin sırasıyla 1.2 ve 1.0 log₁₀kob/g olduğunu belirtmişlerdir. İncili ve ark., (2020) yaptıkları çalışmada tavuk eti marinyasyonunda kullanılan ev yapımı sos içerisinde *Salmonella Typhimurium* sayısının 6 saatte 3.6 log₁₀kob/g azaldığını tespit etmişlerdir. Başka bir çalışmada, %50 ve %100 limon suyu içeren marinyasyon sosu, 6 gün boyunca 4°C'de depolanan tavuk filetolarında *Salmonella* sayısında 2.0 ve 3.0 log₁₀kob/g azalma sağladığı tespit edilmiştir (Eldin ve ark., 2020). Kanatlı etlerinin korukla hazırlanan çeşitli marinyasyon sıvılarıyla muamele edildiği bir çalışmada *Salmonella Typhimurium*'da başlangıç inokülasyonuna kıyasla önemli azalmalar gözlemlenmiştir (Sengün



ve ark., 2020). Çalışmamız ve literatürdeki diğer çalışmalar göz önüne alındığında marinasyonun *Salmonella* spp. üzerinde inaktive edici özellikte olduğu görülmektedir.



Şekil 1: Koruyucu kültür içeren sos ile marinasyonun ardından 4 ve 8°C’lerde muhafaza edilmiş tavuk kanat etlerinde *Salmonella* spp. sayıları

A: 4°C, B: 8°C, Kontrol: marine edilmemiş tavuk kanadı, M-K: marine edilmiş tavuk kanadı, M+L. *plantarum*: *L. plantarum* içeren sos ile marine edilmiş tavuk kanadı

M+L. *sakei*: *L. sakei* içeren sos ile marine edilmiş tavuk kanadı

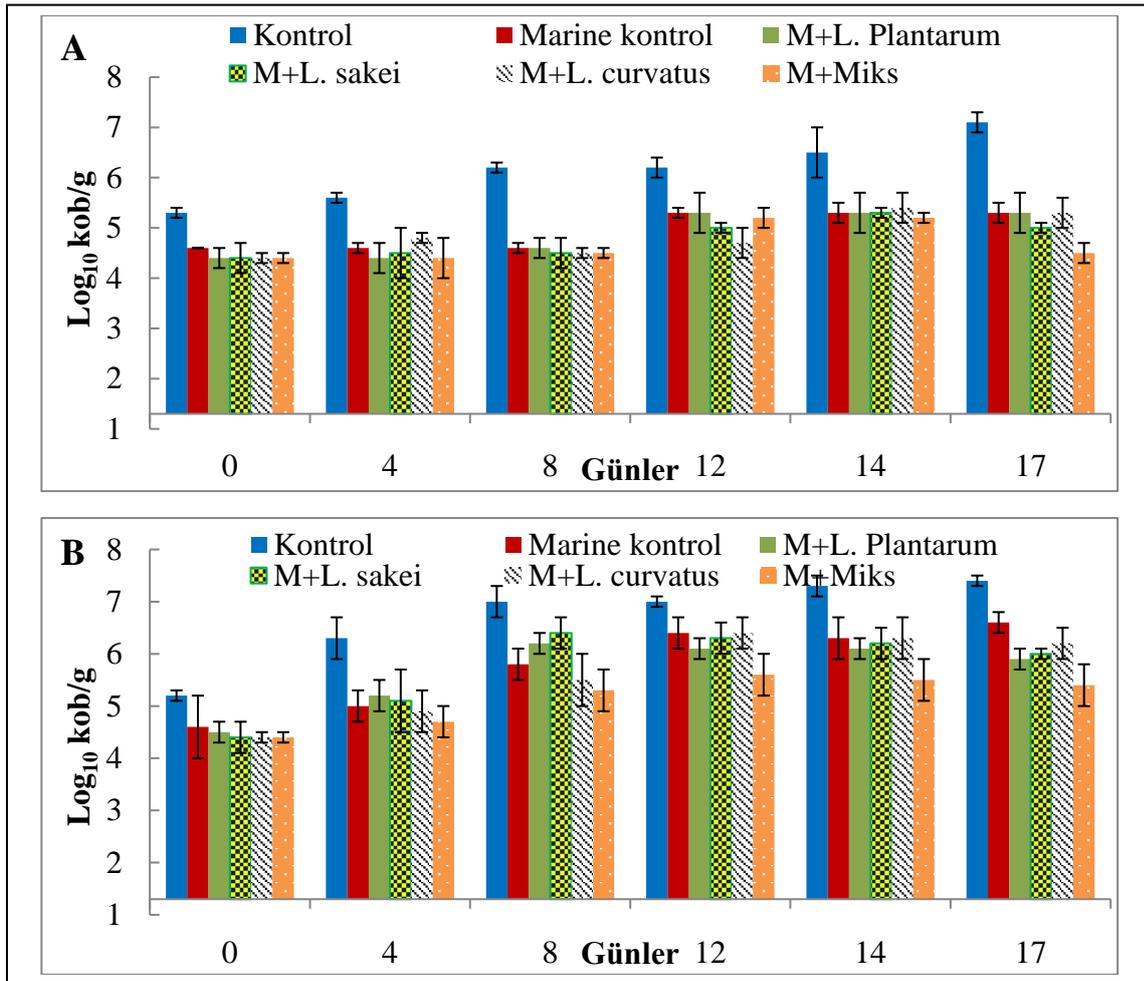
M+L. *curvatus*: *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

M+Mix: *L. plantarum*, *L. sakei* ve *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

L. monocytogenes üzerine sosun bakteriyostatik etki gösterdiği ve bu patojenin sayısının kontrole kıyasla sabit kaldığı görülmektedir. 8°C de muhafaza ettiğimiz gruplar arasında 12. ve 17. günlerde yapılan analizlerde, M+Mix’in diğer gruplara nazaran sayısal olarak en düşük değere sahip olduğu saptanmıştır ($P<0.05$) (Şekil 2). Fouladkhah ve ark., (2013) tavuk göğsü etiyle yaptıkları çalışmada *L.monocytogenes* düzeylerinin 7 gün sonunda limon suyu ile marine edilen gruplarda kontrol grubuna kıyasla 2 log₁₀kob/g düşük olduğunu bildirmişlerdir. Beristain-Bauza ve ark., (2017)’nin yaptığı bir çalışmada *Lactobacillus sakei*’nin bazı suşlarının taze ete inoküle edilen *Listeria monocytogenes*’i de 2 log₁₀kob/g azalttığı tespit



edilmiştir. Ev yapımı marinatin kullanıldığı bir çalışmada tavuk etlerinde *Listeria monocytogenes* sayısında önemli bir değişiklik gözlenmediğini ortaya koymuştur (İncili ve ark., 2020). Kanatlı etlerinin korukla hazırlanan çeşitli marinasyon sıvılarıyla muamele edildiği bir çalışmada *L. monocytogenes* ($2.55 \log_{10} \text{kob/g}$), düşük dozlarda inoküle edilmiş ve marinasyon uygulanan bütün numunelerde tespit edilemeyecek seviyelere düştüğü bildirilmiştir (Sengün ve ark., 2020). *Listeria monocytogenes*'lerin düşük sıcaklık, pH ve a_w 'ye karşı yüksek direnç olduğu belirtilmiştir (Nyhan ve ark., 2018). pH'nın 4.1'e düşmesi *L. monocytogenes*'in üreyebilmesi, canlılığını devam ettirebilmesi, virulansı açısından önemlidir. Bu nedenle ki *L. monocytogenes*'in ağız yoluyla alındığında, mideden geçerken, buradaki olumsuz şartlarda dahi canlılığını koruyabileceğini bildirmişlerdir (Cotter ve ark., 2000; McLauchlin ve ark., 2004). Bu özellikler *L. monocytogenes*'in, düşük pH'da hayatta kalmasını açıklayabilir. Ayrıca asidik koşullarda *L. monocytogenes*'lerin büyümesinin yavaşladığı ve sabit faza girdiği de belirtilmiştir (Buchanan ve ark., 1993).



Şekil 2: Koruyucu kültür içeren sos ile marinasyonun ardından 4 ve 8°C'lerde muhafaza edilmiş tavuk kanat etlerinde *L. monocytogenes* spp. sayıları



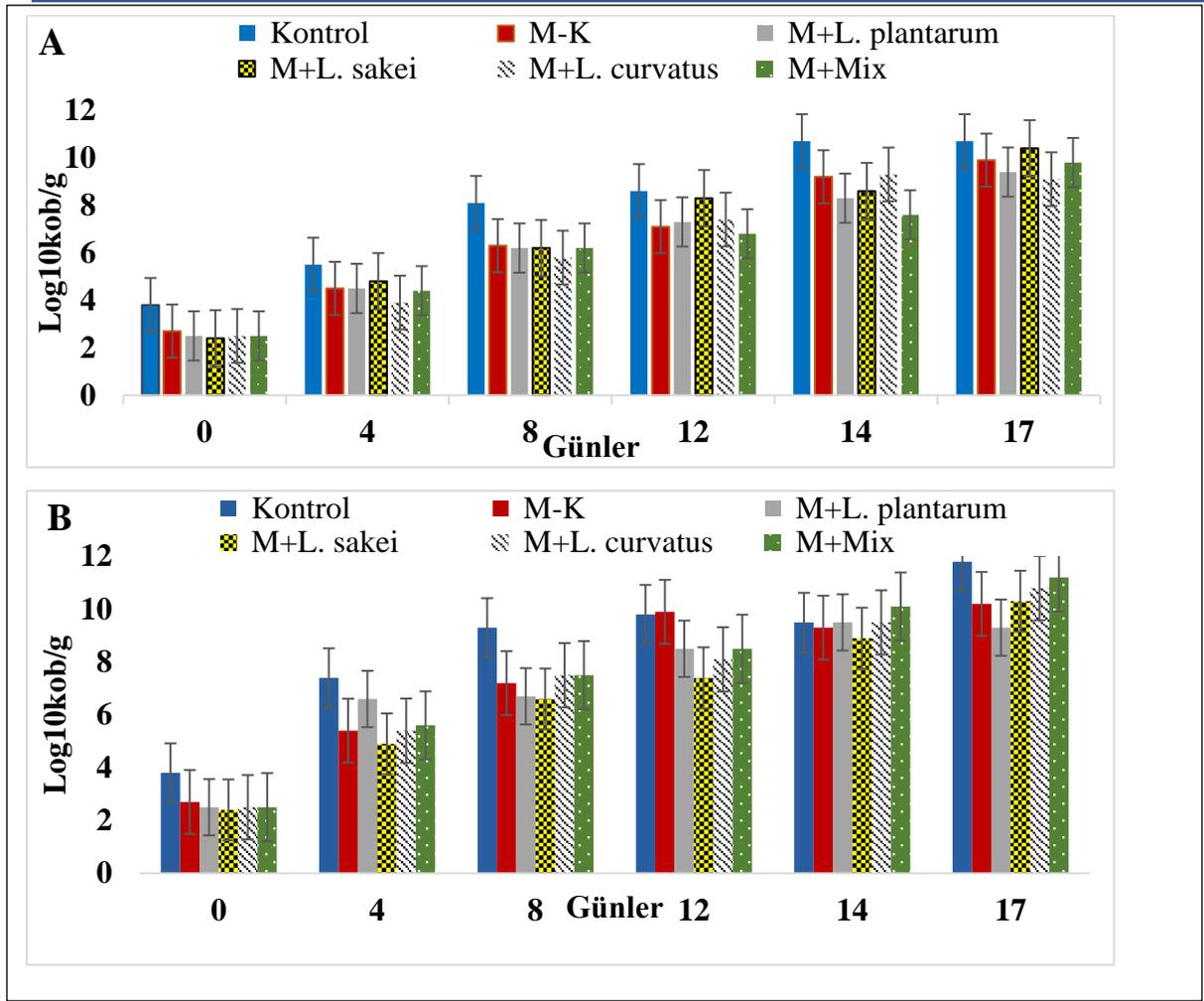
A: 4°C, B: 8°C, Kontrol: marine edilmemiş tavuk kanadı, M-K: marine edilmiş tavuk kanadı, M+L. *plantarum*: L. *plantarum* içeren sos ile marine edilmiş tavuk kanadı
M+L. *sakei*: L. *sakei* içeren sos ile marine edilmiş tavuk kanadı
M+L. *curvatus*: L. *curvatus* içeren sos ile marine edilmiş tavuk kanadı
M+Mix: L. *plantarum*, L. *sakei* ve L. *curvatus* içeren sos ile marine edilmiş tavuk kanadı

Kontrol numunelerinin başlangıç pH değeri 6.13 iken diğer marine grupların pH değeri en yüksek 5.10 olarak tespit edilmiştir ($P<0.05$). Hazırladığımız sosun pH değeri 4.00'den küçük olmasına rağmen tavuk etinin tamponlama etkisi yaparak pH değerini yükselttiği düşünülmektedir. pH değeri 4°C'de muhafaza edilen grupta depolama süresi boyunca tüm gruplarda anlamlı olarak artmıştır. Laktik asit bakteri gruplarında her iki sıcaklıkta da depolama süresinin sonunda kontrol ve MK gruplarına kıyasla koruyucu kültür eklenen gruplarda pH'lar daha düşük bulunmuştur. Eklenen kültürlerin laktik asit üreterek pH değerinin düşmesine sebep olduğu düşünülmektedir. Kontrol gruplarının pH değerlerindeki hızlı artışın nedeni ise *Pseudomonas* spp. gibi düşük sıcaklıklarda üreyebilen mikroorganizmaların proteolitik aktivitelerinden kaynaklanıyor olabileceği düşünülmektedir (Lytou ve ark., 2019). Baltic ve ark., (2015), tüm marine edilmiş tavuk göğsü etlerinde pH değerinde artışlar kaydedilmiştir. Çalışmamızla uyumlu olarak İncili ve ark., (2020)'de yapmış oldukları depolama süresince hem kontrol hem de marine edilmiş gruplarda pH seviyeleri arttığını belirtmişlerdir.

Bozulmaya sebep olan mikroorganizmalar, tavukta hoşta gitmeyen koku, tat, yapı ve renk değişikliğine sebep olmaktadır. Duyu organları ile fark edilir bir değişikliğe sebep olmasa bile, toplam canlı sayımı $7 \log_{10} \text{kob/g}$ 'a ulaştığında, gıdanın mikrobiyal olarak bozulmuş olduğu kabul edilmektedir. Mikrobiyolojik bozulma bu bakterilerin çoğalması ve ürettikleri metabolitler sonucu gerçekleşmektedir. Düşük sıcaklıklardaki muhafazası sırasında tavuğun bozulmasında rol oynayan bakteriler psikrotroflar ve psikrofillerdir (Rouger ve ark., 2017). Psikrofil bir bakteri olan *Pseudomonas* spp. tavuk etlerinde bozulmaya ve kokuşmaya sebep olan türdür. 4°C'de muhafaza edilen kanat etlerinde muhafazanın ilk günü kontrol grubu $4 \log_{10} \text{kob/g}$ 'a iken muhafaza süresinin sonunda $10 \log_{10} \text{kob/g}$ 'a ulaşmıştır (Şekil 3). 4°C'de kontrol grubu 8. günde bozulurken marinasyonun etkisi ile marine gruplar 12. günde bozulmuştur. 8°C'de ise kontrol grubu 4. günde bozulurken marine ettiğimiz gruplar 8. günde bozulmuştur. Koruyucu kültür içermeyen sos ile marine edilen kanat etlerinde *Pseudomonas* spp. sayısının kontrol grubuna göre önemli oranda düşük olduğu ve marinasyon işleminin ürünün raf ömrünü 4°C'de 12 güne, 8°C'de ise 8 güne kadar uzattığı tespit edildi (Şekil 3) ($P<0.05$). Sos içerisine teker teker veya miks halinde L. *plantarum*, L. *sakei* ve L. *curvatus* ilave edilmesinin *Pseudomonas* spp.'ye karşı biyokoruyucu etkisinin sınırlı olduğu görülmüştür.



LAB'nin uyguladığı birincil antimikrobiyal etkiler, birçok faktörün bir kombinasyonundan kaynaklanmaktadır, örneğin, laktik asit üretiminden kaynaklanan düşük pH ve ayrıca sorumlu olan bakteriyosinler, çok sayıda antimikrobiyal maddenin üretimi hidrojen peroksit ve karbon dioksit üretimi bunlara örnek verilebilmektedir (Ahmadi ve Moreno, 2013). Özellikle sosta organik asitlerin bulunması bu bakterilerin büyümesini önemli ölçüde yavaşlatabilmektedir (Smaoui ve ark., 2011). Çalışmamızla benzer bazı sonuçlar ise İncili ve ark., (2020) yaptıkları çalışmada kullanılan marine sosunun, marine edilmiş gruplarda psikrotrofik bakterilerin büyümesini yavaşlattığını tespit etmişlerdir. Marine edilmiş sığır ve domuz etlerinin raf ömrünü uzatmak için probiyotik suşların kullanıldığı bir çalışmada *L. curvatus*, *L. sakei* ve *L. delbrueckii* probiyotik suşlarının eklenmesinin, depolama sırasında mezofilik ve psikrotrofik bozulma bakterilerini baskıladığını göstermiştir (Mutegi ve Patimakorn, 2020). Yılmaz (2021)'de koruyucu kültür ile yaptığı bir çalışmada *L. sakei* ile inoküle edilen LS grubu ve koruyucu kültürle inoküle edilmeyen kontrol grubunun *Pseudomonas* spp. sayısı LS grubuna kıyasla 28. güne kadar artış göstermiştir.



Şekil 3: Koruyucu kültür içeren sos ile marinasyonun ardından 4 ve 8°C’lerde muhafaza edilmiş tavuk kanat etlerinde *Pseudomonas* spp. sayıları

A: 4°C, B: 8°C, Kontrol: marine edilmemiş tavuk kanadı, M-K: marine edilmiş tavuk kanadı, M+L. *plantarum*: *L. plantarum* içeren sos ile marine edilmiş tavuk kanadı

M+L. *sakei*: *L. sakei* içeren sos ile marine edilmiş tavuk kanadı

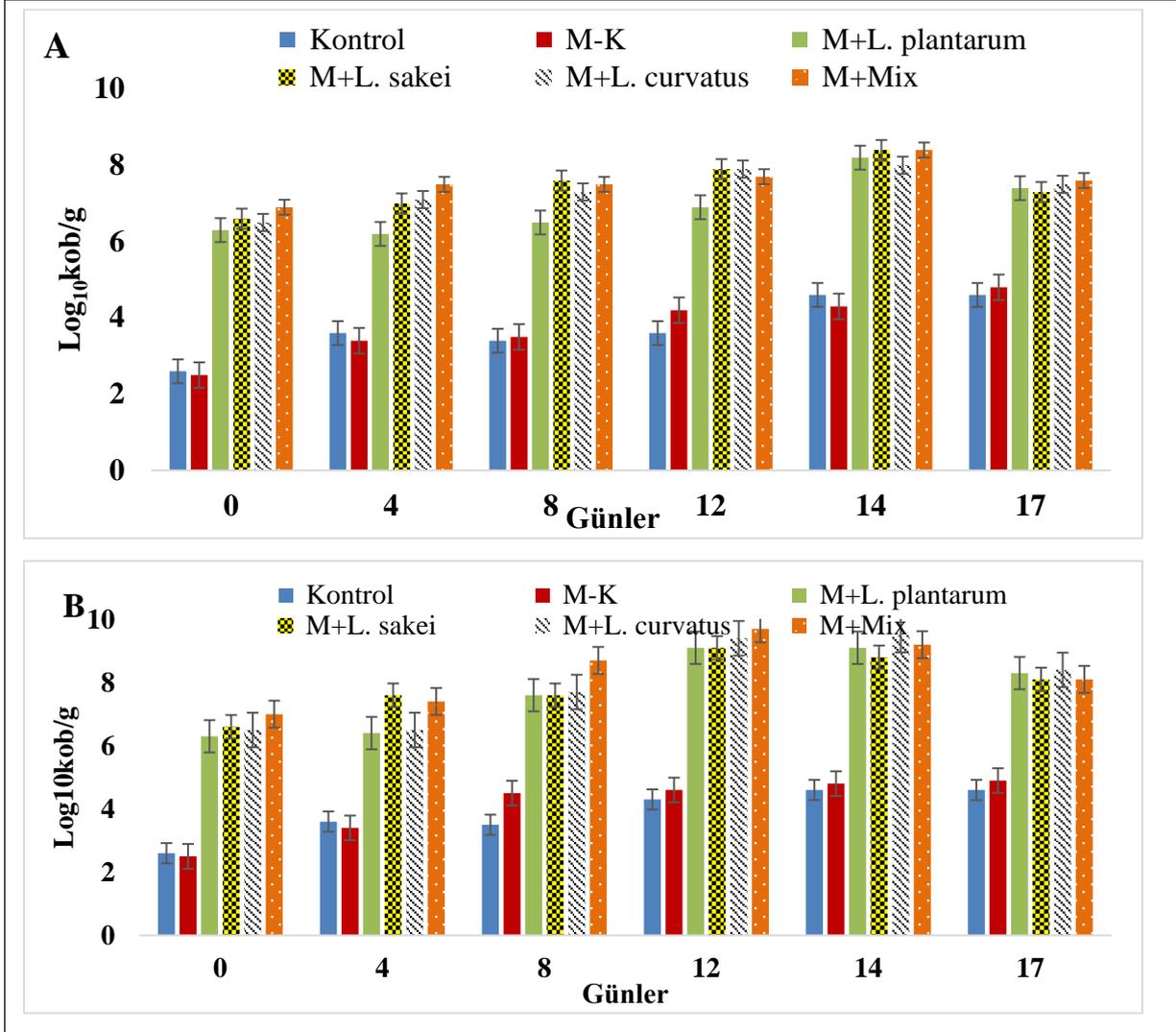
M+L. *curvatus*: *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

M+Mix: *L. plantarum*, *L. sakei* ve *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

Depolama başlangıcında biyokoruyucu kültür inokülasyonu nedeniyle laktik asit bakterileri eklenen gruplarda kontrol grubundan daha yüksek LAB sayısına sahip olmuştur ($P < 0.05$). Sos içerisine ilave edilen *L. plantarum*, *L. sakei* ve *L. curvatus*’un hem 4°C hem de 8°C’de canlılıklarını korudukları ve gelişim gösterebildikleri görülmüştür (Şekil 4). Her üründe biyokoruyucu kültürlerden her zaman benzer sonuçlar almak mümkün değildir. Ürün, ambalaj içi ortam, sıcaklık, doğal flora ve koruyucu kültür arasındaki etkileşimler biyokoruyucu kültürünün lehine olmalıdır (Trias ve ark., 2008). Biyokoruyucu kültürler hazırladığımız marinat içerisinde canlılığını koruyup gelişme gösterebilseler de istenilen antimikrobiyal etkilerini gösterememişlerdir. Bunun sebebi biyo-koruyucu kültürler, mevcut mikroflora üzerinde baskın olmayabilir veya soğuk ortamlarda muhafaza edilen gıdalarda organizmaları



inhibe etmek için yeterli antimikrobiyal ajanları sentezleyemeyebilirler (Moradi ve ark., 2019). Ayrıca bakteriyosinlerin taze et ve et ürünlerinde kullanımına ilişkin bazı sınırlamalar bulunmaktadır. Bu ürünlerde bulunan protein ve lipidlerin bakteriyosin ile etkileşime girebildiği ve proteolitik enzimlerin bakteriyosinleri ve katyonik peptidler olan bakteriyosin benzeri inhibitör maddeleri (BLIS) inhibe ettiği belirtilmektedir (Hartmann ve ark., 2011; Sakaridis ve ark., 2012; Reis ve ark., 2012; Sahraoui ark., 2015).



Şekil 4: Koruyucu kültür içeren sos ile marinasyonun ardından 4 ve 8°C'lerde muhafaza edilmiş tavuk kanat etlerinde Laktik Asit Bakteri sayıları

A: 4°C, B: 8°C, Kontrol: marine edilmemiş tavuk kanadı, M-K: marine edilmiş tavuk kanadı, M+L. *plantarum*: *L. plantarum* içeren sos ile marine edilmiş tavuk kanadı

M+L. *sakei*: *L. sakei* içeren sos ile marine edilmiş tavuk kanadı

M+L. *curvatus*: *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

M+Mix: *L. plantarum*, *L. sakei* ve *L. curvatus* içeren sos ile marine edilmiş tavuk kanadı

Sonuç olarak, her evde bulunan baharat ve bileşiklerle hazırlanan, içerisinde sentetik bir kimyasal madde içermeyen ev yapımı sos ile marine edilen tavuk kanat etlerinde Salmonella



spp. ve *L. monocytogenes* sayısının önemli seviyede azaldığı görüldü ($P<0.05$). Marinasyon işleminin tavuk kanat etlerinde raf ömrünü önemli derecede uzattığı tespit edildi ($P<0.05$) Sos içerisine teker teker veya miks halinde *L. plantarum*, *L. sakei* ve *L. curvatus* ilave edilmesinin *Salmonella* spp., *L. monocytogenes* ve *Pseudomonas* spp.'ye karşı biyokoruyucu etkisinin sınırlı olduğu görüldü.

Soslama işlemi hem soğuk zincir şartlarında ($\leq 4^{\circ}\text{C}$) hem de soğuk zincirin kırılma ihtimali olan (piknik aktivitesi, elektrik kesintisi vs.) durumlarda tavuk kanat etlerinde hem raf ömrü hem de patojen inaktivasyonu açısından önerilebilir. Özellikle ticari veya ev yapımı et sosları içerisinde yaşamını ve kendilerinden beklenen antimikrobiyal etkilerini gösterebilecek biyokoruyucu bakteri suşlarının araştırılması gıda endüstrisinin kimyasal koruyuculara mümkün olduğunca ihtiyaç duymaması açısından önemli olacaktır. Biyokoruyucu kültür olarak etki gösterdikleri kanıtlanan Laktik asit bakterilerinin sos içerisinde bu aktivitelerini gösterebilmeleri için gerekli ortam şartlarının araştırılması, gelecekte marine edilmiş ürünlerde bu bakterilerin antimikrobiyal, antioksidant, probiyotik ve postbiyotik özelliklerinden yararlanmak açısından faydalı olacaktır.



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AYÇİÇEĞİ KÜSPESİNİN HAM PROTEİN ORANLARININ MAKİNE ÖĞRENMESİ ALGORİTMALARI İLE SINIFLANDIRILMASI

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ÖZET

Küspe; yağlı tohumlardan yağı alındıktan sonra kalan, proteince zengin kısmına verilen isimdir. Rasyon yaşama ve verim payı besin maddeleri ihtiyacını karşılamak için hayvana verilen bir günlük yem miktarıdır. Hayvanların yaşı, türü, bakım şartları ve fizyolojik durumları besin madde ihtiyaçlarının değişmesine neden olur. Rasyonun ham protein içeriğinin ihtiyaç doğrultusunda oranlanabilmesi, rasyona ilave edilen protein yemleri ile mümkündür. Hayvancılıkta küspeler, yüksek ham protein içeriklerinden ötürü rasyonların ham protein içeriğini düzenlemek için tercih edilen bitkisel kökenli protein yemleridir. Türkiye, Dünyada en çok ayçiçeği tohumu üreten altıncı ülke konumundadır. Türkiye'de ayçiçeği küspesi, bütün ay çekirdeğinden sürekli pres yöntemi (expeller yöntemi) veya solvent ekstraksiyon yöntemi kullanılarak yağın alınmasından sonra kalan ürünün öğütülmesi ile elde edilir. Ayçiçeği küspesinin ham protein ve ham selüloz içerikleri bakımından farklılık gösteren kabuğu alınmamış, kabuğu alınmış ve yüksek proteinli olarak 3 sınıfa ayrılabilceğini bildirmiştir. Çalışmada %25, %27 ve %35 ham protein değerlerine sahip ayçiçeği küspesi numuneleri Kjeldahl metodu ile teyit edilmiş ve akabinde fotoğraflanarak üç farklı sınıf oluşturulmuştur. Ardından elde edilen resimler 224x224 piksel ebatlarında boyutlandırılarak orijinal veriseti elde edilmiştir. Lojistik regresyon, k en yakın komşu, naif bayes ve rastgele orman algoritmaları kullanılarak yapay zeka sınıflandırma modelleri oluşturulmuştur. Model sınıflandırma başarımları 6 farklı metrik üzerinden değerlendirilmiş ve yapılan sınıflandırma işlemleri sonucunda %95 üzerinde toplam doğruluk oranı elde edilmiştir. Çalışma sonucunda elde edilen değerler, bilgisayarlı görü tekniklerinin ve makine öğrenmesi algoritmalarının ayçiçeği küspesinin ham protein oranının görsel olarak tespitinde oldukça başarılı olduğunu ve sınıflandırma işlemlerinde yüksek başarımla değerleri ile uygulanabileceğini göstermektedir..

Anahtar Kelimeler: Ayçiçeği küspesi, bilgisayarla görme, ham protein tahmini, makine öğrenimi.



CLASSIFICATION OF CRUDE PROTEIN CONTENT OF SUNFLOWER MEAL USING MACHINE LEARNING ALGORITHMS

ABSTRACT

Meal; It is the name given to the rich part of the protein after the oil is removed from the oil seeds. Ration is a daily amount of feed given to the animal to meet the need for nutrients. The age, species, care conditions and physiological conditions of animals cause changes in nutrient needs. It is possible to proportion the raw protein content of the ration in line with the need for protein feeds added to the ration. In animal husbandry, resentments are preferred protein feeds to regulate the raw protein content of rations due to high raw protein content. Turkey is the sixth country that produces sunflower seeds in the world. In Turkey, sunflower meal is obtained by grinding the remaining product after the oil is taken using the continuous press method (Expeller method) or solvent extraction method from the entire sunflower seeds. It was reported that sunflower meal could be divided into 3 classes with un-dehulled, dehulled and high-protein. In the study, 25%, 27% and 35% crude protein samples of sunflower kücpe samples were confirmed by Kjeldahl method and then photographed in three different classes. Then the pictures obtained were sized in 224x224 pixels sizes and original data was obtained. Artificial intelligence classification models have been created using logistics regression, K -nearest neighbor, Naïf Bayes and random forest algorithms. Model classification achievements were evaluated over 6 different metrics and as a result of the classification processes, the total accuracy ratio was obtained above 95%. The values obtained as a result of the study show that computerized vision techniques and machine learning algorithms are very successful in visual detection of the crude protein ratio of sunflower meal and can be applied with high success values in classification processes.

Keywords: Sunflower meal, computer vision, raw protein estimation, machine learning



GİRİŞ

Ayçiçeği küspesi (SFM), ayçiçeği yağı üretiminin bir yan ürünüdür. Yağlı tohumlardan yağ ayırmak için üç yöntem vardır. Bu yöntemler hidrolik pres yöntemi (adi pres yöntemi), sürekli pres yöntemi (ekspeller yöntemi) ve solvent ekstraksiyon yöntemidir. Türkiye'de ayçiçeği küspesi genel olarak; sürekli pres yöntemi (ekspeller yöntemi) ve solvent ekstraksiyon yöntemi ile bütünlüğü bozulmamış ayçiçeği tohumlarından yağının çıkarılmasının ardından arda kalan ürünün öğütülmesi ile elde edilmektedir. Kabuğu çıkarılmamış SFM, kabuk içeriğine bağlı olarak %22-44 ham protein (HP) ve %12-32 ham selüloz (HS) içerebilir (Bonos (E. Μπονος) vd., 2017). Öte yandan, ayçiçeği tohumları yağ üretimi sırasında kısmen kabuğundan arındırıldığında, elde edilen küspenin HP seviyesi %34-40'a ulaşmaktadır (Ravindran & Blair, 1992; Villamide & San Juan, 1998). Genel olarak, kabuğu alınmış SFM ile kabuğu alınmamış SFM arasında %15-19 HS oranı farkı olduğu söylenebilir (Villamide & San Juan, 1998). Günümüzde yem teknolojisi alanındaki değişiklikler, yaklaşık %44-45 HP içeren ayçiçeği küspesi üretimine olanak sağlamaktadır (Sredanovic vd., 2011).

Yapay zekâ uygulamaları tarım ve hayvancılıkta kullanım imkânı bulmakta, işletme maliyetlerini düşürmekte ve işgücünün verimli kullanılmasını sağlamaktadır. Kullanılan makine öğrenimi metotlarının başarı oranı arttıkça, kullanım alanına bağlı olarak sunduğu katkı da yükselmektedir. Bununla birlikte tarım ve hayvancılık alanında elde edilen verilerin sınıflandırma başarısının değerlendirildiği araştırmaların sayısı da gün geçtikçe artmaktadır. You vd., (2020) damızlık kümeslerindeki tavukların (Ross 708) yumurtlama olaylarını tahminde rastgele orman algoritması ile %85 oranında doğruluk elde edilebildiğini bildirmişlerdir. Diğer taraftan soya fasulyesinin ekim başarısı açısından tohum çatlaklarını NIR ve rastgele orman algoritması kullanarak sınıflandıran Wang vd., (2021) rastgele orman algoritması ile %80 oranında sınıflandırma doğruluğu elde ettiklerini bildirmişlerdir. Tanyildizl & Yildirim, (2019) mastitli süt ineklerinin sınıflandırılmasında makine öğrenim yöntemlerinden J48, rastgele orman algoritması, destek vektör makineleri, k-en yakın komşu algoritması ve naif bayes algoritması kullanmışlar, J48 algoritmasının %98 doğruluk oranıyla en iyi performansa sahip olduğunu bildirmişlerdir. Toksin proteinlerinin analizinde makine öğrenimi metotlarından rastgele orman algoritması kullanımının %85.71 oranında doğrulukla sonuç verdiği bildirilmiştir (Pan vd., 2019). Kader vd., (2021) bir dizi makine öğrenimi metodunu ve veri madenciliği algoritmalarını kümes hayvanlarının hastalıklarına karşı önlem almak amaçlı değerlendirdikleri bir araştırmada tüm algoritmalarından kabul edilebilir



algoritmalar sağlamışlar ancak rastgele orman algoritmasının %97 doğruluk ile en doğru sonucu ürettiğini bildirmişlerdir. Bununla birlikte, yemlerin veya yem ham maddelerinin içerdiği ham protein düzeyini “Visual Feature Extractor” kullanarak tahmin etmeye yönelik çalışma bulunmamaktadır. Yemlerin HP analizinde 2 yöntem kullanılmaktadır. Bunlar Kjeldahl ve Dumas yöntemidir (Jung vd., 2003; Thompson vd., 2002). Kjeldahl yönteminde AOAC International'ın 981.10 metodu kullanılmaktadır (AOAC, 2019). Yöntemde 0,5 g yem numunesi bakır sülfat ve gümüş nitrat içeren katalizör eşliğinde 450 °C'de 2 saat bekletilir. Soğutulan çözeltinin azot içeriği nötralizasyon ve ardından titrasyon ile belirlenir. Ham protein içeriği 6,25'lik bir dönüştürme faktörü kullanılarak hesaplanır. Dumas yönteminde ise azot 950-1100 C sıcaklıkta yakılarak gaza dönüştürülür. Açığa çıkan nitrik oksit azota indirgenir ve bir termal dedektör ile ölçülür (Jung vd., 2003).

Günümüzde yakın kızılötesi spektroskopisi (NIRS) yem üreten firmalar tarafından tercih edilen hızlı bir yöntemdir. Ancak Kjeldahl veya Dumas yöntemleri ile elde edilen veriler doğrultusunda kalibre edilmesi gerekmektedir. Diğer yandan NIRS cihazının işletme gideri ve yem fabrikaları için bir maliyeti söz konusudur. Bu araştırmanın amacı Farklı ham protein düzeylerinde piyasaya sunulan ayçiçeği küspesinin ham protein değerinin görsel özellik çıkarıcı ve 4 farklı makine öğrenimi kullanılarak vizual feature extractor ve 4 farklı makine öğrenimi (Haif bayes, lojistik regresyon, k en yakın komşu ve rastgele orman algoritması) kullanarak tahmin etmek, çalıştırılan metotları kıyaslayarak en doğru tahmin yöntemini belirlemektir.

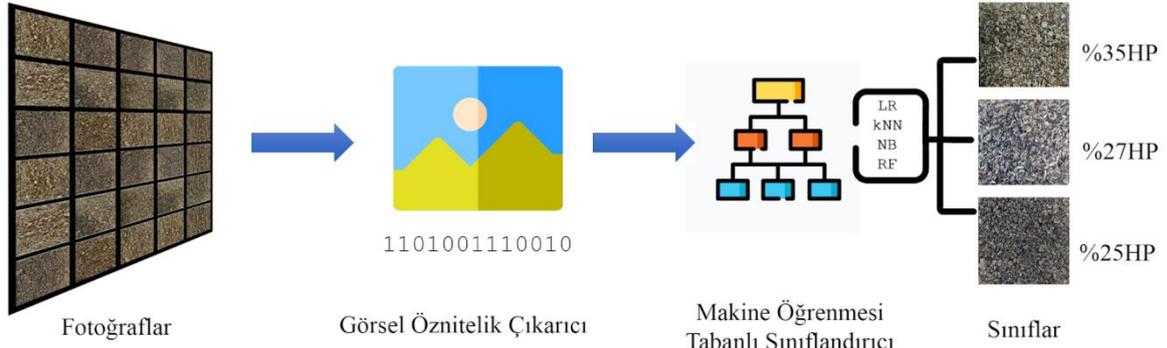
MATERYAL METOD

Türkiye de satılmakta olan 3 farklı ayçiçeği küspesinin ham protein içeriği Kjeldahl ham protein metodu kullanılarak AOAC'de bildirilen yöntemle göre belirlenmiştir (AOAC, 2019) Ham protein değerleri hesaplanan AÇK örnekleri (sınıfları), her bir sınıf için 70'er adet fotoğraf çekilmiş ve sonrasında her sınıfta 2.000 örnek olacak şekilde resim işleme teknikleri kullanılarak çoğaltılmıştır. Resim çoğaltma işlemi için orjinal fotoğraflar öncelik 224x224 piksel boyutlarına indirgenmiş, ardından saat yönünde 3 kez çevrilerek her bir resim kopyası veri setine dahil edilmiştir.

Çalışma kapsamında Inception v-3 derin öğrenme modelinin konvolüsyon filtreleri kullanılarak 2048 adet öz nitelik elde edilmiştir. Böylece sadece sayısal veriler işleyebilen naif bayes, lojistik regresyon, k en yakın komşu ve rastgele orman algoritması gibi makine öğrenmesi metodları görüntü işleyerek sınıflandırma yapabilir hale getirilmiştir. Fotoğraflar üzerinden sayısal özniteliklerin çıkarılması işlemine “Görsel öznitelik çıkarma- Visual feature extraction” adı verilmektedir. Şekil 1'de ayçiçeği küspesi fotoğraflarından sayısal öznitelik çıkarımı ve



sonrasında dört farklı makine öğrenmesi tekniği kullanarak küspenin ham protein oranlarının tahmin edilmesi görülmektedir.



Şekil 1. AÇK fotoğraflarından sayısal öznitelik çıkarımı ve tahminleme

Makine öğrenmesi tekniklerinden lojistik regresyon, ikili sınıflandırma problemleri için basit ve yaygın olarak kullanılan bir algoritmadır. Model, sınıflar arasında net bir ayırım olduğunda ve girdi özellikleri yüksek korelasyonlu olmadığında iyi performans gösterir. Rastgele orman algoritması, eğitim verilerini ve özelliklerin alt kümelerini rastgele seçerek birden fazla karar ağacı oluşturan bir topluluk algoritmasıdır. Model, yüksek boyutlu verilerle ve özellikler ile yanıt arasındaki doğrusal olmayan ilişkilerle başa çıkabilir ve özellik önem ölçütleri sağlar. Naif Bayes, tahmin ediciler arasında koşullu bağımsızlık olduğunu varsayarak tahmin edicilerin ve yanıtın ortak olasılık dağılımını modelleyen olasılıksal bir algoritmadır. Model, özellikle yüksek boyutlu veriler için hesaplama açısından verimlidir ve hem ikili hem de kategorik özellikleri işleyebilir. Bununla birlikte, tahmin edicilerin bağımsızlığını varsayar, ancak bu pratikte geçerli olmayabilir ve tahmin ediciler yüksek oranda ilişkili olduğunda düşük performans gösterebilir. K-en yakın komşular (KNN), yeni veri noktalarını eğitim verilerindeki k-en yakın komşularının çoğunluk sınıfına göre sınıflandıran parametrik olmayan bir algoritmadır. KNN'nin uygulanması basittir ve karmaşık karar sınırlarını ve özellikler ile yanıt arasındaki doğrusal olmayan ilişkileri idare edebilir. Bununla birlikte, k ve mesafe metriği seçimine duyarlı olabilir ve büyük veri kümeleri için hesaplama açısından maliyetli olabilir. Sınıflandırma problemleri için geliştirilen modellerin başarımlarını ölçmek için karmaşıklık matris yapısı kullanılır (Tablo 1).



Tablo 1. Karmaşıklık matrisi

		Tahmin Değerleri	
		Negatif	Pozitif
Gerçek Değerler	Negatif	DN Doğru Negatif	YP Yanlış Pozitif
	Pozitif	YN Yanlış Negatif	DP Doğru Pozitif

Yanlış pozitif sayısı istatistikte tip 1 hata olarak da isimlendirilmektedir ve gerçekte negatif olduğu halde model tarafından pozitif olarak tespit edilen kayıtların sayısını gösterir. Yanlış negatif sayısı da tip 2 hata olarak adlandırılır ve gerçekte pozitif olduğu halde model tarafından negatif olarak işaretlenen kayıtların sayısını verir. Başarılı bir modelde tip 1 ve tip 2 hatasının olmaması veya diğer verilere göre çok daha az olması istenir. Sınıflandırma modellerinin performanslarının belirlenmesinde kullanılan diğer metrikler kesinlik, recall, F1-skoru, kümülatif doğruluk, ve eğri altında kalan alan (area under curve) hesaplamalarıdır. İlgili metrik ve hesaplamada kullanılan formüller Tablo 2’de verilmiştir.

Tablo 2. Model performans metrikleri

Ölçüm Metriği	Denklem
Duyarlılık	$\frac{DP}{DP + YN}$
Pozitif Tahmin Değeri (Hassasiyet)	$\frac{DP}{DP + YP}$
Negatif Tahmin Değeri	$\frac{DN}{YN + DN}$
Kesinlik	$\frac{DN}{YP + DN}$
Doğruluk	$\frac{DP + DN}{DP + DN + YP + YN}$
F1- puanı	$\frac{2 \cdot \text{Hassasiyet} \cdot \text{Duyarlılık}}{\text{Hassasiyet} + \text{Duyarlılık}}$

F1 puanı, hassasiyet ve geri çağırmanın harmonik ortalamasıdır; burada F1 puanı en iyi değerine 1’de (mükemmel hassasiyet ve duyarlılık) ve en kötü değerine 0’da ulaşır. Sınıflandırma modellerinin doğruluk hesaplamalarında Alıcı Çalışma Karakteristiği-ACK (Receiver Operating Characteristic - ROC) eğrisi sıklıkla kullanılır. ACK temelde sınıflandırma problemlerini çözmek için kurduğumuz modellerin iyi çalışıp çalışmadığını anladığımız bir metriktir ve farklı sınıflar için bir olasılık eğrisidir. ACK eğrisi altındaki alan (EAA), model



performansının bir özeti olarak kabul edilebilir. Çalışmada yer alan her bir performans metriği için 1'e yakın değerler başarılı olarak kabul edilir.

TARTIŞMA VE SONUÇ

Şekil 2'de çalışmada kullanılan makine öğrenmesi tekniklerinin farklı protein seviyelerini ifade eden resimleri tahminleme başarıları görülmektedir. Mavi renk ile işaretli kutular toplam 2000 adet resim içerisinde doğru pozitif tahminlerin sayısını göstermektedir. Kırmızı ve tonları ile işaretlenen değerler de modellerin hatalı tahmin sayılarını gösterir.

		Tahmin edilen			
		25	27	35	Σ
Gerçek Değer	25	1463	135	402	2000
	27	105	1864	31	2000
	35	379	62	1559	2000
	Σ	1947	2061	1992	6000
Naif Bayes					
		Tahmin edilen			
		25	27	35	Σ
Gerçek Değer	25	1869	12	119	2000
	27	9	1982	9	2000
	35	94	1	1905	2000
	Σ	1972	1995	2033	6000
Lojistik Regresyon					
		Tahmin edilen			
		25	27	35	Σ
Gerçek Değer	25	1768	10	222	2000
	27	66	1905	29	2000
	35	156	2	1842	2000
	Σ	1990	1917	2093	6000
K En Yakın Komşu					
		Tahmin edilen			
		25	27	35	Σ
Gerçek Değer	25	1609	55	336	2000
	27	73	1894	33	2000
	35	351	14	1635	2000
	Σ	2033	1963	2004	6000
Rastgele Orman					

Şekil 2. Çalışmada kullanılan modellerin karışıklık matrisleri

Çalışma kapsamında kullanılan modellere ait performans değerleri Tablo 2'de belirtilen formüllere göre hesaplanarak Tablo 3'de verilmiştir.

Tablo 3. Modellere ait performans değerleri

Model	Eğri Alan	Altındaki	Kümülatif Doğruluk	F1 Puanı	Kesinlik	Hassasiyet
K En Yakın Komşu	0.9813		0.9191	0.9196	0.9208	0.9192
Rasgele Orman	0.9560		0.8543	0.8544	0.8546	0.8543
Naif Bayes	0.9253		0.8143	0.8134	0.8128	0.8143
Lojistik Regresyon	0.9949		0.9593	0.9593	0.9594	0.9593

Performans metrikleri incelendiğinde en başarısız modelin Naif Bayes olduğu görülmektedir. Naif bayes modelini Rasgele orman modeli takip etmektedir. En iyi sınıflandırma sonucunu veren model ise lojistik regresyondur ve 0.95 gibi yüksek bir kümülatif doğruluk değerine ulaşabilmektedir. Yine EAA, F1 puanı, kesinlik ve hassasiyet parametrelerinde de 0.95'in üzerinde değerler elde edilmiştir.



Rasyonlarda sıklıkla kullanılan ay çiçeği küspesinin ham protein içeriği, çeşitli yakıcı ve dağlayıcı kimyasalların kullanımını gerektiren, pahalı alet ve ekipman gerektiren bir süreç sonrasında belirlenmektedir. Gerçekleştirilen çalışma sonucunda farklı ham protein değerlerine sahip ayçiçeği küspesi numunelerinin sadece optik fotoğraflar çekilerek ve sonrasında yapay zeka teknikleri ve makine öğrenme algoritmaları kullanılarak başarılı bir şekilde sınıflandırılabilmesi görülmüştür. Söz konusu sınıflandırma yöntemi ürünün açığa çıkma sürecinde makine öğrenimi yöntemlerinin kullanılarak kalitesinin anlık olarak kontrol edilebilmesini ekonomik olarak sağlayabilir.

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EKİM SIKLIĞI ve KISITLI SULAMA ETKİSİ ALTINDA SORGUMDA VERİM POTANSİYELİ ve KLOROFİL (SPAD) İÇERİĞİ

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ÖZET

Tarımsal üretimde birim alandan elde edilen verim potansiyelini artırmanın bir çok yolu vardır. Ekim sıklığı, ekim yöntemi, ekonomik tür ve çeşit seçimi ve bakım işlemleri bu yöntemlerden bazılarıdır. Özellikle birim alanda bitki sayısı ve sulama miktarı verim potansiyelini oldukça etkilemektedir. Suyun öneminin her geçen gün daha fazla hissedildiği günümüzde birim alanda elde edilen yüksek verim yanında su kullanım etkinliği yüksek olan bitki türlerinin seçimi önem arz edecektir. Bu bilgilere dayanarak yapılan çalışmamız tatlı sorgum yetiştiriciliğinde (cv. Tonka) 3 ekim sıklığı (4.1, 10.3, 14.7 cm) ve 2 farklı sulama dozunun (%100 ve %50 TK) verim potansiyeli ve SPAD değerlerine olan etkisi üzerine olmuştur. Çalışma Aydın ekolojik koşullarında 3 tekrarlamalı olarak 2021 yılında yürütülmüştür. Pinömatik mibzer ile yapılan hassas ekimin ardından uygulama parsellerinin etrafı sulama amacıyla toprakla set çekilmiştir. SPAD değerleri 3 farklı fenolojik dönemde (Bayrak yaprak, çiçeklenme, hamur olum) olacak şekilde ölçülmüştür. Biçim işlemleri ardından verim ve verim ögeleri incelenmiştir. Gözlenen sonuçlara göre en sık ekimin ve tam sulamanın verimde en yüksek değere (3.32 t da⁻¹) sahip olduğu gözlenmiştir. Su kullanım etkinliği yüksek olsa da sorgumda sulama miktarının azaltılması verimde düşüş meydana getirmiştir. SPAD değerleri ile ekim sıklığı arasındaki ilişkide önemli farklar ortaya çıkmaması yanında sulama açısından tam sulamada değerlerin daha yüksek olduğu gözlenmiştir. Çalışmada çeşit ve sulama dozları artırılarak çalışma daha kapsamlı hale getirilebilir. Ancak bu sonuçlara göre verim açısından değerlendirdiğimizde sık ekim ve tam sulamanın sorgum yetiştiriciliğinde ekonomik olarak daha yüksek bir değere sahip olacağı sonucu elde edilmiştir.

Anahtar Kelimeler: Ekim sıklığı, spad, sorgum, yem verimi



BIOMASS POTENTIAL and CHLOROPHYLL (SPAD) CONTENT of SORGHUM AS EFFECTED BY SOWING DENSITY AND DEFICIT IRRIGATION

ABSTRACT

There are many ways to increase the biomass potential obtained from unit area in agricultural production. Sowing density, sowing method, economical species and variety selection and maintenance are some of these methods. Especially the number of plants per unit area and the amount of irrigation affect the biomass potential. In today's world, where the importance of water is felt more and more each passing day, the selection of plant species with high water use efficiency will be important in addition to the high yield per unit area. Based on this information, our study was on the effect of 3 sowing density (4.1, 10.3, 14.7 cm) and 2 different irrigation doses (100% and 50% FC) on biomass potential and SPAD values in sweet sorghum cultivation (cv. Tonka). The study was carried out in Aydın ecological conditions with 3 replications in 2021. After the precision planting with pneumatic seeder, the surrounding of the application plots was dammed with soil for irrigation purposes. SPAD values were measured in 3 different phenological periods (flag leaf visible, flowering, soft dough). After mowing, yield and yield components were examined. According to the results, it was observed that the most frequent sowing and full irrigation had the highest yield (3.32 t da⁻¹). Although water use efficiency is high, reducing the amount of irrigation in sorghum caused a decrease in yield. Although there were no significant differences in the relationship between SPAD values and sowing density, it was found that the values were higher in full irrigation. The study can be made more comprehensive by increasing the variety and irrigation doses. However, according to these results, when we evaluate it in terms of yield, it is concluded that frequent sowing and full irrigation will have a higher economic value in sweet sorghum cultivation for silage.

Keywords: Sowing density, spad, sweet sorghum, forage yield



1. INTRODUCTION

Sorghum is an important forage crop used for livestock feed worldwide. Its high yield potential, adaptability to a wide range of climatic conditions, and drought tolerance make it a preferred forage crop in many regions. Sorghum forage is a rich source of nutrients, particularly proteins, carbohydrates, and fiber, which are essential for livestock growth and development. Additionally, sorghum forage is low in lignin, a compound that limits the digestibility of other forage crops, making it a highly digestible and palatable feed option for livestock. Sorghum also has a unique characteristic of being able to accumulate nitrates, which can be harmful to livestock if consumed in large quantities. Proper management and harvesting techniques can mitigate this risk and ensure the safe use of sorghum forage as a feed source for livestock (Colombini et. al. 2012; Afzal et. al. 2012; Pino and Heinrichs, 2017).

The sowing density of sorghum is an important factor that can affect the yield and quality of the forage. In general, the recommended sowing density for sorghum as forage varies depending on the specific cultivar, soil type, and climate conditions. However, as a general rule, a sowing density of 8-12 kg ha⁻¹ is typically recommended for most forage sorghum varieties. A higher sowing density can result in more plants per unit area, which can increase the overall yield of the forage. However, if the plants are too densely spaced, this can lead to competition for resources such as water and nutrients, which can negatively impact the growth and development of individual plants. Conversely, a lower sowing density may result in fewer plants per unit area, which can decrease the overall yield of the forage. However, with more space between individual plants, each plant can access more resources, which can promote better growth and development (Berenguer and Faci, 2001; Xuan et. al. 2015; Silva et. al. 2017).

It is important to note that the optimal sowing density for sorghum as forage may vary depending on the specific goals of the cultivator, such as maximizing yield or quality. It is also important to consider other factors such as soil fertility, irrigation, and pest management when determining the optimal sowing density for sorghum as forage

Deficit irrigation is a water management strategy that involves supplying less water to crops than their optimal requirements. This technique has been increasingly used in the cultivation of sorghum as forage to save water resources while maintaining crop productivity. Several studies have reported that deficit irrigation can significantly increase the water use efficiency (WUE) of sorghum crops, which is the ratio of biomass production to the amount of water used (Farre and Faci, 2006; Klocke et. al. 2012; Bell et. al. 2018). This means that sorghum crops can



produce more biomass per unit of water under deficit irrigation than under full irrigation. Moreover, deficit irrigation has been shown to have little or no impact on the quality of sorghum forage. In fact, some studies have reported that water stress can even improve the nutritional quality of sorghum forage by increasing its protein and mineral content. However, it is important to note that the impact of deficit irrigation on sorghum forage yield and quality may vary depending on the specific cultivar, soil type, and climate conditions. Therefore, it is important to carefully determine the appropriate level of deficit irrigation to avoid excessive water stress that could lead to yield losses or quality reduction (Jahansouz et. al. 2014; Bean et. al. 2013).

In perspective of these goals, it is now crucial to cultivate plant species that use less water in today's world, which is experiencing the effects of global climate change. This is why the sorghum kind was selected for our study. In terms of yield and chlorophyll content, the reaction of this plant to various irrigation settings and frequency in cultivation was examined.

2. MATERIAL AND METHOD

The experiment was conducted in 2021 in the ecological conditions of Aydın province, with three replications. The material was Sudangrass (*Sorghum bicolor* x *Sorghum sudanense* Stapf., cv. Tonka), and sowing was done at three different sowing densities (4.1, 10.3, 14.7 cm). The row spacing was set at 70 cm. The 0–30 cm depth of the soil in the experimental region was loamy, alkaline, and deficient in organic matter. The soil contains 3.82% of lime, 0.02% of total saline, 35 ppm of phosphorus (P), and 320 ppm of accessible potassium (Table 1.). Climate statistics have shown that July and August are warmer this year than the temperature records have shown for many years. Checking the precipitation data reveals that the experiment was carried out in a year with a dry summer. The growth of the sorghum species, which is renowned for its water use efficiency, was also impacted by this circumstance (Table 2). The seeds used for sowing are 3 kg da⁻¹. Fertilizer was applied as 210 kg ha⁻¹ pure nitrogen (NH₄NO₃) (60 kg.ha⁻¹ with 15-15-15 composite (N-P-K) was applied immediately at the beginning of cultivation – 150 kg ha⁻¹ with urea before first water.



Table 1. Soil analysis report of the experimental area

	Sand (%)	Silt (%)	Clay (%)	Texture	Total Salt (%)	pH	Lime (%)	Org. Matter (%)
	47,19	34,56	18,25	Tınlı	0,0189	8,10	3,82	1,10
					Saltless	Alkali	Limy	Low
P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
35	320	3218	413	240	10,62	3,71	5,24	21,80
High	High	High	Very High	High	High	Enough	Enough	Enough

Table 2. Monthly temperature and total precipitation during growth period and long-term mean (1985-2022) in Aydın

	Temperature (°C)		Precipitation (mm)	
	2020	Long-term	2020	Long-term
May	23.7	21	0	40.3
June	25.9	26	5.8	14.5
July	31.5	28.6	0	6.1
August	30.8	28.1	0	6.7
September	24.7	23.9	0	16.9

The water content of the soil after being saturated by irrigation and allowed to drain is called field capacity (FC). Crop can no longer take up water from the soil is referred wilting point (WP). The water held by the soil between field capacity and the permanent wilting point is considered available water. Irrigation water requirement was calculated with the following formulas (Martin and Gilley, 1993; Lamm et. al., 1994). Irrigation was carried out in line with these processes, with full irrigation (4 times) and not falling below 50% field capacity (2 times). Measurements of chlorophyll content were carried out under full sunlight before harvesting with the help of a SPAD meter (Konica-Minolta SPAD-502, Tokyo, Japan). The plot's edge rows were cut out, and the rest of the plot was harvested and weighed to determine fresh forage yield. Biomass yield ($t\ da^{-1}$) was determined using a fan drying oven (Mikrotest, MST) set to 70°C until the weight was determined (Cook and Stubbendieck, 1986).

The agricolae package in the R Studio program (de Mendiburu F and de Mendiburu M.F., 2019) was used to conduct statistical analysis ($\alpha=0.05$) utilizing the split-split plots experimental design in randomized blocks in order to compare the results.

3. RESULTS

In the light of the data obtained, a statistical difference was determined between irrigation applications in SPAD values. Full irrigation applications were determined to be higher than 50% field capacity. According to the relationship between sowing frequency and irrigation, the highest value was obtained with 54.2 in plots with 10.3 cm in-row spacing and full irrigation. This situation was not the same when the row spacing was increased to 14.7 cm. (Table 3.).



Table 3. SPAD values of the experiment

	%50	%100	Mean
4.1 cm	48.4	53.8	51.1
10.3 cm	50.2	54.2	52.2
14.7 cm	47.6	51.2	49.4
Mean	48.7 B	53.1 A	

According to the biomass yield, it has been seen that full irrigation has a higher value in the experiment season, taking into account the climate data. This is an expected situation. However, it is in the hypotheses of the experiment that sorghum-sudangrass can tolerate water restriction up to a certain percentage, since it is a prominent species in terms of water use efficiency. In the light of these results, it was seen that water restriction may cause a decrease in yield in sorghum-sudangrass species (Table 4).

Table 4. Biomass yield of the experiment (t da⁻¹)

	%50	%100	Mean
4.1 cm	1.37	3.34	2.35 A
10.3 cm	1.21	2.31	1.76 B
14.7 cm	1.06	2.23	1.64 B
Mean	1.21 B	2.63 A	

4. CONCLUSION

Sorghum-sudangrass is a very important species with its high yield potential and being an alternative to maize as a forage. The high water demand of silage maize poses some question marks for the future of this species. For this purpose, in this study carried out in the Mediterranean climate, where the dry summer months are experienced, the response of sorghum-sudangrass to drought at different frequencies was examined in terms of yield and chlorophyll. Although the study is one-year, it has been determined that drought is very important for every plant and the yield may increase as the sowing frequency in sorghum species increases, but the application with 10.3 cm sowing density will have a higher value in terms of chlorophyll content. When the trial is examined together with other yield components and quality characteristics, it may have more precise results.



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ÇOK YILLIK ÇİM / ÇAYIR ÜÇGÜLÜ KARIŞIMLARININ FARKLI BİÇİMLERDE KLOROFİL (SPAD) İÇERİĞİ

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ÖZET

Çok yıllık baklagil ve buğdaygil yem bitkileri karışımları yalın üretime nazaran yüksek verim potansiyeli yanında olumsuzluklara karşı birbirlerine olan destek özellikleri ile önem taşımaktadırlar. Özellikle baklagillerde bulunan nodüller vasıtasıyla kimyasal azotlu gübre kullanımının azaltılması olumlu bir örnektir. Yapay mera alanlarında kullanım imkanı bulan çok yıllık çim (cv. Esquire) ve çayır üçgülü (cv. Diplomat) aynı zamanda karışım olarak da yem bitkileri üretiminde değerlendirilebilmektedir. Yapmış olduğumuz çalışmada bu iki türün 5 farklı karışımı (%0-100, %25-75, %50-50, %75-25, %100-0) 3 tekrarlamalı olarak Aydın ekolojik koşullarında 2019 yılında yürütülmüştür. Çalışma yılında 4 farklı biçimden önce karışımda yer alan her türe ait SPAD değerleri ölçülmüştür. Elde edilen sonuçlara göre en yüksek SPAD değerleri yalın çayır üçgülünden elde edilmiştir. Karışımlar arasında en yüksek SPAD değerine sahip çok yıllık çimin %50-50 karışımında olduğu gözlenmiştir. Karışımda baklagil yüzdesi düştükçe çayır üçgülüne ait SPAD değerlerinin de düştüğü elde edilen sonuçlardandır. İlerleyen biçim devresinde buğdaygillerde değer artışı gözlenirken baklagilde önemli fark tespit edilmemiştir. Çalışma tesis yılına ait bir çalışmadır. Çok yıllık türlere ait çalışmalarda net sonuçların ortaya konulabilmesi için uzun dönem ölçümlerin tekrarlanması gerekmektedir. Ancak elde edilen sonuçlara göre çayır üçgülü ile birlikte yetiştirilen çok yıllık çim türünün belirli bir karışım yüzdesine kadar klorofil içeriğinde artış gösterdiği tespit edilmiştir.

Anahtar Kelimeler: baklagil-buğdaygil karışımı, spad, biçim



CHLOROPHYLL (SPAD) CONTENT of PERENNIAL RYEGRASS / RED CLOVER MIXTURES UNDER DIFFERENT CUTTING

ABSTRACT

Mixtures of perennial legumes and grasses are important with their high yield potential, as well as their support for each other against unfavourable conditions. Reducing the use of chemical nitrogen fertilizers, especially through nodules in legumes, is a positive example. Perennial ryegrass (*Lolium perenne* cv. Esquire) and red clover (*Trifolium pratense* cv. Diplomat), which can be used in sown pasture areas, can also be used as a mixture in the production of forage crops. In our study, 5 different mixtures of these two species (0-100%, 25-75%, 50-50%, 75-25%, 100-0%) were carried out in 3 replications in Aydın ecological conditions in 2019. SPAD values of each species in the mixture were measured before 4 different cutting in the study year. According to the results obtained, the highest SPAD values were obtained from pure clover plots. It was observed that the perennial ryegrass with the highest SPAD value among the mixtures was 50-50% in the mixture. It is one of the results obtained that as the percentage of legumes in the mixture decreases, the SPAD values of the red clover also decrease. While an increase in value was observed in grasses in the advancing cutting period, no significant difference was detected in legumes. The experiment is a study of the establishment year. Long-term measurements need to be repeated in order to reveal clear results in studies of perennial species. However, according to the results obtained, it was determined that perennial ryegrass grown together with red clover showed an increase in chlorophyll content up to a certain percentage of mixture.

Keywords: legume-grass mixture, spad, cutting



1. INTRODUCTION

Perennial ryegrass is a popular forage crop due to its high nutritional value and palatability for livestock. It is commonly used for grazing, hay production, and silage. Perennial ryegrass is a cool-season grass that grows rapidly in the spring and fall, producing high yields of nutritious forage. The high-quality forage produced by perennial ryegrass is rich in protein, energy, and minerals, making it an excellent feed for dairy cows, beef cattle, sheep, and horses. Its high digestibility and palatability make it a preferred forage crop for many livestock producers. Perennial ryegrass is often grown in combination with other forage crops, such as clovers, to improve pasture quality and extend the grazing season. It can also be used in rotational grazing systems to help maintain the health and productivity of pastureland (Grogan and Gilliland, 2011; Cunningham et. al., 1994).

Red clover is commonly used for grazing, hay production, and silage, and is often grown in combination with other forage crops, such as grasses and other legumes, to improve pasture quality. The high-quality forage produced by red clover is rich in protein, energy, and minerals, making it an excellent feed for dairy cows, beef cattle, sheep, and horses. Its high digestibility and palatability make it a preferred forage crop for many livestock producers. In addition to its nutritional value, red clover has the ability to fix nitrogen from the air into the soil, which can improve soil fertility and reduce the need for synthetic nitrogen fertilizers. This can make it an attractive option for farmers looking to improve the sustainability of their farming practices (Boller et. al. 2010).

While it is generally acknowledged that plant species richness and plant trait variety are beneficial to ecosystem health, new developments in community ecology have also highlighted the significance of intraspecific diversity (Verwimp et. al. 2018).

Grass-legume mixtures typically produce higher yields of forage than pure grass or pure legume stands. They also tend to have higher nutritional quality, with increased protein and energy content, which can improve animal performance and productivity. Legumes in the mixture fix atmospheric nitrogen, reducing the need for nitrogen fertilizers, and improving soil fertility. Grasses also contribute to soil health by increasing soil organic matter and promoting soil stability.

For these purposes, the study investigated the amount of chlorophyll in perennial ryegrass and red clover mixtures. Although the data for only the first year of the study did not reveal clear results in the study, it is important in terms of giving an idea about the possible effects of the



mixtures on each other. In perennial species, data on the amount of chlorophyll to be taken in the following years will be able to reveal clear results.

2. MATERIAL and METHOD

The experiment was conducted in 2017-2018 in the ecological conditions of Aydın province, with three replications. 5 different mixtures of perennial ryegrass (*Lolium perenne* cv. Esquire) and red clover (*Trifolium pratense* cv. Diplomat) (0-100%, 25-75%, 50-50%, 75-25%, 100-0%) was tested in the study. In the study, a distance of 20 cm between rows was left.

The land where the experiment was conducted has soil properties that are low in organic matter but sufficient in terms of some micro-minerals in the Büyük Menderes Basin (Table 1). According to the climate data of the year in which the experiment was conducted, it is seen that the trial year was warmer than the long years. In terms of precipitation, it can be seen that less precipitation is obtained in summer compared to long years. (Table 2.).

Before sowing, 15-15-15 (N-P-K) compound fertilizer was applied to each application. In order to better see the difference between the applications, no top fertilizer was applied. SPAD measurements were made on the leaves on the main stem of 10 plants belonging to the family in each plot. Measurements were made with the Konica-Minolta SPAD-502 device under full sunlight before each cutting (Jia et. al 2018). In the experiment, four cuttings were made and the beginning of flowering of the meadow clover is in the phenological period during these cuttings.

Table 1. Soil analysis report of the experimental area

	Sand (%)	Silt (%)	Clay (%)	Texture	Total Salt (%)	pH	Lime (%)	Org. Matter (%)
	47,19	34,56	18,25	Tınlı	0,0189	8,10	3,82	1,10
					Saltless	Alkali	Limy	Low
P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)	Fe (ppm)	Zn (ppm)	Mn (ppm)	Cu (ppm)
35	320	3218	413	240	10,62	3,71	5,24	21,80
High	High	High	Very High	High	High	Enough	Enough	Enough



Table 2. Monthly temperature and total precipitation during growth period and long-term mean in Aydın

	Temperature (°C)		Precipitation (mm)	
	2019-20	Long-term	2019-20	Long-term
November	16.5	13.4	65.1	85.6
December	10.5	9.4	117.7	111.5
January	7.7	8.2	91.5	109.8
February	10.4	9.4	90.7	86.1
March	13.3	12.1	65.6	71.8
April	16.8	16.2	57.7	50.9
May	22	21	33.9	40.3
June	25.3	26	20.2	14.5
July	29.8	28.6	0	6.1
August	29.1	28.1	0.7	6.7
September	27	23.9	0	16.9
October	21.2	18.8	42.8	41.1

The agricolae package in the R Studio program (de Mendiburu F and de Mendiburu M.F., 2019) was used to conduct statistical analysis ($\alpha=0.05$) utilizing the split-split plots experimental design in randomized blocks in order to compare the results.

3. RESULTS and DISCUSSION

In the study, each species was taken into statistical analysis with its own form periods. In this context, although the highest values are always in the parcels containing 100% legumes, changes in SPAD values were observed according to the percentage of their presence in the mixture. Especially in the mixtures, the increase in the percentages of the grasses up to a certain level caused an increase in the SPAD values of the grasses. The opposite was true for legumes. There were no statistically significant differences between the forms. This revealed that each form had similar chlorophyll content before. These data obtained in the year of the study are similar to the data of Kara and Sürmen (2017), which were conducted before. Olszewska (2022) made some statements in his study that the changes in SPAD values may change in the following seasons and forms. This will probably be the case in our study as well.

Table 3. SPAD values of mixtures at different cutting times

%	1st CUTTING		2nd CUTTING		3rd CUTTING		4th CUTTING	
	GRASS	LEGUME	GRASS	LEGUME	GRASS	LEGUME	GRASS	LEGUME
%100	40.6		41.2		40.3		41.2	
%75-25	41.2	39.3	41.4	38.5	42.2	40.5	41.4	39.7
%50-50	43.7	39.9	42.3	40.2	42.7	41	43	41.7
%25-75	40.9	40.2	40	40.7	41.9	41.5	42.3	41.3
%100		42.8		43.6		43.6		42.8
Mean	41.6	40.55	41.22	40.75	41.77	41.65	41.97	41.37



4. CONCLUSION

Perennial ryegrass and red clover plants are perennial species. They can be preferred in mixtures. However, it is necessary to pay attention to the mixture percentages and growing conditions in terms of features such as variety characteristics and purpose of use. This preliminary study we have done, besides being a field study, provides information about the chlorophyll content of the species in the mixture before the 4 cutting time. The long-term duration of the study and the handling of the relationship between year-form with quality and yield characteristics will enable the study to be carried forward.



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SOME PHYSIO-CHEMICAL CHARACTERISTICS OF PROMISING MULBERRY (*Morus alba* Linnaeus) GENOTYPES IN KAYNAŞLI (DÜZCE) REGION

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ABSTRACT

In this study, physio-chemical properties of fruits obtained from genetic sources of mulberry (*Morus alba* Linnaeus) naturally grown in Kaynaşlı district of Düzce province were determined. In terms of the highest values in genotypes, fruit weight was 5.12 g, fruit width was 16.94 mm, fruit length was 35.86 mm, fruit thickness was 18.44 mm, fruit stem thickness was 1.80 mm, fruit stem length was 11.79 mm, fruit SSC was 20.93%, fruit pH was 5.86, and fruit TA was 5.58%. In terms of the highest values in fruit color parameters, L* value was 42.78, a* value was 4.13, b* value was 8.56, Chroma value was 8.86, Hue value was 84.94. The highest values in leaves were observed as 17.56 cm in leaf length, 15.30 cm in leaf width, 3.44 mm in petiole thickness, and 53.30 cm in petiole length. In the study, KYN01, KYN08 and KYN10 genotypes were prominent in terms of some quality criteria and it was determined that these promising genotypes could be used in future studies on the subject.

Key words: *Morus alba*, mulberry, genotype, pomology, ssc, ta



1. INTRODUCTION

Mulberry (*Morus alba* Linnaeus), an important member of the Moraceae family, is a sparse and ball-like plant that can grow fast, has a cylindrical body, an upright, thick and cracked shell structure on the trunk, and a sweet and plump white fruit when ripe (De Candolle, 1967). Mulberry trees, which have a crown structure that can reach 6-8 meters on average, can grow up to about 15 meters, and since this fruit is not very selective in terms of soil and climatic conditions, it can be grown in almost all areas in our country (Anonymous, 2023). Mulberry, which can prefer temperate and subtropical climate conditions and first appeared in gene centers such as China, Korea and Japan, can grow in different temperatures and in a wide variety of climate, topographic and soil conditions from the tropics of the Southern hemisphere to the subtropical regions of the Northern hemisphere (Bellini et al., 2000; Ercişli and Orhan, 2007). In terms of mulberry fruits, whose leaves and fruits are generally used, they can be consumed as fresh, dried or fruit juice in our country, as well as processed as molasses, vinegar, jam, fruit pulp, spirit and kome (Güven and Başaran, 1979; Huo, 2004; Erdoğan and Pırlak, 2005). When evaluated in terms of leaves, mulberry cultivation, which can be done because of the feeding of silkworms (*Bombyx mori* Linnaeus), which is used to obtain silk in our country, is also one of the important resources that contribute to the economy of our country. In addition to these features, mulberry fruit can also be used in the production of some musical instruments, and in the paper and furniture industry in our country. In addition, some types of mulberry, which can be used in garden architecture as ornamental plants, can also be used as hedge plants (Güven and Başaran, 1979; Güneş and Çekiç, 2004). When evaluated in terms of living health, it is known that the root and stem shells of mulberry can be used in the treatment of many diseases in humans, and especially black mulberry syrup can help in curing mouth and throat diseases in humans (Baytop, 1996). Mulberry fruits, of which 85% consists of water, are rich in proteins, free acids, sugars, cellulose and phenolic compounds, and this fruit contains carotene, B1, B2 and C vitamins in terms of vitamins (Güneş, 2013; Keskin, 2016). Mulberry fruit, which can be grown in a wide range of climatic and soil conditions compared to other fruit groups, is one of the fruits that are curious in terms of its physio-chemical properties. Therefore, consumer tendencies towards this fruit are increasing day by day, thanks to its many positive effects on living health and the many usage advantages mentioned above.



This study was carried out to investigate some chemical and pomological properties of certain promising genotypes of mulberry grown in Kaynaşlı district of Düzce province. It is thought that this study can make important contributions to other literature researches on this subject.

2. MATERIAL AND METHOD

Material

This study was carried out in Kaynaşlı district of Düzce province, which has an important place in mulberry production. The research material was formed by the mulberry population, which grows spontaneously in nature and is grown by farmers and whose source is unknown. According to the evaluations made by considering the selection criteria, 10 genotypes were determined and these genotypes were used in the study.

Method

Physical and chemical characterization

The following pomological and chemical analyzes were performed on the 10 genotypes examined. Evaluations were made on 20 fruit and 5 leaf samples to represent each genotype.

Fruit Weight (g): Each of the 10 fruits taken from the genotypes was weighed on a scale sensitive to 0.1 g and the averages were taken. Fruit weights were determined by weighing on a scale with a sensitivity of 0.001 g (Güleryüz, 1977; Ercişli, 1996; Orhan, 2009).

Fruit Width (mm) and Fruit Length (mm): Fruit width and fruit length were measured with a millimetric digital caliper sensitive to 0.05 mm. Average values were calculated by dividing all measurement values by the number of fruits (Güleryüz, 1977; Ercişli, 1996; Orhan, 2009).

Fruit Thickness (mm): The thickness measurements of the fruits were made using a digital compass caliper sensitive to 0.01 mm (Erdem, 2015).

Fruit Stem Thickness (mm): The fruit stem thickness was measured with a millimetric digital caliper sensitive to 0.05 mm. Average values were calculated by dividing all measurement values by the number of fruits (Güleryüz, 1977; Ercişli, 1996; Orhan, 2009).

Fruit Stem Length (mm): In calculating the fruit stem length, the part of the fruit from the stem pit to the branch attachment was measured with a 0.1 mm sensitive digital caliper (Orhan, 2009).

Leaf Length (cm) and Leaf Width (cm): Leaf width was determined by measuring from the widest part of the leaf with a digital caliper sensitive to 0.01 mm. Leaf length was measured in the same way from the distance between the tip of the leaf and the point where the leaf blade ends on the petiole (Cemeroğlu, 1992).



Petiole Thickness (mm) and Petiole Length (cm): Petiole length was determined by measuring from the distance between the point where the leaf blade ends on the petiole and the place where it attaches to the branch with a digital caliper sensitive to 0.01 mm. Petiole thickness was measured from the middle part of the petiole in the same way (Cemeroğlu, 1992).

Water Soluble Dry Matter (SSC) (%): The amount of SSC in mulberry juice was measured with a hand refractometer and the averages were taken (Orhan, 2009).

Titrateable Acidity (TA) (%): 10 ml of fruit juice was taken from the sample used in the reading of SSC, and it was made up to 100 ml and titrated with 0.1 N NaOH. The obtained results were calculated in terms of % titration acidity (malic acid) using the following formula.

Acidity formula: $0.07 \times \text{amount of NaOH spent} \times 20 \times \text{factor (0.963)}$ (Altan, 1989; Ağca and İlgin, 2017).

SSC/TA: The ratio of SSC/TA in mulberry fruit genotypes was determined by the ratio of SSC to TA.

pH Determination: The pH of the juice was determined in the squeezed juice using a digital pH meter (Cemeroğlu, 1992).

Color Determination: Measurements of the color values of fruits in color determination were carried out using a Minolta brand CR300 model colorimeter. L*, a*, b*, Chroma and Hue values, which are the Hunter Lab Chromameter color values of the material, were determined with a colorimeter (McGuire, 1992).

3. RESULTS AND DISCUSSION

In the study, in Table 1, fruit weight, fruit length, fruit width, fruit thickness, fruit stem thickness and fruit stem length values were examined in 10 different genotypes. According to the average results obtained, the lowest fruit weight was 1.35 g (KYN03 genotype) and the highest fruit weight was 5.12 g (KYN05 genotype), the least fruit length was 20.20 mm (KYN03 genotype) and the most fruit length was 35.86 mm (KYN08 genotype), the least fruit width was 11.65 mm (KYN03 genotype) and the most fruit width was 16.94 mm (KYN05 genotype), the least fruit thickness was 11.99 mm (KYN03 genotype) and the most fruit thickness was 18.44 mm (KYN05 genotype), the least fruit stem thickness was 0.93 mm (KYN03 genotype) and the most fruit stem thickness was 1.80 mm (KYN08 genotype), the least fruit stem length was 7.01 mm (KYN10 genotype) and the most fruit stem length was 11.79 mm (KYN08 genotype) (Table 1).



Table 1. Fruit weight (g), fruit length (mm), fruit width (mm), fruit thickness (mm), fruit stem thickness (mm) and fruit stem length (mm) values of mulberry genotypes

Mulberry/ Genotypes	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fruit thickness (mm)	Fruit stem thickness (mm)	Fruit stem length (mm)
KYN01	4.78±0.22a*	30.48±0.63c	16.01±0.12a	17.31±0.25bc	1.65±0.05ab	7.28±0.54c
KYN02	2.60±0.08d	25.00±0.45d	12.20±0.23c	13.36±0.22e	1.15±0.04e	8.99±0.25bc
KYN03	1.35±0.07e	20.20±0.45e	11.65±0.18c	11.99±0.15f	0.93±0.04f	10.06±0.51ab
KYN04	3.13±0.09c	24.24±0.75d	15.78±0.65a	16.86±0.32c	1.21±0.07e	10.18±1.10ab
KYN05	5.12±0.24a	34.31±2.20ab	16.94±0.23a	18.44±0.23a	1.65±0.05ab	8.68±1.20bc
KYN06	4.18±0.18b	32.36±1.08bc	16.15±0.23a	17.27±0.24bc	1.53±0.06bc	9.20±0.37bc
KYN07	4.66±0.22ab	31.54±0.90bc	16.64±0.50a	18.07±0.20ab	1.72±0.14ab	9.57±1.08ab
KYN08	4.89±0.26a	35.86±2.07a	13.99±1.25b	17.04±0.44bc	1.80±0.12a	11.79±0.46a
KYN09	2.86±0.13cd	24.52±0.39d	13.55±0.48b	14.79±0.63d	1.24±0.06de	7.14±0.86c
KYN10	2.92±0.15cd	25.18±0.99d	13.69±0.34b	15.12±0.24d	1.43±0.02cd	7.01±0.99c

*Values with different letters in the same column are statistically different (P=0.05).

When the literature studies are examined, Islam et al. (2004) observed the mulberry fruit weight between 2.12 g and 4.72 g in Şebinkarahisar region. Güneş and Çekiç (2004) determined the mulberry fruit weight between 3.15 g and 6.88 g in the Tokat region. Polat (2004) reported mulberry fruit weight between 1.13 g and 4.25 g in Antakya district of Hatay province. Sümerli and Kazankaya (2020) examined the mulberry fruit weight between 0.54 g and 4.09 g in their study on mulberry trees in the central district of Batman. Pınar et al. (2018) reported mulberry fruit weight between 0.82 g and 4.27 g in their study on mulberry. Orhan (2009) recorded mulberry fruit weight between 1.36 g and 5.77 g in his study in Olur and Oltu districts. Yılmaz (2004) examined the mulberry fruit weight between 2.96 g and 6.42 g in his study on mulberry trees in Adana province. Keskin (2016) observed mulberry fruit weight between 1.92 g and 5.27 g in his research in Gümüşhane region. Yılmaz et al. (2012) examined mulberry fruit weight between 0.66 g and 3.07 g in their study on mulberry trees in Malatya region. Hashemi and Khadivi (2020) observed mulberry fruit weight between 0.94 g and 2.86 g in their study on the morphological and pomological characteristics of mulberry. Considering some other literature studies on mulberry fruit weight, it was examined as 1.38-2.62 g by Çam (2004), as 1.46-2.32 g by Aslan (1998), as 4.5-8.2 g by Özgen et al. (2009). When the literature on fruit length is examined, Islam et al. (2004) observed mulberry fruit length between 22.6 mm and 32.6 mm in Şebinkarahisar region. Polat (2004) reported mulberry fruit length between 12.84 mm and 23.55 mm in the Antakya district of Hatay province. Güneş and Çekiç (2004) determined the mulberry fruit length between 25.75 mm and 34.85 mm in the Tokat region. Sümerli and Kazankaya (2020) examined the mulberry fruit length between 13.30 mm and



32.60 mm in the central district of Batman. Gündoğdu et al. (2012) reported mulberry fruit length between 12.66 mm and 19.52 mm in their study in the Van Lake basin. Pınar et al. (2018) examined mulberry fruit length between 17.37 mm and 29.49 mm in their study on mulberry. Orhan (2009) stated the mulberry fruit length between 19.75 mm and 31.03 mm in his study in the Olur and Oltu districts. Yılmaz (2004) examined the mulberry fruit length between 2.20 mm and 3.43 mm in his study on mulberry trees in Adana province. Keskin (2016) observed mulberry fruit length between 19.28 mm and 33.95 mm in his research in Gümüşhane region. Hashemi and Khadivi (2020) reported mulberry fruit length between 14.35 mm and 26.98 mm. Considering the studies on fruit width, Islam et al. (2004) studied mulberry fruit width between 13.7 mm and 20.0 mm in Şebinkarahisar region. Polat (2004) reported the mulberry fruit width between 7.36 mm and 16.85 mm in the Antakya district of Hatay province. Güneş and Çekiç (2004) determined the mulberry fruit width between 15.32 mm and 21.28 mm in the Tokat region. Sümerli and Kazankaya (2020) examined the mulberry fruit width between 10.17 mm and 20.96 mm in their study on mulberry trees in the central district of Batman. Gündoğdu et al. (2012) reported the fruit width of mulberries in the Van Lake basin region between 6.65 mm and 10.11 mm. Pınar et al. (2018) reported mulberry fruit width between 10.87 mm and 17.20 mm in their study on mulberry. Orhan (2009) observed the width of mulberry fruit between 9.97 mm and 17.36 mm in his study in Olur and Oltu districts. Yılmaz (2004) examined the mulberry fruit width between 1.50 mm and 2.10 mm in his study on mulberry trees in Adana province. Keskin (2016) observed mulberry fruit width between 11.85 mm and 18.23 mm in his research in Gümüşhane region. When the studies on fruit stem thickness were examined, Sümerli and Kazankaya (2020) examined the mulberry stem thickness between 0.98 mm and 1.69 mm in their study on mulberry trees in the central district of Batman.

When the studies on fruit stem length were examined, Islam et al. (2004) reported the length of mulberry fruit stem between 6.5 mm and 35.9 mm in Şebinkarahisar region. Polat (2004) reported the mulberry fruit stem length between 2.54 mm and 7.23 mm in the Antakya district of Hatay province. Sümerli and Kazankaya (2020) examined the mulberry fruit stem length between 3.5 mm and 23.30 mm in the central district of Batman. Pınar et al. (2018) observed mulberry fruit stem length between 1.29 mm and 7.42 mm in their study on mulberry.

In Table 2, leaf length, leaf width, petiole thickness and petiole length values were examined. According to the average results obtained, the least leaf length was 12.46 cm (KYN08 genotype) and the most leaf length was 17.56 cm (KYN01 genotype), the least leaf width was 8.38 cm (KYN08 genotype) and the most leaf width was 15.30 cm (KYN01 genotype), the least



petiole thickness was 2.07 mm (KYN08 genotype) and the most petiole thickness was 3.44 mm (KYN01 genotype), the least petiole length was 27.96 cm (KYN09 genotype) and the most petiole length was 53.30 cm (KYN03 genotype).

Table 2. Leaf length (cm), leaf width (cm), petiole thickness (mm) and petiole length (cm) values of mulberry genotypes

Mulberry/ Genotypes	Leaf length (cm)	Leaf width (cm)	Petiole thickness (mm)	Petiole length (cm)
KYN01	17.56±0.62a*	15.30±0.58a	3.44±0.13a	50.85±2.99a
KYN02	15.00±0.36abc	9.58±0.14cde	2.47±0.06cd	43.66±1.43abc
KYN03	13.03±1.53c	9.63±0.60cde	2.21±0.12cd	53.30±2.51a
KYN04	15.32±0.71abc	10.62±1.26cd	2.48±0.15cd	36.09±0.64cd
KYN05	13.82±1.62bc	11.78±1.09bc	2.50±0.13cd	44.36±5.10abc
KYN06	16.73±1.55ab	13.18±1.08ab	2.77±0.32bc	46.91±4.64ab
KYN07	14.68±1.66abc	13.50±0.93ab	3.37±0.48ab	40.72±4.01bc
KYN08	12.46±0.82c	8.38±0.54e	2.07±0.14d	40.51±6.12bc
KYN09	12.78±1.14c	8.84±0.52de	2.31±0.12cd	27.96±2.66d
KYN10	14.06±0.75bc	9.62±0.46cde	2.55±0.11cd	36.24±1.63cd

*Values with different letters in the same column are statistically different (P=0.05).

Sümerli and Kazankaya (2020) determined mulberry leaf length as 6.63 cm and 15.9 cm, mulberry leaf width as 3.91 cm and 11.69 cm, and mulberry petiole thickness as 1.39 mm and 2.98 mm in mulberry fruit. When the literature on petiole length is examined, Sümerli and Kazankaya (2020) reported the mulberry petiole length between 2.28 cm and 4.8 cm in the central district of Batman. Ağca and Ilgın (2017) examined the mulberry petiole length between 26.74 mm and 37.6 mm in their study on mulberry in different regions of Turkey.

In Table 3, water soluble dry matter (SSC), titratable acidity (TA), SSC/TA ratio and pH values were examined. According to the average results obtained, the least SSC was 9.47% (KYN07 genotype) and the most SSC was 20.93% (KYN10 genotype), the least TA was 1.24% (KYN06 genotype) and the most TA was 5.58% (KYN04 genotype), the least SSC/TA ratio was 2.21 (KYN04 genotype) and the most SSC/TA ratio was 14.67 (KYN10 genotype), the least pH was 4.13 (KYN04 genotype) and the most pH was 5.86 (KYN10 genotype).



Table 3. Water soluble dry matter (SSC), titratable acidity (TA), SSC/TA ratio and pH values of mulberry genotypes

Mulberry/Genotypes	SSC (%)	TA (%)	SSC/TA	pH
KYN01	12.07±1.07def*	2.62±0.27bc	4.75±0.16de	5.79±0.05ab
KYN02	15.13±0.48bc	1.83±0.09c-f	8.26±0.87bc	5.52±0.11b
KYN03	12.73±0.44cde	3.06±0.10b	4.13±0.11ef	4.52±0.02d
KYN04	11.73±0.48def	5.58±0.52a	2.21±0.24f	4.13±0.13e
KYN05	13.97±1.09bcd	2.28±0.07b-e	6.61±0.14cd	4.63±0.11d
KYN06	10.63±0.30ef	1.24±0.01f	8.38±0.09bc	5.51±0.14b
KYN07	9.47±0.35f	1.67±0.36def	6.21±1.48d	5.12±0.17c
KYN08	11.80±1.64def	2.52±0.58bcd	5.56±1.04de	4.78±0.10d
KYN09	16.00±0.31b	1.82±0.01c-f	8.70±0.20b	5.52±0.02b
KYN10	20.93±1.37a	1.52±0.01ef	14.67±0.16a	5.86±0.07a

*Values with different letters in the same column are statistically different (P=0.05).

Özdemir and Topuz (1998) investigated some chemical properties of mulberries grown in the Antalya region and found the fruit SSC between 11.40% and 26.60%. Güneş and Çekiç (2004) determined the mulberry fruit SSC of Tokat region between 12.40% and 18.60%. Islam et al. (2004) observed the mulberry fruit SSC in Şebinkarahisar region between 15.3% and 23.8%. Polat (2004) reported the mulberry fruit SSC in the Antakya district of Hatay province between 13.73% and 16.01%. Çam (2004) examined the mulberry fruit SSC of Edremit and Gevaş regions between 16.62% and 19.16%. Pınar et al. (2018) reported mulberry fruit SSC between 16.20% and 29.60% in their study on mulberry. Yılmaz (2004) reported the mulberry fruit SSC between 9.30% and 26.2% in his study on mulberry trees in Adana province. Orhan (2009) examined the mulberry fruit SSC between 13.2% and 23.1% in his study in the Olur and Oltu districts. Yılmaz et al. (2012) reported mulberry fruit SSC between 17.33% and 30.67% in their study on mulberry trees in Malatya region. Keskin (2016) reported the SSC of mulberry fruit between 14.8% and 24.4% in his research in Gümüşhane region. Hashemi and Khadivi (2020) examined mulberry SSC between 7.7% and 25.8%. When literature studies are examined in terms of TA value, Islam et al. (2004) observed mulberry fruit TA between 1.21% and 2.17% in Şebinkarahisar region. Polat (2004) examined the mulberry fruit TA between 0.06% and 1.0% in the Antakya district of Hatay province. Çam (2004) reported mulberry fruit TA between 0.167% and 0.264% in Edremit and Gevaş regions. Pınar et al. (2018) stated that the TA of mulberry fruit was between 0.06% and 0.37% in their study on mulberry. Yılmaz (2004) reported TA of mulberry fruit between 0.04% and 1.31% in his study on mulberry trees in Adana province. Yılmaz et al. (2012) reported the TA of mulberry fruit between 0.06% and 1.62% in their study on mulberry trees in Malatya region. Keskin (2016) examined the TA of mulberry fruit between 0.02% and 0.07% in his research in Gümüşhane region. When the



literature studies were examined in terms of pH value, Özdemir and Topuz (1998) found the fruit pH between 3.74 and 5.65. Polat (2004) investigated the pH of mulberry fruit between 4.39 and 6.29 in Antakya district of Hatay province. Çam (2004) observed the pH of mulberry fruit between 6.2 and 7.4 in Edremit and Gevaş regions. Pınar et al. (2018) reported the pH of mulberry fruit between 1.6 and 6.18 in their study on mulberry. Yılmaz (2004) reported the pH of mulberry fruit between 2.29 and 6.21 in his study on mulberry trees in Adana province. Yılmaz et al. (2012) reported the pH of mulberry fruit between 2.19 and 5.86 in their study on mulberry trees in Malatya region. Keskin (2016) reported the pH of mulberry fruit between 5.67 and 6.59 in his research in Gümüşhane region.

When the color values of mulberry fruit were examined, it was determined that the L* value changed between 13.41 (KYN03 genotype) and 42.78 (KYN06 genotype) values. While the L* value expresses the brightness values of the fruits, it varies between 0-100. An L* value of 0 indicates that the color of the products is black, that is, there is no reflection, while an L* value of 100 indicates that the color value is white, that is, the reflection is complete. When the chroma value was examined, it was determined that it was between 0.6 (KYN03 genotype) and 8.86 (KYN05 genotype). Chroma value refers to the shade of fruit color. With a low chroma value, pale fruit colors are seen, with a high value, vivid fruit colors are seen. When the Hue value was examined, it was determined that it was between 16.00 (KYN02 genotype) and 84.94 (KYN01 genotype). The Hue value makes it easy to see the colors corresponding to each angle in a 360° color radiant. Accordingly, it indicates as 0° is red color, as 90° is yellow color, as 180° is green color, as 270° is blue color. In the parts between these angle values, it is seen that intermediate colors are formed in the fruits. As the values increase in a* value, which is another color parameter in fruits, the red color tone becomes dominant. As the values decrease, the green color tone becomes dominant. The a* value was found to be between 0.47 (KYN03 genotype) and 4.13 (KYN08 genotype). As the b* value increases, the yellow color tone becomes dominant. As the values decrease, the blue color tone becomes dominant in the fruits. The b* value was found to be between 0.29 (KYN10 genotype) and 8.56 (KYN05 genotype) values (Table 4).



Table 4. Color (L*, a*, b*, Chroma and Hue) values of mulberry genotypes

Mulberry/Genotypes	L*	a*	b*	Chroma	Hue
KYN01	42.17±1.37a*	0.74±0.06cd	8.46±0.77a	8.50±0.77a	84.94±0.78a
KYN02	13.97±0.25d	1.14±0.18c	0.36±0.14c	1.21±0.21c	16.00±4.65d
KYN03	13.41±0.75d	0.47±0.02d	0.35±0.09c	0.60±0.03c	35.47±7.73b
KYN04	14.86±0.30d	0.91±0.17cd	0.33±0.01c	0.97±0.16c	21.54±3.56bcd
KYN05	37.89±0.36b	2.19±0.16b	8.56±1.22a	8.86±1.18a	75.22±1.96a
KYN06	42.78±0.97a	0.85±0.09cd	8.51±0.18a	8.56±0.18a	84.32±0.56a
KYN07	41.37±2.49a	1.00±0.10cd	7.26±0.81a	7.33±0.80a	81.68±1.53a
KYN08	19.24±0.44c	4.13±0.36a	2.94±1.06b	5.28±0.51b	33.93±10.42bc
KYN09	14.67±0.23d	1.15±0.43c	0.39±0.09c	1.22±0.44c	20.41±2.97cd
KYN10	14.34±1.46d	0.78±0.04cd	0.29±0.06c	0.85±0.02c	21.36±4.71bcd

*Values with different letters in the same column are statistically different (P=0.05).

In the study, when all the above literature study samples were examined in terms of the parameters related to mulberry fruit and leaf characteristics, similar data were obtained in this study and literature case studies in all of the fruit weight, fruit stem thickness, fruit stem length, leaf height, leaf width, petiole thickness and SSC values. On fruit length and fruit width, except for studies of Gündoğdu et al. (2012) and Yılmaz (2004), similar data were found between this study and all literature samples. In external studies, less fruit length and fruit width were determined compared to this study. In all of the literature samples examined on petiole length, different results were obtained than the petiole length data determined in this study, and a lower petiole length was determined in the examined literature samples compared to this study. On the other hand, some of the literature samples examined on fruit TA have similar results with the TA data of this study, and a lower percentage of TA was found in the other part of the literature sources compared to this study. Regarding fruit pH, similar results were obtained with the pH value of this study in all other studies, except only Çam (2004) (which has a higher pH value). When a general evaluation is made in accordance with all these determinations, while the majority of the examined literature samples have reached similar results with the data of this study, different results have been determined in some literature study samples. It is thought that this situation observed in the study may be related to many factors such as working on different mulberry species and the growth of fruits in different climatic and ecological conditions.

4. CONCLUSION



The genotypes selected as cultivar candidates in this study are valuable both in terms of their pomological and chemical properties and in terms of their good adaptation to the ecology they are in, and it is very important to protect such genotypes that can contribute to the existing plant gene resources in our country. In terms of the highest values in the parameters related to fruit quality in cultivar candidate genotypes, fruit weight was 5.12 g, fruit width was 16.94 mm, fruit length was 35.86 mm, fruit thickness was 18.44 mm, fruit stem thickness was 1.80 mm, fruit stem length was 11.79 mm, fruit SSC was 20.93%, fruit pH was 5.86, and fruit TA was 5.58%. In terms of the highest values in fruit color parameters, L* value was 42.78, a* value was 4.13, b* value was 8.56, Chroma value was 8.86, Hue value was 84.94. The highest values in leaves were observed as 17.56 cm in leaf length, 15.30 cm in leaf width, 3.44 mm in petiole thickness, and 53.30 cm in petiole length. In line with the data determined in the study, KYN01, KYN08 and KYN10 genotypes became prominent genotypes compared to other genotypes. As a result, it is thought that the protection and reproduction of these promising genotypes as gene source material is important for breeding studies.



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**INFLUENCE OF TEACHERS' PROFESSIONAL AND CAREER DEVELOPMENT
PROGRAMS ON SECONDARY SCHOOL BIOLOGY TEACHERS' PRODUCTIVITY
IN NIGER SOUTH SENATORIAL ZONE OF NIGER STATE**

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ABSTRACT

The study investigated the Influence of Teachers' Professional and Career Development Programs on Secondary School Biology Teachers' Productivity in Niger South Senatorial Zone of Niger State. Survey research design was employed for the study. A total of 301 biology teachers in Niger south senatorial zone made up the sample size of the study. Researchers' designed questionnaire which was validated by experts in field of teachers' professional and career development unit was used for data collection. Pilot test was conducted and reliability coefficient of 0.76 was obtained. A research questions which was answered using mean and standard deviation guided study. The study revealed that professional and career development program significantly influenced the biology teachers' productivity. Recommendations were made that Government should organize different type of Professional and Career Development programs for all teachers in form of seminars, conferences or workshops. Non-Governmental Organizations (NGOs) should also be encouraged to contribute in providing professional and career development programs to our teachers. Also, teachers should be promptly motivated at all levels of Nigeria educational sector.

Keywords: Career, development, influence, professional, programs and senatorial



INTRODUCTION

Quality education depends on the quality of the teachers saddled with the responsibility of implementing the curriculum of their respective subject of instruction. This implies that teachers must be professionally qualified to be able to effectively offer a quality instructional delivery which is one objectives of the National Policy on Education (FGN, 2014). Quality of knowledge acquired by learners in a nation is solely dependent on the quality of its teachers since the teachers are the agents that transmits knowledge to the students, evaluate the learning out-come of the students and also help the students overcome misconceptions and learning difficulties faced during learning (Bennet, 2005). Quality of education therefore has a significant influence on the national development. Lawal (2011), sees a teacher as a person who influence the learner by what they say, what they do and how they do it. This is because teachers have direct contact with the students in the classroom. It is therefore, necessary to intermittently look into teachers' professional and career development programs in order to improve teachers' instructional strategy that would lead to effective teaching and adequate curriculum implementation by teachers as well as meaningful learning among students in our secondary schools. Unfortunately, most teachers teaching at our secondary school level of education are not professional teachers especially in the area of science education. This is one of the major factors responsible for teachers' poor productivity and students' poor performance. Such teachers need to possess prerequisite teaching qualification so as to be able to properly impart knowledge to student (Shopelu *et al.*, 2021).

It is also observed by the chief examiners' report on Senior School Certificate Examination (SSCE) conducted by National Examination Council (NECO, 2021) that, poor teaching of biology by most biology teachers at Senior Secondary School level is due to lack of qualified teachers to handle biology curriculum, poor instructional strategies used by biology teachers and teachers' poor mastery of subject matter. Lack of professional biology teachers to be employed by Ministry of Education to teach at secondary school level has forced the available ones to adopt a poor instructional strategy which is one of the major factors contributing to poor performance of biology students (Aliyu *et al.*, (2018a). This result to poor teachers' poor productivity and poor job performance, hence the need for continuous professional and career development programs for biology teachers. In addition, most biology teachers at secondary school use the traditional chalk and talk or conventional teaching strategy. This is mainly a classroom-based strategy consisting of lectures and direct instructions from teachers to students



(Koroka *et al.*, 2018). The strategy is teacher-centered involving learning through the teachers' guide at all times. Students are expected to listen to lectures and hence, learn little from the lecture. The teachers mostly talk to the students instead of encouraging them to interact, ask questions, or make them comprehend the lesson thoroughly especially in too large classes (Ahmed, 2013). This strategy promotes rote learning, where students depend on memorization without having a proper comprehension of the topic they are taught (Ayeni, 2010). Teachers therefore do not prepare adequately for teaching as most of them are not professionally trained resulting to poor teaching and learning.

However, to be able to come up with proper instructional strategy that will promote and enhance effective teaching of biology concepts by the biology teachers, increase and speed up the conceptual comprehension of the students and enhance biology teachers' productivity and job performance. Teachers' Professional and Career Development (PCD) program is one of the areas that Government and Non- Governmental Organizations (NGOs) must pay attention to with the view of improving biology teachers' instructional strategies, proper curriculum implementation and students' better performance Koroka *et al.*, (2018). This therefore calls for the need to have standard Professional and Career Development program (PCD) programs especially for biology teachers.

Professional and Career Development (PCD) program is a process by which teachers are continually trained in subject content mastery, update their pedagogy, classroom management strategies and cultural value orientation of the local community where they are expected to teach. Furthermore, Professional and Career Development (PCD) program can be referred to as the process by which teachers are trained to acquire both content knowledge and pedagogical knowledge and skills necessary for effective teaching as stated by Niger State Ministry of Education (NGMOE, 2016). It is on the basis of this that, this study attempts to assess the Influence of Teachers' Professional and Career Development Programs on Secondary School Biology Teachers' Productivity and job performance.

One of the ways by which this can be achieved is by focusing on the provision of professional and career development programs and continuously exposing teachers to the programs. In addition, teachers must have the ability and the willingness to teach and also ready to learn from students' prior experiences.

Government at both Federal and State levels must be proactive in providing teachers with facilities that would enable them undergo periodic but continuous training or retraining programs, workshops, seminars, conferences and refresher courses in order to keep them



updated in their various subject content mastery and pedagogical skills. One of the ways by which unprofessional teachers can be professionally equipped for meaningful classroom instruction is through training and retraining programs like In-service training services. An in-service training service ensures that teachers are kept up to date and adequately empowered to offer quality instructional delivery. This is because pre-service training received before employment might not perfectly prepare them for effective productivity and job performance. Therefore, many teachers sought the opportunity of in-service training services as a means of further professional and career development.

Review of empirical studies reveals that, Aliyu *et al.*, (2018a) conducted a research study on the types of Continuous Professional Career Development do Basic Science and Technology teachers receive in Bida Educational Zone which reveals that, there is no any formal type of Continuous Professional Career Development Receive by Basic Science and Technology Teachers in Bida Educational Zone of Niger State to enable them effectively implement the Basic Science and Technology Curriculum. Also, Olalere *et al* (2019) reported that, as a result of lack of both intrinsic and extrinsic motivation of teachers by government at all levels of our education system, teachers' training Institutions have not been able to provide quality training to potential teachers during training. Also school management has failed to provide teachers especially the science teachers with periodic Continuous Professional Career Development (CPCD) due to lack of motivation.

Objective of the Study

The aim of this study is to determine the Influence of Teachers' Professional and Career Development Programs on Secondary School Biology Teachers' Productivity during classroom instruction in Niger South Senatorial Zone of Niger State, Nigeria. The specific objective to be achieved is to determine:

- i. the influence of teachers' professional and career development programs on secondary school biology teachers' productivity

Research Question

Based on the above objectives of the study, the following research questions were raised and answered using mean and standard deviation:

- i. what is influence of teachers' professional and career development programs on secondary school biology teachers' productivity?



METHODOLOGY

The research design used for the study is survey research design. The population of this study comprised of all the 301 (146 Male) and (155 Female) biology teachers in Niger South Senatorial Zone of Niger State. All the biology teachers in all the senior secondary schools in Niger South Senatorial Zone of Niger State were used for the study. The research instrument used for this study is a questionnaire designed by the researchers for the purpose of this study. The questionnaire is known as the Biology Teachers' Professional and Career Development Questionnaire (BTPCQ). The questionnaire is a 5-Likert point scale which is: Strongly Agree (SA), Agree (A), Undecided (UD), Disagree (DA) and Strongly Disagree (SDA). The weighing are: Strongly Agree (SA) = 5, Agree (A) = 4, Undecided (UD) =3, Disagree (DA) =2 and Strongly Disagree (SD) =1. For decision rule, an arithmetic Mean (\bar{x}) was computed ($5 + 4 + 3 + 2 + 1 = 15/5 = 3.00$). The questionnaire (BTPCQ) was validated by experts in the field of biology and pedagogy. Their observations, suggestions and recommendations were used to produce the final copy of the instrument used for this study. Also, the instrument was pilot tested 0.76 was obtained indicating that the instrument is reliable and used for this study.

The researchers visited all the nineteen schools used for the study to seek permission from the school authorities to use their schools for the study. The researchers after been granted the permission gave orientation to the teachers about the research study. All the biology teachers in all the schools were used for the study. The data collected using Biology Teachers' Professional and Career Development Questionnaire (BTPCQ) was analyzed using Mean and Standard Deviation.

RESULT AND DISCUSSION

Answers to Research Question

Research Question: What is influence of teachers' professional and career development programs on secondary school biology teachers' productivity? To answer this research question, mean and standard deviation was used as presented in Table 1.



Table 1: Mean and Standard Deviation on Influence of Teachers' professional and career development programs on secondary school biology teachers' productivity
As a biology teacher, these are the type of Professional and Career Development Programs (PCDP) I have being exposed to and which have significantly and positively influenced my productivity during classroom instruction.

S/ N	Items	N	Mean (X)	S.D	Decision
1	Seminar is the only type of PCDP I have being exposed to as a biology teacher	301	4.51	1.01	Agree
2	Workshop training is the only type of PCDP I have being exposed to as a biology teacher	301	4.52	1.02	Agree
3	Conference is the only type of PCDP I have being exposed to as a biology teacher	301	3.66	0.16	Agree
4	In-Service training is the only type of PCDP I have being exposed to as a biology teacher	301	3.58	0.08	Agree
5	As a biology teacher, I have being exposed to Seminars, Workshops, Conferences and In-Service training	301	3.97	0.47	Agree
Grand Mean Total			4.05	0.55	Agree

Table 1 shows the mean and standard deviation of Influence of Teachers' professional and career development programs on secondary school biology teachers' productivity in Niger south senatorial zone of Niger State. The table reveals that, the lowest mean is 3.58 (with Standard Deviation of 0.08) which is higher than the decision mean of 3.00. Also, the grand mean total is 4.05 with Standard Deviation of 0.55 which is also higher than the decision mean of 3.00. This result therefore, indicates that teachers' professional and career development programs has a significant influence on secondary school biology teachers' productivity in Niger south senatorial zone of Niger State.

Finding of the Study

Analysis of the Research question reveals that, Biology teachers in Niger south senatorial zone of Niger state are always exposed to different type of professional and career development programs which have significantly influenced their productivity during classroom instruction

Discussion of the Finding

Finding of research question on influence of teachers' professional and career development programs on secondary school biology teachers' productivity reveals that biology teachers in



Niger south senatorial zone of Niger state are always exposed to different type of professional and career development programs which have significantly influenced their productivity during classroom instruction. This finding is not in agreement with finding of Aliyu *et al.*, (2018a) who reported that, there is no any formal type of Continuous Professional Career Development Receive by Basic Science and Technology Teachers in Bida Educational Zone of Niger State to enable them effectively implement the Basic Science and Technology Curriculum. The finding is also not in agreement with the finding of Aliyu *et al.*, (2018b) who in another study reported that, government and school management have not been adequately providing teachers especially the science teachers with periodic Continuous Professional Career Development (CPCD) in form of seminars, workshops, conferences or regular in-service training.

RECOMMENDATIONS

Based on the finding of the study, the following recommendations are made.

1. Biology teachers should be subjected to periodic teachers' professional and career development programs
2. Government should organize different type of professional and career development programs for secondary school teachers in form of seminars, conferences or workshops nationwide.
3. Non-Governmental Organizations should be encouraged to contribute in providing professional and career development programs for the secondary school teachers nationwide.



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SULU VE KURU KOŞULLARDA ASPIRDE (*Carthamus tinctorius* L.) FARKLI ÇEŞİTLERİN FARKLI SIRA ÜZERİ MESAFELERİN VERİME VE YAĞ ORANINA ETKİLERİNİN BELİRLENMESİ

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ÖZET

Bu araştırma aspir (*Carthamus tinctorius* L.) bitkisinde sulanan ve sulanmadan yetiştirilen 4 tescilli çeşitin (Hasankendi, Koç, Linas ve Olas) farklı sıra üzeri mesafelerdeki ekiminden elde edilen verim ve ham yağ oranının belirlenmesi amacıyla yürütülmüştür. Araştırma, Yozgat ili Yerköy ilçesinde 2021 yılında Tesadüf Bloklarında Bölünen Bölünmüş Parseller Deneme Desenine göre 4 tekrarlamalı olarak yürütülmüş olup; ana parsellerde sulama, alt parsellerde çeşitler, altın altı parsellerde ise 10, 15, ve 20 cm sıra üzeri mesafeler yer almıştır. Araştırmada sulanan parsellerdeki bitkilere sapa kalkma ve çiçeklenme başlangıcı olmak üzere iki defa sulama yapılmıştır. Kuru parsellerdeki bitkiler ise doğal şartlar altındaki yağışlarla yetiştirilmiştir. Araştırma sonuçlarına göre tohum veriminde sulama, çeşit, sıklık, ve çeşitxsıklık interaksyonu istatistiki olarak önemli bulunmuştur. Çalışmada kuru alanlarda verim en yüksek 190.5 kg/da, en düşük ise 91.7 kg/da; sulanan alanlarda ise en yüksek 249 kg/da, en düşük ise 173 kg/da olarak bulunmuştur. Yağ oranında sulama, çeşitxsulama interaksyonu, çeşitxsıklık ve sulamaxçeşitxsıklık interaksyonu istatistiki olarak önemli bulunmuştur. Yağ oranı ortalamaları değerlendirildiğinde kuru alanlarda ham yağ oranı %37.48- %33.15 arasında ölçülmüştür. Sulamalı şartlarda ham yağ oranı en yüksek %37.15, en düşük %33.15 olarak bulunmuştur.

Anahtar Kelimeler: Aspir, sulama sıra üzeri mesafe, verim, yağ oranı



**DETERMINATION OF THE EFFECT OF DIFFERENT VARIETIES IN
SAFFLOWER (*Carthamus tinctorius* L.) UNDER IRRIGATED AND WITHOUT
IRRIGATION TREATMENTS ON SEED YIELD AND CRUDE OIL RATIO**

ABSTRACT

This research was performed to determine the safflower (*Carthamus tinctorius* L.) seed yield and crude oil ratio obtained under the irrigated and grown non-irrigated treatments with four safflower varieties (Hasankendi, Koç, Linas and Olas) at three different intra-row spacing. In Yerköy, Yozgat, randomized block split-split plot design with four replications was applied in 2021. Irrigation (irrigated and non-irrigated) were the main plots, varieties (Hasankendi, Koç, Linas, and Olas) were the sub-plots, and intra-row spacings (10, 15, and 20 cm) were the sub-sub plots. In the irrigated plots, plants were irrigated twice (at the stem elongating and at the beginning of flowering stages). In the non-irrigated or dry plots, plants were grown with precipitation under natural conditions. The research results showed that the interaction of irrigation, variety, intra-row spacing, and variety x intra-row spacing interaction for seed yield was found to be statistically significant. The highest average seed yield of 190.5 kg/da and the lowest 91.7 kg/da were obtained in non-irrigated plots. Under irrigation, the highest seed yield was found as 249 kg/da and the lowest was 173 kg/da. Irrigation, variety x irrigation interaction, variety x intra-row spacing and irrigation x variety x intra-row spacing interaction were found to be statistically significant. The highest average crude oil ratio was 37.48% and the lowest was 33.15% in non-irrigated plots. Under irrigation, the highest crude oil ratio was found 37.15% and the lowest oil ratio was 33.15%.

Keywords: Safflower, irrigation, intra-row spacing, seed yield, oil ratio



1. INTRODUCTION

Safflower (*Carthamus tinctorious* L.), a member of the Asteracea family and grown for the quality cooking oil in its main seeds today, is thought to be an ancient plant that was used to make crowns from flowers in Egypt 3000 years ago BC and was cultured in the Middle East(Dajue & Mündel, 1996; Mündel et al., 1987).

Considering the agricultural system and ecological conditions applied in our country, there have been rapid increases in the production areas of safflower, which is resistant to cold and drought(Akınerdem, 2011).

In all other areas of our country except the Black Sea region, global warming, temperature, increase in evapotranspiration, decreases in spring and summer rainfall will lead to decreases in the yield and production areas of summer crops and pastures. For this reason, there is a possibility that the amount of irrigation water needed by the plants will double . Even if the plant is supplied with irrigation water, it is expected that there will be a decrease in its yield planted in the spring, as critical periods (such as flowering and grain filling) will face temperatures at a high degree and for a long time (Kadioğlu et al., 2017). In addition to being drought resistant, safflower is significantly increased in yield when irrigated during critical vegetative periods. It is reported that the most critical phase of safflower for seed yield is the period of elongation uptake and the beginning of flowering. Additional irrigation during critical periods of soil moisture and severe drought increases safflower yield(Beyyavas & Dogan, 2022; Omidi et al., 2012; Santos et al., 2018)

When the F.A.O. records are examined, 1,953,162 tons of vegetable crude oil was imported in Türkiye in 2021 and the total value was 2.332.914.000 U.S. Dollars In the same year, Türkiye imported 3,563,275.02 tons of oilseeds and in return for 2.369.785.980 U.S. dollars and 1.871.983 tons of cake for 734.360.000 U.S. dollars imported. When these values are added up, 4.776.135.980 U.S. dollars have met its needs by importing oilseeds, crude oil, and cake.(Anonymous, 2023).

While 18 tons of safflower was produced in Turkey in 2000 and 215 tons in 2005, 26,000 tons in 2010, 70,000 tons in 2015 and 16,200 tons in 2021(Anonymouse, 2023) While production increased 325 times in ten years after 2005, a partial decrease began after 2016. The most important reason for this is the lack of a market and negative propaganda as it affects grain agriculture (Akınerdem, 2010)



Due to the effects of climate change, it is foreseen that the severity of the drought will increase in the areas dominated by Turkey's dry agricultural system and that there may be a decrease in the current production. It is thought that there may be decreases in irrigated areas due to lack of rainfall in Turkey and as a result, there will be contractions in production. At this point, safflower is thought to be one of the important oil plants that will contribute to the solution of the problems that may occur in the future and to eliminate the existing oil deficit. Even so, safflower has started to be produced all over Anatolia to meet the producer's own oil needs, and commercial cold pressing facilities have been established for this.

It is aimed to determine the most appropriate yield and oil ratio of safflower, which is known to be very high in drought resistance due to changing climatic conditions due to reasons such as global warming and climate change, which has not been tried in non- irrigated and irrigated areas before.

2. MATERIAL AND METHOD

This study was carried out in Yozgat-Yerköy district by using Koç, Linas, Hasankendi and Olas safflower varieties as materials.

The place where the research is carried out is hot and dry, with a typical continental climate, and cold and rainy winters. Table 2.1 of the climate data for 2021 and many years of the months in which the research was conducted is given.

Table 2.1. Many years (1991-2021) climate data of the research site

Months	Temperature (°C)		Precipitation (mm)		Moisture (%)	
	2021	Avg.	2021	Avg.	2021	Avg.
February	4.0	2.4	5.2	30.8	61.0	66.7
March	5.0	6.9	78.8	39.4	67.0	57.9
April	12.9	11.9	19.8	42.4	54.6	54.4
May	19.2	16.6	3.8	54.6	42.5	53.9
June	19.3	20.6	67.8	36.4	57.8	49.7
July	24.9	24.1	11.6	17.1	42.7	42.6
August	24.5	24.1	8.4	14.7	44.3	43.4

At the place where the research was carried out, it was determined that the soil (0-30 cm) was sandy, alkaline, calcareous, low organic matter, nitrogen grade was good, phosphorus was moderate, potassium, calcium, magnesium was high, iron medium, zinc, manganese and copper amount was low.



The sowing is set to be 25 cm between the rows by closing one out of every two rows with the combined sowing. Fertilization (3.6 kg/da N, 9.2 kg/da P₂O₅) was done with the seed. The amount of seed was determined to be 15 kg / da according to the norm of the parcel, and the distances above the wort were adjusted according to the trial plan during weeding. The weed control was mechanically done by hand twice, after the emergence and during the rosette leaf period. Chemical struggle against *Bangasternus spp.* and *Myzus persicae* L. has been applied 2 times, including the start of at elongation and beginning flowering.

A total of 800 ml/m² additional water was given to the irrigated parcels by sprinkler method, including water at elongation (400 ml/m²) and at the beginning of flowering (400 ml/m²).

Harvesting was done by cutting the plants with a scythe. The cut stalks were processed collectively in each parcel in the threshing machine and the seeds were taken. In the cleaned seeds, the yield was calculated by converting to kg/decare. The crude oil content was determined in the Soxhlet device.

3. Research Results and Discussions

Seed yield: The average seed yield in non- irrigated and irrigated areas obtained from the results of this research is given in Table 3.1, and the seed yield averages and statistical difference groups related to irrigation x variety interaction are given in Table 3.2.

Table 3.1. Means of seed yield in dry and irrigated areas (kg/da)

Non-irrigated Area	147.8 b
Irrigated Area	211.5 a

Table 3.2. Irrigation x variety interaction seed yield (kg/da) means and L.S.D difference groups

Interaction	Variety	10 cm	15 cm	20 cm	Mean
Variety X Intra-row spacing	Hasankendi	182.5 b A	173.2 bc A	119.8 b B	158.5 b
	Koç	165.7 b A	148.3 c A	142.8 b A	152.3 b
	Linaz	217.6 a A	189.7 ab A	212.9 a A	206.7 a
	Olas	215.5 a A	202.2 a AB	185.3 a B	201.0 a
	Mean	195.3 A	178.3 B	165.2 B	179.6

*Groups classified with the same lowercase letter have no importance level among them in the table column.

*Groups classified with the same capital letter have no importance level between them in the table row

*L.S.D. VXIntrarow space= 28.76

When Table 3.1 and Table 3.2 were examined, irrigation, variety, intra-row spacing (1%) and intra-row spacing x variety interaction (5%) of seed yield were found to be important in the statistical negligence limit.



While the general average of irrigated varieties was 211.5 kg/da, the general average of dry agricultural parcels without irrigation was obtained at 147.8 kg/da. The highest yield was obtained from Linas (206.7 kg/da) and the lowest from Koç (152.3 kg/da).

When the varieties are evaluated among themselves at a distance between each intra row spacing in seed yield; The highest Linas (217.6 kg/da) and the lowest Koç 165.7 (kg/da) at 10 cm were obtained and two different levels of significance were found. The highest yield at 15 cm was obtained from Olas with 202.2 kg/da and the lowest yield was obtained from Koç with 148.3 kg/da and three different levels of importance were found. The highest Linas 206.7 kg/da and the lowest Hasankendi variety 119.8 kg/da were obtained at 20 cm and two different groups were identified. In Figure 3.1, the varieties at the above intra row spacing distances of seed yield are shown in the graph.

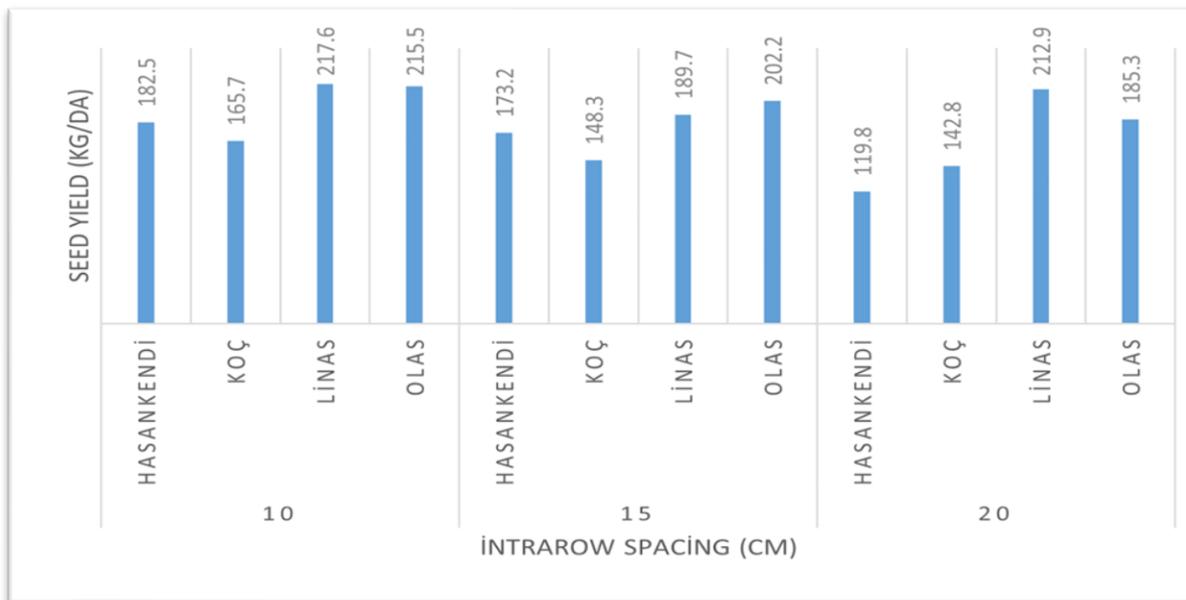


Figure 3.1. Graphical representation of varieties at intra row distances of seed yield

In the research, when the varieties are evaluated at different intra row space distances; Hasankendi was obtained from the highest 10 cm with 182.5 kg/da and the lowest 20 cm at 119.8 kg/da. Koç was obtained from the highest 10 cm with 165.7 kg/da and the lowest 20 cm with 142.8 kg/da. Linas was obtained from the highest 10 cm, 189.7 kg/da and the lowest 15 cm with 217.6 kg/da. Olas was obtained from 10 cm with the highest 215.5 kg/da and from 20 cm with the lowest 185.3 kg/da. In Figure 3.2., the varieties of seed yield are shown in the graph at above the intro row spacing distances.



Figure 3.2. Representation of seed yield varieties in the graph at distances above the intra row spacing

The yield values obtained as a result of this research (Kırıcı & İnan, 2005; Sefaoğlu, 2017) lower than (Yavuz, 2019), 2001(Ada, 2012; Akınerdem et al., 2001; Öztürk et al., 2009). This difference in seed yield may have been due to the fact that the varieties were different and the trials were carried out in different years. As can be understood from the figures and tables given, it was determined that Linas and Olas stood out in terms of yield and that the yield increased as the distance over the intra row spacing decreased.

Crude Oil Ratio: The average oil ratio and statistical difference groups related to irrigation x variety x intra row spacing interaction in non-irrigated and irrigated areas obtained from these research results are given in Table 3.3.

In the results of the research, it was determined that irrigation, variety, irrigation x variety interaction, variety intra row spacing interaction, irrigation x variety x intra row spacing interaction were important.



Table 3.3. Irrigation x variety x intra row spacing interaction averages for oil ratio (%) and L.S.D. difference groups

Irrigated	Variety	10 cm	15 cm	20 cm	Mean
Non irrigated	Hasankendi	35.06 b A	34.48 b AB	33.88 b B	35.06 b
	Koç	35.40 b B	36.72 a A	37.30 a A	35.40 b
	Linan	34.93 b A	34.74 b A	34.40 b A	34.93 b
	Olas	37.48 a A	37.43 a A	37.52 a A	37.48 a
	Mean	35.72	35.84	35.77	35.72
Irrigated	Hasankendi	34.84 b A	35.28 b A	34.55 c A	34.84 b
	Koç	34.67 bc B	35.32 b AB	35.68 b A	34.67 bc
	Linan	33.98 c A	33.15 c B	34.34 c A	33.98 c
	Olas	36.68 a A	37.15 a A	37.20 a A	36.68 a
	Mean	35.04	35.22	35.44	35.04

*Groups classified with the same lowercase letter have no importance level among them in the table column.

*Groups classified with the same capital letter have no importance level between them in the table row

*A.Ö.F. irrigationXVarietyXIntra-row space= 0.7617

When the varieties are evaluated among themselves at each intra row distance in the ratio of crude oil in the ratio of non -irrigated area; The highest Olas (37.48%), the lowest Linan (34.93%), the highest rate in 15 cm (37.43%), the lowest Hasankendi (34.48%), the highest Olas in 20 cm (37.52%), the lowest Koç (33.88%) crude oil ratio were determined from the intra row space planting distances. Two different levels of importance were found within the distances above the intra row spacing.

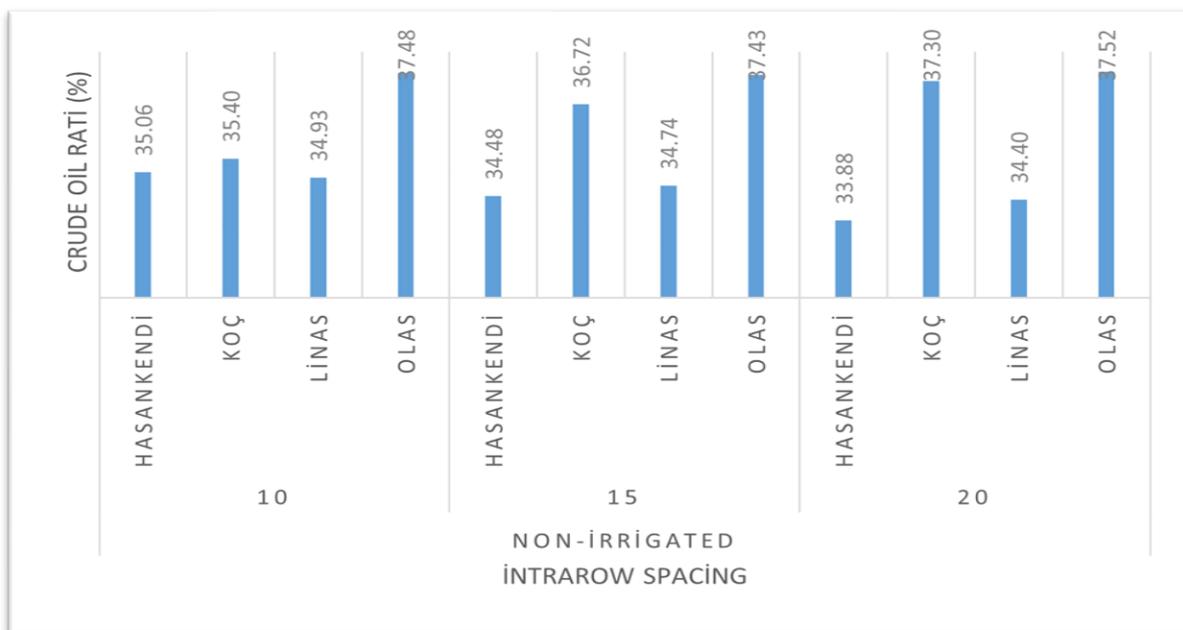


Figure 3.3. Graphical view of varieties at over-row distances of crude oil ratio under dry conditionslerin grafiksel görünümü

In irrigated conditions, in the ratio of crude oil, when varieties are evaluated among themselves at a distance above each intra row spacing; the highest Olas (36.68%), the lowest Linan (33.98%)



(33.98%) per 10 cm; The highest rate at 15 cm is Olas (37.15%), the lowest is Linas (33.15%); It was obtained from the high Olas (37.20%) variety at 20 cm, the lowest from Linas (34.34%). Three different levels of significance were found within above the intra row space distance. Figure 3.4. In irrigated conditions, the varieties are shown in the graph at the intra row distance of crude oil ratio.

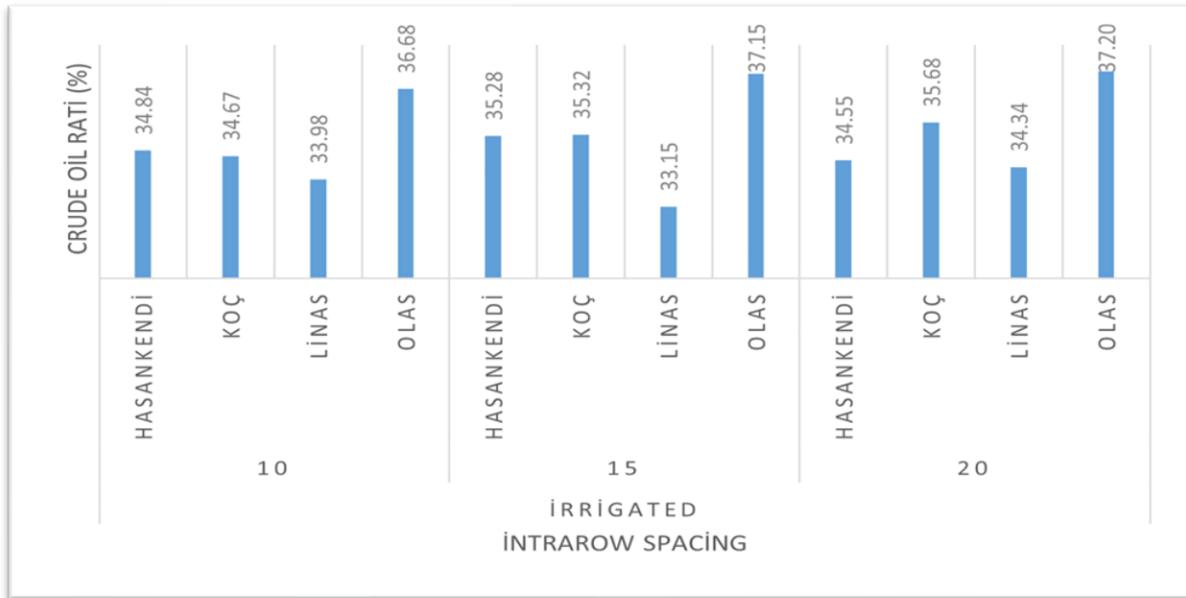


Figure 3.4. Graphical view of varieties at over-intra row space distances of crude oil ratio under irrigated conditions

In non – irrigated, varieties are at a distance above the intra row spacing; Hasankendi above the intra row spacing from the highest 10 cm to 35.06%, from the lowest 20 cm to 33.88%; Koç from the highest 20 cm to 37.30%, from the lowest 10 cm to 35.10%; Linas from the highest 10 cm 34.93%, from the lowest 20 cm 34.40%; Olas were obtained from the highest 20 cm to 37.52% and the lowest 15 cm (37.43%). Hasankendi and Koç formed two difference groups, Linas and Olas did not make a difference. Figure 3.5. Graphical representation of crude oil grade varieties at distances above the intra row spacing under non-irrigation conditions is given.

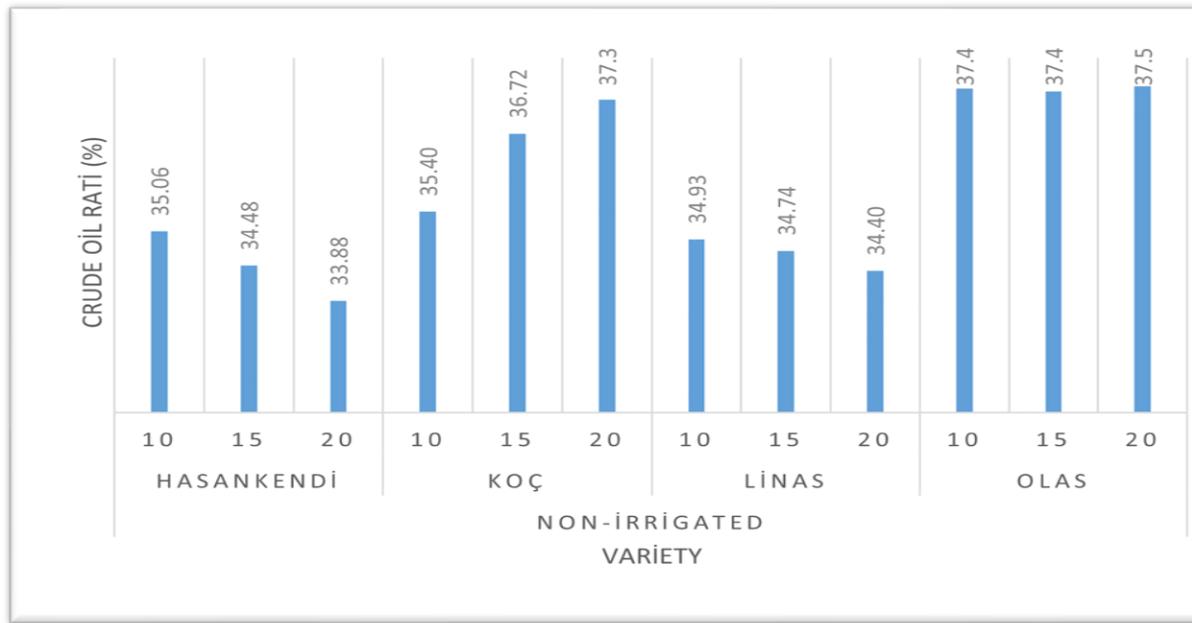


Figure 3.5. Graphical view of crude oil ratio varieties at intra row distances under non irrigated conditions

In irrigated, varieties are at the intra row spacing themselves; Hasankendi was most than 15 cm (35.28%), at least 20 cm (34.55%), Koç was more than 20 cm (35.68%), and at least 10 cm (35.67%). Linas were obtained from 20 cm (34.34%), from at least 15 cm (33.15%), from 20 cm (37.20%) and from at least 10 cm (36.68%) in Olas. While there was no statistical difference in Hasankendi and Olas, two importance groups were determined in Koç and Linas. Figure 3.6. Graphical representation of crude oil ratio varieties at above intra row spacing distances under irrigated conditions is given.

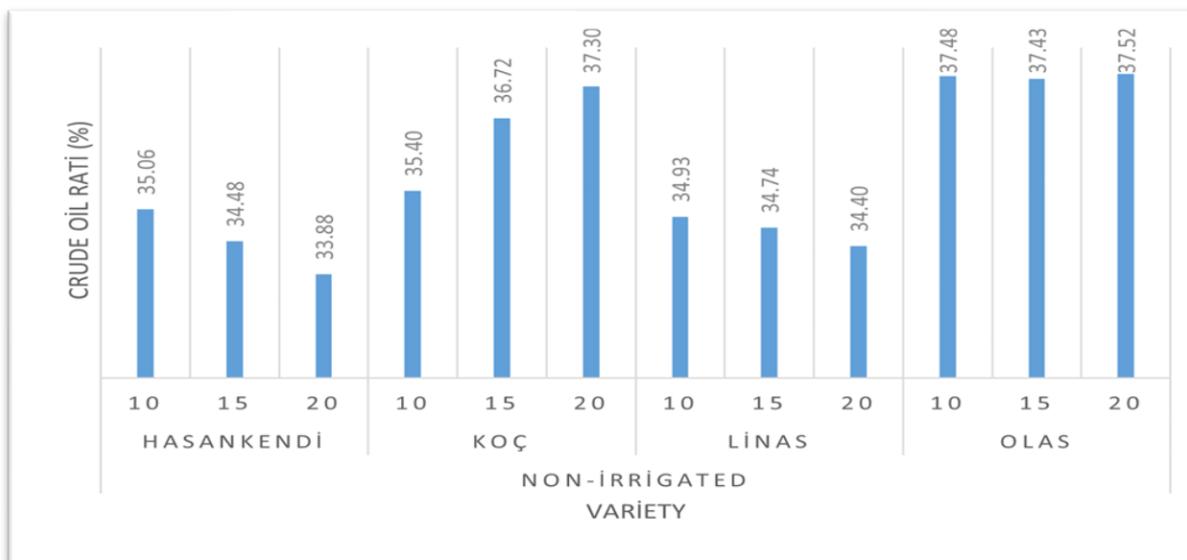


Figure 3.6. Graphical view of crude oil ratio varieties at intra row space row distances under non irrigated conditions



The crude oil ratios obtained as a result of this research partially coincide with the values (Andırman, 2022; Erpay, 2022; Kılılı et al., 2016)they found, Results were found to be more than their. The difference in crude oil ratios may be due to the genetic structure of the varieties and the fact that the climatic conditions are different.

4. CONCLUSION

A survey is carried out in 2021 and when the seed yield and crude oil ratios are taken into account the ecological conditions of the year and the place where it is made, Linas and Olas varieties can be recommended in irrigated and non - irrigated conditions in terms of seed yield at intra row spacing distances between 10, 15 and 20 cm. When the seed yield was evaluated under the conditions of the research, there was an increase in yield as the distance over the intra row space narrowed in the majority of the varieties. In the ratio of crude oil, Olas and Koç reached their highest value. Different results were obtained from the varieties at rows of distances in in irrigation and non-irrigation. Similar research needs to be repeated in different years and ecologies to make more accurate recommendations.

Explanation: This study was accepted as a thesis proposal by Selcuk University Institute of Natural and Applied " The Effect of Safflower (*Carthamus tinctorius* L.) on Important Agricultural and Quality Characteritics of The Different Row Distances in Dry and Wed Conditiouons" is derived from his doctoral thesis.



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ISITILMAYAN SERALARDA ALÇAK TÜNEL VE MALÇ UYGULAMASININ BİTKİ YETİŞTİRME ORTAMI ÜZERİNDEKİ ETKİLERİ

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ÖZET

Bu çalışma, İğdır ilinde serada örtüaltı yetiştiriciliğinde üretim periyodunu genişletmek için sera içerisinde alçak tüneller ve plastik malç kullanarak tünel iç ortam havasını ve kök bölgesi sıcaklıklarını analiz etmek amacıyla yürütülmüştür. Alçak tüneller özellikle Akdeniz Bölgesi'nde açık alanlara erkenci ürün yetiştirmek için fidelerin ilkbahar geç donlarından korunması amacıyla kullanılmaktadır. Bu çalışmada 525 m² taban alanına sahip yan duvarları polikarbon çatısı polietilen plastik malzemeden oluşan sera içerisine polietilen plastik örtü ile 12 adet tünel yapılmış ve 6'sına siyah plastik film ile malçlama işlemi yapılmıştır. Dış ortam hava sıcaklığı, sera iç ortam hava sıcaklığı, tünel iç ortam hava sıcaklığı ve nemi ile hem malçlı hemde malçsız tünel için kök bölgesi toprak sıcaklıkları ölçülmüştür. Sera iç ortam havasının sıcaklığı dış ortam havasına göre günlük ortalama 3.5 °C daha yüksek olarak gözlenmiştir. Alçak tünellerin sera iç ortamında kullanılması bitki çevresindeki havanın sıcaklığını arttırmış ve sera iç ortamın havasına göre günlük ortalama 1.9-2.3 °C arasında daha yüksek gözlemlenmiştir. Alçak tünel içerisinde siyah plastik malç kullanımı ise tünel iç ortam havasını malç kullanılmayan seraya göre 0.5 °C arttırmıştır. Kök bölgesi ve daha derin toprak sıcaklıkları malç uygulamasından etkilenmiştir. Toprak yüzünden daha derinlere doğru gidildikçe daha kararlı sıcaklık değerleri oluşurken kök bölgesinde ise daha hareketli değerler gözlenmiştir. Malç uygulamasının yapıldığı tünelde toprak sıcaklıkları derinliğe göre 0.6 ile 1.3 °C arasında değişiklik göstermektedir. Deneme periyodu boyunca dış ortam sıcaklığı en düşük -11.4 °C olurken sera iç ortamında -5.8 °C, malç uygulamasının yapılmadığı tünelde -1.2 °C ve malçın uygulandığı tünelde -0.3 °C gözlenmiştir. Ayrıca hem malç uygulamasının yapıldığı tünel (%82.9) hem de malçlamanın yapılmadığı tünelde (%82.6) iç ortam havasının nemi birbirine yakın değerler göstermiştir. Yapılan çalışma ile sera içinde alçak tünel ve malç kullanımının üretim periyodunu kışı soğuk geçen illerde uzatabileceği ve sıcaklık isteği düşük olan marul bitkisinin bu üretim şekli ile verimli bir şekilde yetiştirilebileceği görülmüştür.

Anahtar Kelimeler: Alçak tünel, kök bölgesi sıcaklığı, malç, marul, sera



EFFECTS OF LOW TUNNEL AND MULCH ON PLANT MICROCLIMATE IN UNHEATED GREENHOUSES

ABSTRACT

This study was carried out to analyze low tunnel indoor air and root zone temperatures by using low tunnels and plastic mulch in greenhouse in order to expand production period in greenhouse cultivation in Iğdır. Low tunnels are used to protect seedlings from late spring frosts in order to grow early crops in open areas, especially in Mediterranean Region. In this study, 12 low tunnels were made with polyethylene plastic cover and 6 of them were mulched with black plastic film, inside greenhouse with a 525 m² floor area, side walls of which are made of polycarbonate and roof of polyethylene plastic material. Outdoor air temperature, greenhouse indoor air temperature, tunnel indoor air temperature and humidity, and root zone soil temperatures for both mulched and unmulched tunnels were measured. Temperature of indoor air of greenhouse was observed to be 3.5 °C higher on average daily compared to outdoor air. Use of low tunnels in greenhouse indoor environment increased temperature of air around plant and it was observed that daily average was 1.9-2.3 °C higher than indoor air of greenhouse. Use of black plastic mulch in low tunnel increased tunnel indoor air by 0.5 °C compared to tunnels without mulch. Root zone and deeper soil temperatures were affected by mulch application. As gone deeper from the soil surface, more stable temperature values are formed, while more active values are observed in root region. Soil temperatures in low tunnel where mulch is applied vary between 0.6 and 1.3 °C depending on depth. During experiment period, the lowest outdoor temperature was -11.4 °C, while -5.8 °C in greenhouse indoor environment, -1.2 °C in low tunnel where mulch was not applied, and -0.3 °C in tunnel where mulch was applied. In addition, indoor air humidity values were close to each other in both tunnel where mulch was applied (82.9%) and tunnel where mulching was not applied (82.6%). With study, it has been seen that use of low tunnels and mulch in greenhouse can extend production period in cities with cold winters, and lettuce plant, which has a low temperature demand, can be grown efficiently with this production method.

Keywords: Greenhouse, lettuce, low tunnel, mulch, root temperature



1. GİRİŞ

Türkiye’de seracılık faaliyetleri ilk olarak 1940’lı yıllarda başlamış, günümüze kadar olan süreçte özellikle Akdeniz Bölgesi’nin iklim özellikleri sebebiyle burada yer alan illerde seracılık faaliyetleri gelişmiş daha sonra Ege ve Marmara bölgelerinde de yaygınlaşmıştır. Tarım ve Orman Bakanlığı ve ilgili diğer kurumlarca sağlanan destek, hibe ve krediler ile modern şartlarda üretim yapan örtü altı işletmelerinin sayısı hızlı artış göstermiştir. Son 10 yılda ülkemizde 2 da seviyesindeki örtü altı işletme büyüklüğü artış göstererek 4 da seviyesine ulaşmıştır. TÜİK (2022) verilerine göre Türkiye’de ki örtü altı alanlar 81088.2 ha olmuştur (Tablo 1.1).

Dünya’da seracılık faaliyetleri en yoğun Akdeniz Bölgesi’nde ki ülkelerde yapılmaktadır. Ülkemiz sera varlığı bakımından dünyada dördüncü, Akdeniz ülkeleri arasında ise İspanya’nın ardından ikinci sırada yer almaktadır (Anonim, 2017). Iğdır ili sera varlığı ise 113 da yüksek tünel olarak bildirilmiştir.

Tablo 1. Türkiye’de örtü altı tipine göre alan büyüklükleri (TÜİK, 2022)

Yıl	Toplam Alan (ha)	Cam Sera (ha)	Plastik Sera (ha)	Yüksek Tünel (ha)	Alçak Tünel (ha)
2018	77209.1	7811.1	36852.7	11423.2	21122.2
2019	78960.4	7549.5	37867.1	11103.8	22440.0
2020	80515.9	8077.9	40179.6	10425.8	21832.6
2021	85460	7621.3	46497.3	10075.6	21265.7
2022	81088.2	5963.3	47128.4	11042.7	16953.8

Enerji maliyetlerinin yüksekliği sebebiyle il genelinde seralar ısıtılmamakta ve yılın sadece belirli dönemlerinde aktif olmaktadır. Aras Nehri’nin hemen karşı tarafında bulunan Ermenistan’a ait Arask, Jrrat, Metsamor, Guy köylerinden sadece bir tanesi bile incelendiğinde sera alanı miktarının TRA2 bölgesinin sera varlığından kat be kat fazla olduğu gözlenmektedir. Dünya Bankası’nın Sera Bitkileri İhracatı Tedarik Zinciri Raporu’na (WB, 2016) göre Ermenistan, 2014 yılında seracılık faaliyetlerinden yaklaşık 5 000 000 \$ ihracat hacmi yakalamıştır.

Seracılık faaliyetlerinde temel amaç, zamandan ve çevresel etmenlerden bağımsız olarak bitkisel ürün yetiştirmektir. Bu sebeple kullanılan malzemeler bitki yetiştirme ortamındaki atmosferin iyileştirilmesi için tünel örtüleri ve bitki kök bölgesinde ki sıcaklıkların iyileştirilmesi için malç örtü malzemeleridir. Alçak tüneller bitki gelişiminin ilk aşamalarında koruma sağlayan plastik örtülü filmle kaplı küçük kemerli yapılardır. Alçak tünellerin ana



amacı büyüme periyodunun ilerlemesi ya da geciktirilmesidir (Jenni ve ark., 2003) böylece yılın bu teknik olmadan üretim yapılamayacağı zamanlarda ürün elde edilmesine katkı sağlanır. Alçak tüneller hava ve toprak sıcaklığında bir artış sağlar (Soltani ve ark., 1995; Gimenez ve ark., 2003) bu da bitkilerin büyümesini destekler (Wolfe ve ark., 1989; Albright ve ark., 1989). Ayrıca alçak tünel içerisindeki ortamda daha yüksek bağıl nem oranları gözlenmiştir (Hernandez ve ark., 2010; Moreno ve ark., 2003). Genellikle açık alanda kullanılan bu yapılar kışı soğuk geçiren yerlerde don zararına karşı ekstra koruma sağlamak amacıyla sera içerisinde de kullanılabilirler. Alçak tüneller, gökyüzünün açık olduğu gece saatlerinde radyasyon yoluyla enerji kayıplarını azaltmalarının yanı sıra sera ortamındaki ısıtma borularının üstüne yerleştirilmeleri durumunda iletim yoluyla ısı kayıpları da önleyerek büyük enerji tasarrufu sağlarlar (Valera ve ark., 2016).

Yetiştiriciliği yapılan bitki çeşidine göre tünel boyutları değişmekle birlikte çilek, marul gibi kısa boylu bitkiler için 30-40 cm yükseklik, 40-50 cm genişliğinden tüneller uygun olabilirken, domates ve biber gibi yüksek fiziksel yapıya sahip bitkiler için bu değerler arttırılmalıdır. Bu yapılar içerisindeki nem ve sıcaklık miktarının bitki yetiştirme açısından uygun olmayan günün belirli zamanlarında açılıp kapatılabilmektedir. Loy ve Wells (1975), gündüzleri tünel içerisindeki sıcaklıkların dış ortam hava koşullarına göre 4-5 °C daha yüksek olduğunu gözlemlemiş ve kavunda yürüttüğü denemelerin hasat zamanını 12-13 gün arasında kısalttığı bildirmiştir. Abak ve ark. (1994), altın çilekte yaptıkları denemelerde alçak tünel kullanımının açık alanda yetiştirilen ürünlere göre verim değerlerinde artış olduğunu bildirmişlerdir. Cam sera içerisinde kullanılan alçak tünellerin biber bitkisi için meyve kalitesini olumlu etkilediği bildirilmiştir (Gerber ve ark., 1988; Lolliffe ve Gaye, 1995). Alçak tünel ve plastik malç kullanımının ikili etkisinin, sadece plastik malç ve sadece alçak tünelle yapılan yetiştiriciliğe kıyasla bitki yetiştirme açısından daha faydalı olduğu bildirilmiştir (Ibarra ve ark., 2001).

Tek yıllık serin iklim sebzesi olan marulun en uygun gelişme sıcaklığı 15-18 °C arasındadır. Sıcaklığın 20 °C'u geçmesi olumsuz olarak nitelendirilmektedir. Sıfırın altındaki sıcaklıklara ise kısa süre dayanabilmektedir (Splittstoesser, 1990; Günay, 1992). Marul bitkisi ılıman iklime sahip bölgelerde sonbahar ve kış aylarında, kışı soğuk geçiren yerlerde ise kış aylarındaki çok düşük sıcaklıklar ve yaz aylarındaki çok uzun gün koşulları sebebiyle üretim sınırlanmaktadır. Ülkemizde örtü altında marul yetiştiriciliği ile ilgili yüksek ve alçak tüneller altında yürütülen çalışmalar mevcuttur (Karataş ve ark., 1995; Geboğlu ve ark., 1998). Marul yetiştiriciliğinde ilkbahar ve kış aylarında dış ortam koşullarının etkilerinin iyileştirilmesinin verim değerlerine olumlu yansıtıldığı bildirilmiştir (Cerne, 1994; Benoit ve Ceustermans, 1998).



Iğdır ilinde kış aylarındaki sera iç ortamındaki sıcaklıkların bile sıfırın altında olması sebebiyle alçak tünellerin kullanılması bitkisel üretimin yapılabilmesi için gerekli ve zorunludur. İl genelindeki çiftçiler alçak tünelleri ilkbaharda erkenci ürün yetiştirmek amacıyla ürünlerin ilk gelişimi aşamasında don zararından etkilenmemek amacıyla kullanmaktadır. Bu çalışmada serin iklim bölgesinde yer alan Iğdır ilinde plastik örtülü sera içerisine yerleştirilen alçak tünellerin ve plastik malç uygulamasının marul bitkisi yetiştiriciliğinde bitki büyüme ortamı ve kök bölgesindeki iklim etmenlerinin değerlendirilmesi amaçlanmıştır.

2. MATERYAL VE METOT

Deneme Alanına Ait İklim Verileri

Araştırma, Kuzeydoğu Anadolu Bölgesi'nin Erzurum-Kars Bölümü'nde yer alan, 39°, 55.2' kuzey enlemi ve 44°, 03.0' doğu boylamında, karasal iklimin hakim olduğu, 850 m yüksekliğe sahip Iğdır ili sınırları içerisinde yürütülmüştür. Yıllık yağış miktarı 240-260 mm arasında değişmekte olan Iğdır ili bu yağışın yaklaşık yarısını Nisan, Mayıs ve Haziran aylarında almaktadır. İl genelindeki topraklarda Temmuz ve Ağustos aylarında yağışların azalması ve ilkbaharda toprakta oluşan nemin korunamaması sebebiyle 40-50 cm derinliğinden daha aşağıdaki toprak katmanı tamamen kurumakta dolayısıyla bu aylarda sulama ihtiyacı doğmaktadır. Iğdır ili uzun yıllara ait bazı meteorolojik veriler Tablode 2'de verilmiştir (Anonim, 2022).

Tablo 2. Iğdır ili uzun yıllar (1940-2022) hava sıcaklığı değerleri

Aylar	1	2	3	4	5	6	7	8	9	10	11	12
Ortalama sıcaklık	-3.3	-0.3	6.4	13.1	17.8	22.3	25.9	25.3	20.5	13.1	5.9	-0.3
Ortalama en yüksek sıcaklık	2	5.5	12.6	19.8	24.7	29.5	33.4	33.2	28.9	21.2	12.7	4.8
Ortalama en düşük sıcaklık	-8	-5.4	0.3	6.2	10.7	14.4	18.1	17.2	12.3	6.1	0.3	-4.5

Deneme Serası ve Ölçme Sistemi

Çalışma Iğdır Üniversitesi Tarımsal Araştırma ve Uygulama Merkezi'nde yer alan 525 m² (35*15 m) taban alanına sahip yan duvarları sert plastik (polikarbon) çatı kısmı yumuşak plastik (polietilen) örtülü serada yürütülmüştür (Şekil 1). Sera çevresinde yan havalandırma açıklıkları mevcut olup havalandırma açıklıklarının taban alanına oranı %2.5'tir. Deneme sırasında sera iç ortam sıcaklık değerlerinin 25 °C'un üzerine çıktığı günlerde havalandırma pencereleri açılmış,



diğer günlerde bu açıklıklar taşınım yoluyla ısı kayıplarını engellemek için kapalı tutulmuştur. Piyasadan 3 farklı kıvrıcık türü (Carmesi, El Maria ve Fiyonk) temin edilmiş ve 04.11.2022 tarihinde dikim işlemi gerçekleştirilmiştir. Dikim aralıkları sıra arası 40 cm, sıra üzeri ise 30 cm olacak şekilde düzelenmiş ve 8.3 bitki/m² bitki yoğunluğu elde edilmiştir. Alçak tüneller 1 metre genişliğinde ve 0.9 metre yüksekliğinde olup deneme tünellerinin içi hacmi yaklaşık 21 m³ olarak hesaplanmıştır (Şekil 2).

Hava sıcaklıklarının uygun olması sebebiyle bitki materyallerinin üstü 09.11.2022 tarihinde kalınlığı 175 µm olan yumuşak plastik örtü malzemesi ile kapatılmış ve denemem süresi boyunca gün içerisinde dış ortam sıcaklıklarının uygun olduğu zaman dilimlerinde örtüler açılmıştır. Alçak tüneller ve malç uygulamasının etkilerini belirlemek için sera iç ortamına 12 farklı alçak tünel yerleştirilmiş ve bu tünellerin içerisinden 6 tanesine malç uygulaması yapılırken diğer 6 tanesine malç uygulanmamıştır.

Dış ortam hava sıcaklığı, sera iç ortamı hava sıcaklığı, alçak tünellerdeki hava sıcaklığı ve nemi ile malç uygulamasının 0-30 cm toprak derinliğinde ki sıcaklık değişimlerini gözlemlemek amacıyla sensörler yerleştirilmiştir (Şekil 3). Çalışma 03.01.2023 tarihinde bitkilerin hasat edilmesiyle tamamlanmış ve yetiştirme periyodu toplamda 61 gün sürmüştür.



Şekil 1. Alçak tünellerin yerleştirildiği sera



Şekil 2. Sera içine yerleştirilen alçak tüneller



Şekil 3. Sensörlerin yerleşim planı (Kırmızı: Sıcaklık (°C), Yeşil: Nem (%), Sarı: Işınım (W/m²), Turuncu: Rüzgar hızı (m/s))

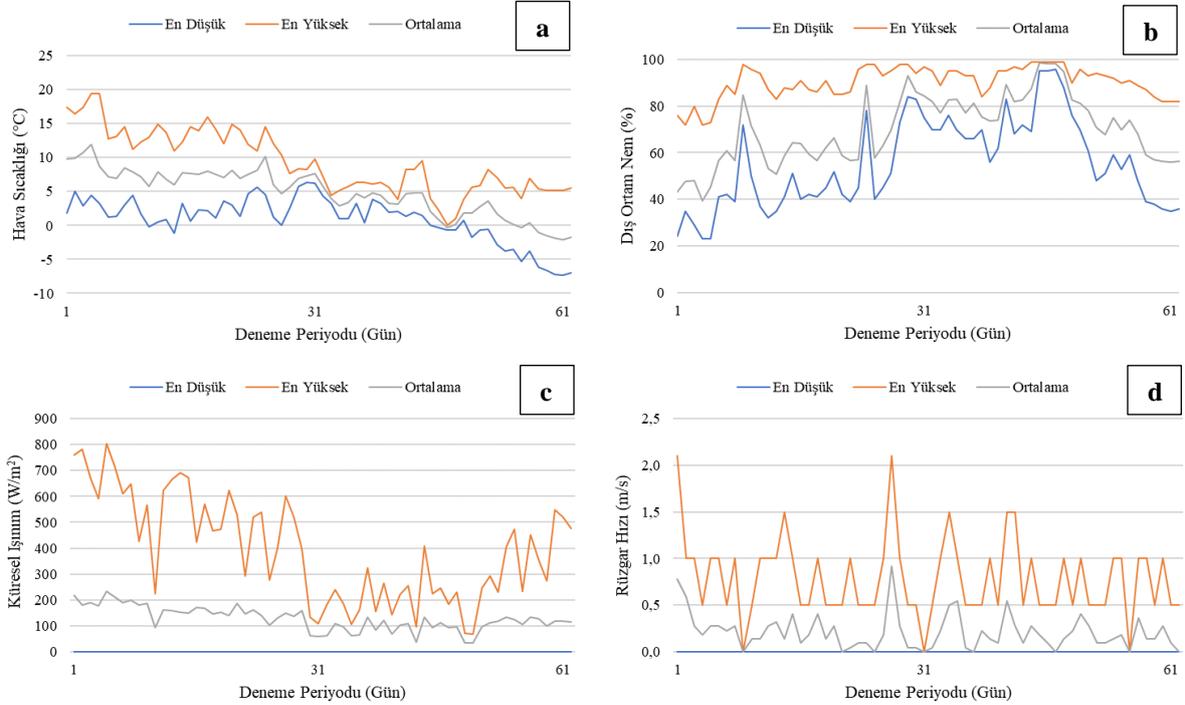
Hava ve toprak sıcaklıkları ölçümü için HOBO UX-120-006M marka/model sıcaklık sensörü ve veri kaydedici kullanılmıştır. Sensörün çalışma aralığı -20 °C ile 70 °C arasında ve hassasiyeti ise $\pm 0.2\%$ 'dir. Bunlarla birlikte seranın ısı kaybının hesaplanması için gerekli olan küresel ışınım ve rüzgar hızı verileri Iğdır İli Meteoroloji Genel Müdürlüğü'nden araştırma alanına en yakın olan istasyondan temin edilmiştir. Toprak sıcaklıklarının ölçümü tüneller içerisinde; toprak yüzeyi, 10 cm, 20 cm ve 30 cm olmak üzere 4 farklı derinlikten yapılmıştır. Tüneller içerisindeki ortam havasının nemi ise Elitech Technolgy RC-4HC sıcaklık ve nem kayıt cihazı ile ölçülmüştür. Cihazda dahili olarak bulunan nem sensörü %10 ile %99 arasında çalışmakta olup, nem sensörünün hassasiyeti $\pm 3\%$ 'tür (Şekil 4).



Şekil 4. Sıcaklık ve nem sensörleri

Deneme süresi boyunca dış ortam sıcaklığı, rüzgar hızı ve küresel ışınım verilerine ilişkin günlük ortalama değerler Şekil 5’te verilmiştir. Deneme periyodu boyunca her beş dakikada bir alınan veriler incelendiğinde dış ortam sıcaklığının en yüksek 27.65 °C, ortalama 4.83 °C ve en düşük -11.40 °C olduğu gözlenmiştir.

Şekil 5a’da verilen değerler deneme süresi boyunca sensörlerden alınan verilerin günlük ortalamalarını ifade etmektedir; Deneme periyodu boyunca her beş dakikada bir alınan veriler incelendiğinde dış ortam sıcaklığının; en yüksek 27.7 °C, ortalama 4.8 °C ve en düşük -11.4 °C olduğu gözlenmiştir. Sera iç ortamına giren ışınım değeri örtü malzemesinin geçirgenliğine göre değişiklik göstermektedir.



Şekil 5. Dış ortam hava sıcaklığı (a), dış ortam hava nemi (b), küresel ışınım (c) ve rüzgâr hızı (d) değerlerinin günlük ortalamaları



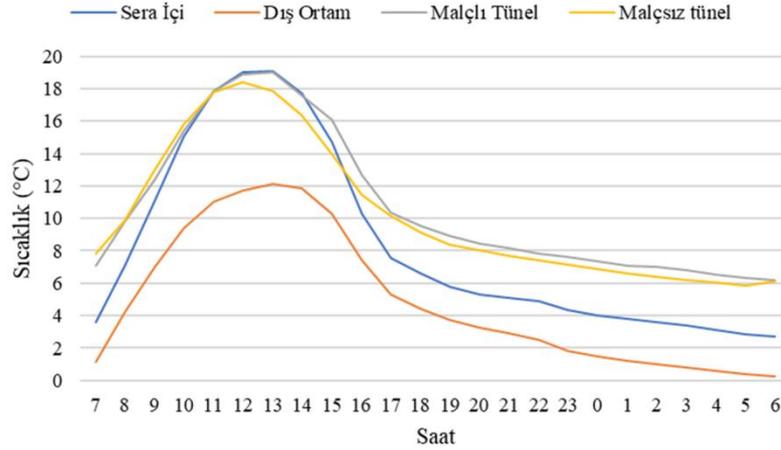
Dış ortamda görülen küresel ışınım değerlerinin en yüksek değeri 805.1 W.m^{-2} , ortalama 128 W.m^{-2} olarak gözlemlenmiştir (Şekil 5c). Sera iç ortamına giren ışınım değeri tek kat polietilen örtü için toplam ışınım değerinin %65'i kadardır (Ozturk ve Kucukerdem, 2016). Sera iç ortamına ulaşan ışınımın en yüksek değeri 523.3 W.m^{-2} , ortalama 83.2 W.m^{-2} olarak, alçak tünel içerisine ulaşan ışınım değeri ise 340.2 W.m^{-2} , ortalama 54.1 W.m^{-2} olarak hesaplanmıştır. Deneme süresince rüzgar hızı en yüksek 2.1 m/s değerine ulaşırken, dış ortam bağıl nem değerlerinin ortalaması en düşük %55.3, en yüksek %90.3 ve ortalama %70 olarak gözlemlenmiştir (Şekil 5d).

3. BULGULAR VE TARTIŞMA

Dış Ortam, Sera İç Ortamı ve Tünel İç Ortamındaki Sıcaklıklar

Sera iç ortamındaki hava sıcaklıklarının ölçümü 0.5 m, 1 m, 1.5 m ve 2 m yüksekliklerde yapılmıştır. Ölçüm yüksekliğine bağlı olarak sıcaklık değerlerin birbirine çok yakın değerler alması sebebiyle bütün verilerin ortalaması alınarak saatlik tek bir değer elde edilmiştir. Yetiştirme periyodu boyunca sera iç ortamında görülen en düşük, en yüksek ve ortalama sıcaklıklar sırasıyla $-5.8 \text{ }^{\circ}\text{C}$, $39.7 \text{ }^{\circ}\text{C}$ ve $8.3 \text{ }^{\circ}\text{C}$ 'dir. En yüksek sıcaklık 06.11.2022 tarihinde saat 11:30 civarında gözlemlendiğinde havalandırma pencereleri ve sera içi fanlar açılmıştır. En düşük sıcaklık 01.01.2023 tarihinde 06:47 saatinde gözlemlenmiştir. Deneme süresi boyunca dış ortam sıcaklık değerleri, sera iç ortam sıcaklık değerleri ile malçlı ve malçsız tünellere ait ortam sıcaklıklarının saatlik ortalamaları Şekil 6'da verilmiştir.

En düşük dış ortam hava sıcaklığının ($-11.4 \text{ }^{\circ}\text{C}$) görüldüğü an, sera iç ortamındaki havanın sıcaklığı $-5.4 \text{ }^{\circ}\text{C}$ olarak gözlemlenmiştir. Yapılan ölçümler sonucunda elde edilen verilerin ortalama değerlerine göre sera iç ortamı hava sıcaklığı dış ortam havasından $3.4 \text{ }^{\circ}\text{C}$ daha yüksek olduğu gözlemlenmiştir. Yetiştiricilik periyodu (61 gün) boyunca 11 günün gecesinde sera iç ortamında sıfırın altında değerler gözlemlenmiştir. Bu değerler marul yetiştiriciliği için uygun olmaması sebebiyle alçak tünel uygulamasının kullanımını bu sürede etkili olmuştur.

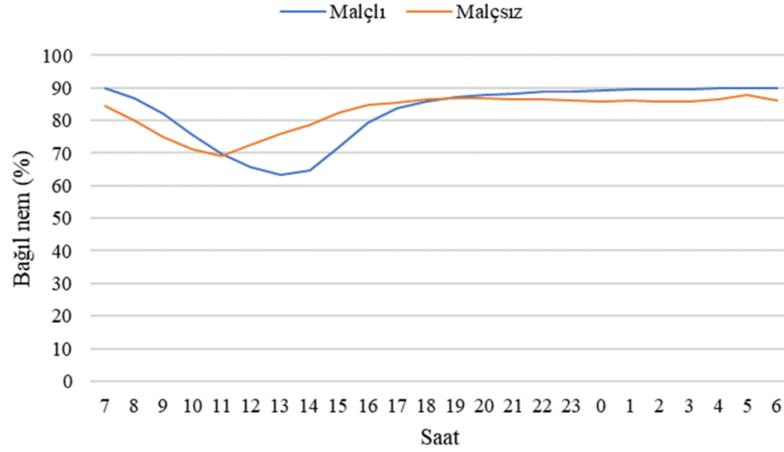


Şekil 6. Dış ortam ve sera iç ortam sıcaklıkları

Lopez-Martinez ve ark. (2021) Akdeniz iklim koşullarında yaptıkları çalışmada sera içerisinde alçak tünel kullandıkları alanlarda, tünel kullanmadıkları alanlara göre ortalama 2.8 ± 1.2 °C farklar gözlemlerken, Loy ve Wells (1975) açık alanda yürüttükleri çalışmada alçak tünel sıcaklığının dış ortama göre gündüz saatlerinde 4 °C daha yüksek olduğunu bildirmişlerdir. Şekil 6 incelendiğinde siyah plastik malçın uygulandığı tünellerde tünel iç ortam sıcaklıkları, malçın uygulanmadığı tünellere göre daha yüksektir. Malç uygulaması toprakta var olan ısıyı gündüz saatlerinde depolamış, gece saatlerinde ise alçak tünel ortamına bu ısıyı bırakarak ortam sıcaklığını arttırmıştır. Alçak tünel toprak yüzeyi ile bitkilerin çevresindeki hava arasında taşınım yoluyla kaybolacak ısının transferini azaltmıştır.

Tünel İç Ortamındaki Nem

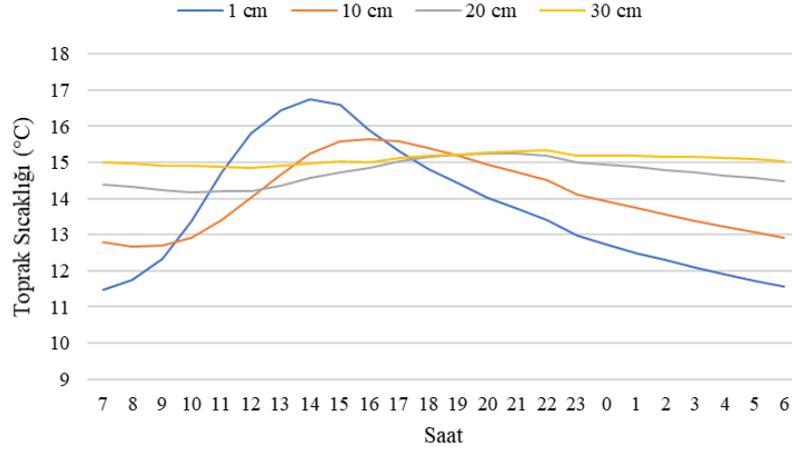
Deneme süresi boyunca, hem malçlı hemde malçsız tüneldeki nem değerlerinin ortalamaları birbirine yakın değerler almıştır. Malçlı tünelde en düşük (%19.8), en yüksek (%95.1), ortalama (%82.9) değerleri gözlemlenirken, malçsız tünelde en düşük (%17.5), en yüksek (%99.9), ortalama (%82.6) değerleri gözlemlenmiştir (Şekil 7). Gündüz saatlerinde ışınım miktarının artmasıyla birlikte artan sıcaklık hem malçlı hem de malçsız tünel içerisindeki nem seviyelerini azaltmıştır. Bu anlamda elde edilen sonuçlar Kapanen ve ark. (2008) ve Lopez-Martinez ve ark. (2021) çalışmalarıyla benzerlik göstermektedir.



Şekil 7. Malçlı ve malçsız tünel bağıl nem değerleri

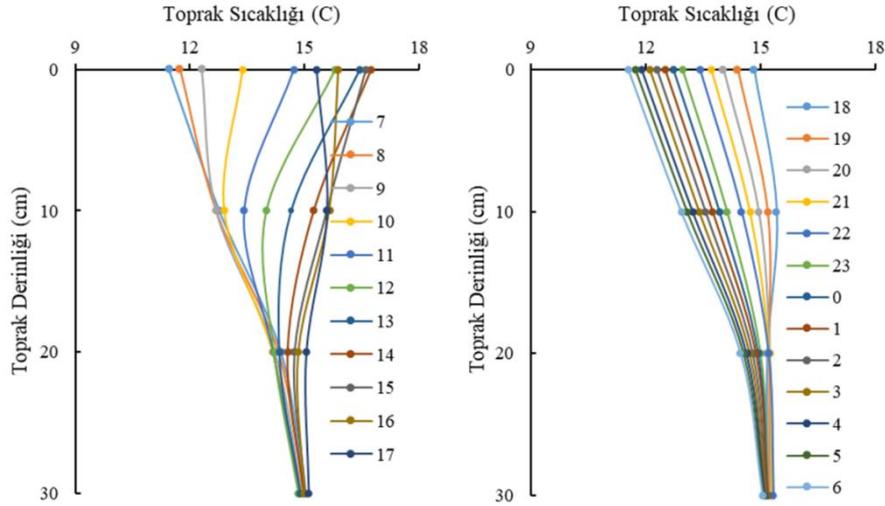
Toprak Sıcaklıkları

Yetiştirme periyodu boyunca kök bölgesi sıcaklıklarının ölçümü yapılmıştır. Malç uygulamasının kök bölgesi sıcaklık değerlerini pozitif olarak etkilemiştir (Şekil 8). Yüzeysel toprağın sıcaklık değerleri deneme süresi boyunca alçak tünel iç ortamının hava sıcaklıklarından etkilenmiştir. Yüzeysel toprağında gündüz saatlerinde alçak tünel iç ortamından daha düşük sıcaklık değerleri gözlemlenirken, gece saatlerinde ise tünel iç ortam havasından daha yüksek değerler gözlemlenmiştir. Bunun sebebi toprağın havaya göre geç ısınıp geç soğumasından kaynaklandığı düşünülmektedir. Toprak yüzeyindeki (1 cm) sıcaklık değerleri en düşük (6.6 °C), en yüksek (24.0 °C), ortalama (13.7 °C) olarak gözlemlenmiştir. 10 cm toprak derinliğindeki sıcaklık değerleri en düşük (8.1 °C), en yüksek (24.1 °C), ortalama (14.1 °C), 20 cm toprak derinliği için en düşük (10.0 °C), en yüksek (24.1 °C), ortalama (14.7 °C), 30 cm toprak derinliğindeki sıcaklıkları ise en düşük (10.8 °C), en yüksek (24.1 °C), ortalama (15.1 °C) olarak gözlemlenmiştir.



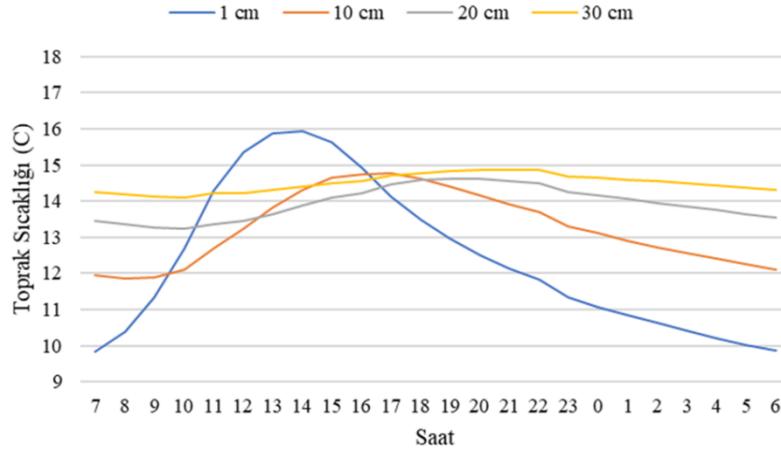
Şekil 8. Malçlı tünel toprak sıcaklıkları

Toprak sıcaklıklarının derinliğe ve gece-gündüz saatlere bağlı olarak değişimi Şekil 9’da verilmiştir. Yüzeysel topraklarından tünel ortamının havasına bağlı olarak daha değişken toprak sıcaklıkları görülürken, toprak derinliğinin artmasıyla birlikte daha kararlı sıcaklık değerleri gözlemlenmiştir.



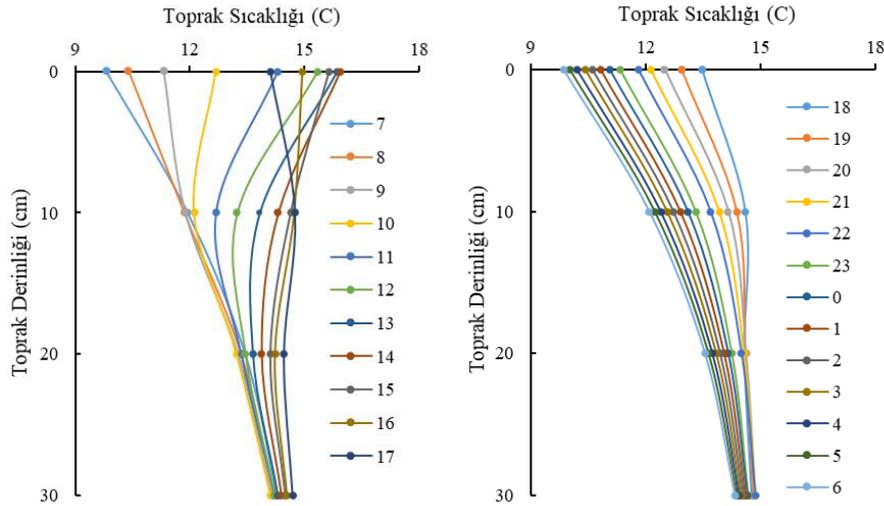
Şekil 9. Malçlı tüneldeki toprak sıcaklıklarının gece ve gündüz saatlerindeki değişimi

Malçsız tüneller için her beş dakikada bir alınan verilerin saatlik ortalamaları alınmış ve Şekil 10’da verilmiştir. Toprak yüzeyindeki (1 cm) sıcaklık değerleri en düşük (5.1 °C), en yüksek (25.2 °C), ortalama (12.4 °C) olarak gözlemlenmiştir. 10 cm toprak derinliğindeki sıcaklık değerleri en düşük (7.5 °C), en yüksek (24.1 °C), ortalama (13.3 °C), 20 cm toprak derinliği için en düşük (9.1 °C), en yüksek (24.1 °C), ortalama (13.9 °C), 30 cm toprak derinliğindeki sıcaklıkları ise en düşük (9.6 °C), en yüksek (24.1 °C), ortalama (14.5 °C) olarak gözlemlenmiştir.



Şekil 10. Malçsız tünel toprak sıcaklıkları

Malçsız tüneldeki toprak sıcaklıklarının derinliğe ve gece-gündüz saatlere bağlı olarak değişimi Şekil 11’de verilmiştir. Malçsız tünellerdeki topraklarda yüzey sıcaklıklarının en küçük değeri 9.8 °C olurken, en yüksek değeri ise 15.9 °C olmuştur. 30 cm toprak derinliği için ise bu değerler sırasıyla 14.1 °C ve 14.9 °C olarak gözlenmiştir.



Şekil 11. Malçsız tüneldeki toprak sıcaklıklarının gece ve gündüz saatlerindeki değişimi

		Saat																							
		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6
Derinlik (cm)	1	1,6	1,4	1,0	0,7	0,4	0,5	0,6	0,8	1,0	1,0	1,2	1,4	1,5	1,5	1,6	1,6	1,6	1,6	1,7	1,7	1,7	1,7	1,7	1,7
	10	0,8	0,8	0,8	0,8	0,7	0,8	0,8	0,9	0,9	0,9	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
	20	0,9	1,0	1,0	1,0	0,8	0,8	0,7	0,7	0,6	0,6	0,6	0,6	0,6	0,6	0,7	0,7	0,8	0,8	0,8	0,8	0,9	0,9	0,9	0,9
	30	0,7	0,8	0,8	0,8	0,7	0,6	0,6	0,6	0,5	0,5	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5	0,6	0,6	0,6	0,7	0,7	0,7

Şekil 12. Malçlı ve malçsız tünel için toprak sıcaklık farkları

Malçlı ve malçsız tünel toprakları arasındaki sıcaklık farkları günün saatlerine ve derinliğe bağlı olarak Şekil 12’de verilmiştir. En yüksek fark 1 cm derinlikteki topraklarda özellikle güneşin olmadığı saatlerde gözlenmiştir. Derinlik arttıkça malç uygulamasının etkisi azalmıştır. Libik



ve Siwek (1994) açık alanda karpuz mahsulü ile 0.5 m yüksekliğinde alçak bir tünelde, toprak sıcaklığında 5.9 °C (8:00'de) ve 6.8 °C (14:00'da) artışlar gözlemlenmiştir. Aynı şekilde, Loy ve Wells (1975), bir kavun mahsulü için çıplak toprağın sıcaklığına kıyasla, sıra örtüsü ile ortalama toprak sıcaklığında 3.0 °C (gündüz) ve 2.7 °C (gece) artış gözlemlenmiştir.

4. SONUÇ

Alçak tünel uygulaması yetiştirme ortamı içerisindeki havanın sıcaklığının artmasına ve bu da marul bitkisinin dondan korunmasına yardımcı olmuştur. Malç uygulaması tüneller içerisindeki toprak sıcaklıklarını korumuş ve özellikle güneşin etkisini yitirdiği saatlerden itibaren malçsız tünel toprağı ile olan sıcaklık farkı artmıştır. Tünel toprağına uygulanan plastik malç özellikle kök bölgesi olan ilk 10 cm'de etkili olmuştur. 20 ve 30 cm toprak derinlikleri için ise sıcaklık değerleri belirli bir seviyeden itibaren sabit kalmıştır.

Açık alanda ve sera içerisinde üretimin aşırı soğuklar nedeniyle durduğu Kasım-Şubat ayları arasında sera içerisinde alçak tünel uygulamaları ile soğuk havanın etkisi azaltılmaktadır. Iğdır ili genelinde kışın ısıtılmadan kullanılmayan seralarda, alçak tünel kullanılarak sıcaklık ve ışık istediği düşük olan marul gibi ürünler yetiştirilebilir. Çalışmada alçak tüneller içerisinde kullanılan siyah plastik malç kök bölgesindeki toprağın sıcaklığını arttırmıştır ve bitki gelişimine olumlu katkı sağlamıştır.



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MER'A TOPRAKLARININ KORUNMASI VE YÖNETİMİNE İLİŞKİN POLİTİKALAR VE SÜRDÜRÜLEBİLİRLİĞİ

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ÖZET

Tarımsal üretimin gerçekleştiği toprak kaynaklarının kullanımında sürdürülebilirliğin koşulları ve başarısı toprak kaynaklarının korunmasına bağlıdır. Tarımsal üretim için tarım toprakları kadar önemli bir fonksiyonu bulunan mer'a topraklarının kendine özgü mülkiyet ilişkileri ve kullanım koşulları açısından benzersiz bir özelliği bulunmaktadır. Hayvansal üretimin doğal ve ekonomik olmasını ve gıda güvenliğini gerçekleştiren mer'a alanları gen kaynaklarının korunması, iklim değişikliği sürecine maliyetsiz katkısı gibi açılardan önemli bir toprak kaynağıdır. Devletin egemenliği alanında bulunan ve köylüye hayvanlarının otlatılması amacıyla kullanımı terkedilen mer'a topraklarının korunamamasının ve alan kaybının nedeni uzun yıllar boyunca bir mer'a yasasının çıkarılmamasına bağlanmıştır. Ancak 1998 yılında çıkarılan Mer'a Yasası'nın da bu azalışı durdurmadığı ve yasaya sürekli bir şekilde eklenen amaç dışı kullanımı kolaylaştıran düzenlemeler ve mer'alara ilişkin bilgi sisteminin bitirilmemesi nedeniyle de mer'aların yönetilemediği sonuç olarak ortaya çıkmaktadır. Ayrıca köy tüzel kişiliklerinin yok edildiği illerdeki mer'aların hukuki durumlarının belirsizliği ve varlıklarının sürdürülebilirliğinin yok edildiği de bir gerçektir. Mer'aların korunmasında etkin ve yeterli bir yasal altyapı ile birlikte korumayı birincil olarak ele alan politika ve planların uyumu kadar kurumsal yapılanmanın mer'aların yönetimi açısından sağlanması ve tüm bunların gerçekleşmesine yönelik politik isteklilik şarttır.

Anahtar Sözcükler: Mer'a, sürdürülebilir mer'a yönetimi, mer'a yasası, mer'aların korunması



POLICIES ON THE PROTECTION AND MANAGEMENT OF PASTURELANDS AND SUSTAINABILITY

ABSTRACT

The conditions and success of sustainability in the use of land resources where agricultural production takes place depends on the protection of land resources. Pasturelands, which have a function as important as agricultural lands for agricultural production, have a unique feature in terms of their own property relations and usage conditions. Pasture areas, which ensure natural and economic animal production and food security, are an important land resource in terms of protection of gene resources and cost-free contribution to the climate change process. The reason why the pasturelands, which are under the sovereignty of the state and whose use was abandoned for the purpose of grazing their animals by the villagers, could not be protected and the loss of land was attributed to the failure to enact a pasture law for many years. However, since the pasture law enacted in 1998 did not stop this decrease, and the regulations that facilitate the use of pastures for different purposes, which are constantly added to the law and the information system regarding the pastures was not completed, it emerges as a result that the pasturelands cannot be managed. In addition, it is a fact that the legal status of the pastures in the provinces where the legal entity of villages are abolished and sustainability of their existence is destroyed. In the protection of pasturelands, an effective and sufficient legal infrastructure, as well as the harmonization of policies and plans that primarily consider protection, as well as the provision of institutional structuring in terms of management of pasturelands and the political willingness to realize all these are essential.

Keywords: Pasture, sustainable pasture management, pasture law, preservation of pastures



1. GİRİŞ

Mer'alar mülkiyet ilişkileri ve kullanım koşulları ve hukuksal yapısı açısından farklı bir toprak alanı olup genel olarak hayvanların otlatılması amaçlı kullanıma uygun olan yerler olarak tanımlanmaktadır. Mer'aların mülkiyet ilişkileri tartışmalıdır, başka bir söylemle mülkiyetinin kime ait olduğu hukuki açıdan net değildir. Ayrıca mer'a yararlanma haklarının ve yükümlülüklerinin somut olmaması, bu alanların korunmasını ve yönetiminin sağlanabilmesini zorlaştırmaktadır.

Yurttaşlar Yasası'nın 715.maddesinde, yararı kamuya ait olan, devletin hüküm ve tasarrufu altında olan yerlerin kimsenin mülkiyetinde olmadığı ve hiçbir şekilde özel mülkiyete konu olamayacağı belirtilmiştir. Bu madde yararı kamuya ait olan yerlerle ilgili olup, sayıca sınırlı bir topluluğun yararlandığı yerler kapsam dışı bırakılmıştır. Ancak mer'aların bu alanların içinde sayılmaması bu alanların yararı kamuya ait niteliğini taşımadığını göstermez. Kuşkusuz bu alanlar bir topluluğun kullanımına terk edilen kamu malları özelliğini taşımaktadır. Mer'alara ilişkin ilk yasal düzenleme olan Arazi Kanunnamesi'nde metruk topraklar sınıfında ele alınan mer'alar belli bir köy ve kasaba halkının kullanma ve faydalanmasına özgülenen yerler olarak tanımlanmıştır (Aksoy S, 1984). Mülkiyet hakkını ve bu hakka ait genel kuralları düzenleyen Yurttaşlar Yasası mer'aların mülkiyet ve hukuki durumlarını açıklamamıştır. Mer'alarla ilgili tek kuralında yetkili makamlar tarafından bitki örtüsünü korumak amacıyla yasaklanmadıkça, herkesin başkasının mer'asına girebileceğini ve oralarda yetişen yabani meyve, mantar ve benzeri şeyleri, yerel âdetlerin izin verdiği ölçüde toplayıp alabileceğini belirtmiş, sonuç olarak bu alanların mülkiyet ilişkileri ile ilgilenmediğini ortaya koymuştur (Madde 751).

Mer'aların amaç dışı kullanılmasının ve tahribinin önlenmesine ilişkin görev ve sorumluluk 1982 Anayasası ile devlete verilen görevler arasında yer almaktadır (Madde 45). Devletin mer'a topraklarının korunmasından ve amacına uygun olarak kullanılmasından Anayasa gereğince olan bu sorumluluğunu üstlenmediği mer'a istatistikleri incelendiğinde mer'aların alansal olarak azaldığı gerçeğinden anlaşılmaktadır. 1940 yılında yaklaşık 44,2 milyon hektar kadar olan mer'a toprakları 1960 yılında 28,7 milyon hektara, 1988 yılında 14,2 milyon hektara gerilemiştir. Bu yıllar arasında gerçekleşen % 67,9 oranındaki azalışta tarımda teknoloji kullanımının ve makinalaşmanın artışı ile mer'a topraklarının tarım topraklarına dönüşümünün önemli bir etkisi vardır. Yürürlükte olan farklı yasalar gereği mer'aların köylüye ait olan ortak kullanım hakkının hayvan otlatılması dışında kullanılmasının yasaklanmış olmasına karşın bu



dönüşümün gerçekleşmesi yasaların uygulanmasındaki yetersizliğin bir sonucudur. Ayrıca mer'a istatistiklerinin güvenilirliğinin de incelenmesi gerekmektedir. 1988 yılında 14,2 milyon hektar olan mer'a toprakları 1991 yılında % 12.7 oranında azalarak 12,4 milyon hektara gerilemiş, 2001 yılında ise % 17.7 artışla 14,6 milyon hektara genişlemiştir. 14,6 milyon hektar olan bu genişlik TÜİK'in istatistiklerinde 2021 yılı için de geçerliliğini korumaktadır. Mer'aların alansal kaybının yanı sıra, ağır otlatma koşulları altında çoraklaşma ve erozyon tehlikesinin yaşandığı verimsiz mer'a alanları gerekli bakım, koruma çalışmalarının yapılmamasına bağlı olarak da özelliklerini yitirmektedir. Türkiye'de mer'a alanlarının %87,6'sı orta ve zayıf mera sınıfında yer almakta ve mer'a alanlarının %29,46'sında çok hafif, %28,18'inde hafif, %13,59'unda orta, %11,57'sinde şiddetli ve %17,2'sinde çok şiddetli erozyon görülmektedir (Anonim, 2019). Mülga Köy Hizmetleri Genel Müdürlüğü'nün il toprak varlığı raporlarına göre çayır-mer'a kullanım alanlarının 733 422 hektarında, çoraklık sorunu bulunmaktadır (Sönmez B, 2003). Bu alanın iklim değişikliği, küresel ısınma nedeniyle daha da artmış olduğu gerçeği kullanılabilir mer'a niteliğinde olan alanın 14,6 milyondan daha az olduğu sonucunu yaratmaktadır. Mer'aların mülkiyeti diğer toprak mülkiyet çeşitlerine göre farklı olduğundan hukuki tanımlarının yapılmış, sınırlarının belirlenmiş ve ilgili köy veya köy topluluğuna özgülenmiş alanların genişliği gerçek mer'a alanı konusunda daha net bir sonuç verecektir. 4342 sayılı Mer'a Yasası gereğince 1999-2021 yılları arasında 14.616.687 dekar olan mer'a genişliğinin 13.061.786 dekar alanda belirleme (% 89,4), 12.623.034 dekar alanda sınırlandırma (% 86,4), 5.722.348 dekar alanda özgüleme (% 39,1) işlemleri tamamlanmıştır (Anonim 2022a). Bu veriler, özellikle özgüleme konusundaki uygulamaların daha yavaş ilerlediğini, başka bir deyişle mer'a alanlarının yaklaşık 1/3 ünün alansal kullanımında yasal sürecin tamamlandığını göstermektedir. Ancak Yasa'nın 1998-2015 yılları arasında 2.433.432,4 dekar genişliğindeki bir alana amaç dışı kullanım için izin vermesi, toplam mer'a alanlarının % 1,7'sinin 18 yıl gibi bir sürede yok edilmesi, Yasa'nın mer'a alanlarının azalışını engellemede bir fonksiyonu olmadığını ve mer'a alanlarını korumada yetersiz kaldığını açık bir biçimde ortaya koymaktadır.

Mer'alar hayvansal üretimin kaba yem girdisini neredeyse maliyetsiz bir şekilde üreticiye sunan önemli bir doğal kaynaktır. Ayrıca Türkiye'deki küçük aile işletmelerinin üretimini sürdürebilmesinde ve varlığını devam ettirebilmesinde mer'a hayvancılığının katkısı büyüktür. Küçük işletmelerin kısa vadeli sermaye gereksiniminde hayvancılık üreticiye önemli bir katkı sağlamakta ve mer'aya dayalı üretimle düşük maliyet avantajı elde edilebilmektedir. Hayvancılığın sürdürülmesine üretim ortamı sağlayan mer'alar, ekolojik dengenin olumlu



yönde gelişmesini gerçekleştiren önemli doğal alanlar olarak kabul edilmektedir. Ayrıca açık alanda ve uzun süreli otlatmaya dayalı üretim, yalnız ülkenin gen kaynakları ile olası olduğundan mer'a hayvancılığı hayvansal gen kaynaklarının koruyucusu da olmaktadır.

Kalkınmanın çoğu zaman ekonomik büyüme ile eş anlamlı olarak düşünülmesi kaynakların kullanım kararlarında çevresel değerlerin yeterince önemsenmemesi sonucunu yaratmaktadır. Ancak küresel ısınma ve iklim değişiklikleri ülkelerin bu kararlarını yeniden değerlendirmesini sağlamış ve sürdürülebilir bir kalkınma için yeşil büyüme politikalarını geliştirmelerine neden olmuştur (Özdemir B, 2009; Anonim, 2012a). Türkiye'nin 2011-2023 yıllarını ele alan iklim değişikliği eylem planında mer'a alanlarının kullanımları ve değişimlerinin iklim değişikliğini olumsuz yönde etkilemesini sınırlandırmak amaçlanmıştır. Bu amaçla 2012 yılında çayır ve mer'a alanlarında tutulan karbon miktarını belirlemek ve 2020 yılına kadar bu değeri %3 oranında artırmak öngörülmüştür. 2011-2015 yılları arasında mer'a mevzuatının sera gazı emisyonları ve yutaklar ilişkisi bağlamında gözden geçirilmesi ve izleme, denetim, yaptırım konularında etkin bir sistemin oluşturulması da eylem planında yer almıştır. Mer'a yönetiminin etkinleştirilmesi amacıyla 2018 yılına kadar mer'a bilgi sisteminin tamamlanması planlanmıştır.

Türkiye'de insan kaynaklı sera gazı toplam emisyonuna %1.8 oranla yutak alan oluşturan mer'alar, iklim değişikliği ile mücadele için karbon tutma kapasitesi açısından korunması gereken alanlardır (Anonim, 2013a). Etkin bir mer'a yönetimi ve mer'aların amaç dışı kullanımının azaltılması iklim değişikliği ile mücadelede herhangi bir maliyet gerektirmeyen önlemler içinde yer almaktadır. Mer'alara ilişkin bu önlemlerin doğru politikalar ve yasal düzenlemelerle desteklenmesinin sonuçları kısa vadede görüleceğinden düşük ve yüksek maliyetli önlemler için de artı getiriler sağlayacaktır (McKinsey&Company, 2009). İklim değişikliğine karşı mücadele bütçesine ekonomik katkılarının dışında, mer'aların korunmasının çok yönlü; çevresel, ekonomik ve sosyal artıları olacağı açıktır.

2. 4342 SAYILI YASADA MER'A TOPRAKLARI

Türkiye'de mer'a konusu 1998 yılına kadar farklı yasalar içeriğinde düzenlenmiştir. Çok sayıdaki kuruluşun yetki ve görev alanında olması ve mülkiyet ilişkilerinin ve kullanımının düzenlenmesinin korumacı bir anlayıştan uzak bir şekilde ele alınması nedeniyle mer'a topraklarının genişliği giderek azalmıştır. Yurttaşlar Yasası'nda mer'aların hukuksal durumunu belirleyen kurallar getirilmemiş, Arazi Kanunnamesi'ndeki (1858) metruk topraklar sınıflamasının Yurttaşlar Yasası'na aykırı olmadığı görüşünden hareketle, mer'alarla ilgili olarak geçerli olduğu kabul edilmiştir (Aksoy S, 1984). Yargıtay kararlarında ve çeşitli



yasalarda ortaya çıkan dağınık bir mevzuat içinde mer'aların hukuki özelliklerini ortaya koyan bir görüş oluşmuştur. Mer'alara ilişkin ilk kapsamlı düzenleme olan 1757 sayılı Toprak ve Tarım Reformu Yasası'nın 131-160. maddeleri mer'a topraklarına ayrılmıştır. Bu Yasa, mer'alardan yararlanmayı ayrıntılı bir biçimde düzenleyen ilk yasa olup dağınık bir mevzuat içinde yer alan kurallar ve eski mevzuatın mer'a kuralları güncellenmiştir. Yasa'nın kısa ömürlü olması nedeniyle mer'alarla ilgili kurallarının uygulanma olanağı kalmamıştır.

25.2.1998 tarihinde kabul edilen ve 28.2.1998 tarihli Resmi Gazete'de yayımlanarak yürürlüğe giren 4342 sayılı Mer'a Yasası 38 madde ve 7 bölümden oluşan bir yasadır (Anonim, 1998a). Yasa'da mer'aların hukuki niteliği ve mülkiyete ilişkin konumu; mer'aların özellikleri, kullanım amacı ve kullanıcıları ile devletin mer'alarla olan hukuki ilişkilerinden yola çıkarak açıklanmaktadır. Yasa gereğince mer'alar devletin hüküm ve tasarrufunda olan alanlardan hayvanların otlatılması ve otundan yararlanılması için daha önce çeşitli yasalarla bir veya birden çok köy veya belediyeye özgülenmiş veya kadimden beri bu amaçla kullanılan yerler olarak belirtilmektedir (Madde 1, 3 ve 4). Bu tanımlama ve içerik Arazi Kanunnamesi ve 1757 sayılı Yasa'da da geçerli olan bir koşuldur. Bu topraklar üzerinde devletin bir mülkiyet hakkı bulunmamakta, yalnız denetim ve koruma yetkisi bulunmaktadır. Yine 4. maddede mer'aların özel mülkiyete geçirilemeyeceği, amacı dışında kullanılamayacağı, zaman aşımının uygulanamayacağı, sınırlarının daraltılamayacağı, ancak kullanım hakkının kiralanabileceğine ilişkin kurallar Yargıtay kararlarında da yer alan ve Yasa öncesi mer'aların hukuki niteliğini belirleyen ve genel kabul görmüş kurallardandır.

Yasa'nın 12. maddesine gereğince, köy veya belediye tüzel kişiliklerine özgülenmesi yapılacak alanın gereksinimden fazla olan kısmının çevre köy veya belediyelere ve hayvancılık yapan özel veya tüzel kişilere kiralanması, doğru bir yaklaşım olmayıp eleştirilmesi gerekmektedir. Çevre köy ve belediyelerin mer'aya olan gereksiniminin o köy veya belediyelere mer'a özgülemesinin yapılması ile karşılaşma yoluna gidilmesi mer'aların hukuki niteliklerine daha uygun olacaktır. Böyle bir uygulama olanağı yasa da yer alırken kiralamaya gidilmesi açıkça yasanın mer'aya ilişkin hukuki niteliğine aykırıdır. Ayrıca, mer'aların hayvancılık yapan özel veya tüzel kişilere kiralanabilmesi, mer'aların kullanım amacına ve özüne aykırıdır. Mer'alar köylünün hayvanlarının otlatılması için köylüye özgülenen bir alandır ve bireysel yararlanma kabul edilemeyecek bir olgudur.

Bu nedenle 27.2.2013 tarihinde 6443 sayılı Yasa ile yapılan değişiklikler, mer'a alanlarının yapısını bozacak nitelikte olmuştur. Kiralanacak alanda hayvancılık için gerekli bakım, barınma ve su gereksinimlerini karşılayacak zorunlu hayvancılık tesislerinin kurulabilmesine



olanak sağlanması ile mer'aların hayvancılık yapan tarım işletmelerine dönüştürülmesi olanağı doğmuştur. Burada köylüye tanınmayan bu uygulamanın kiralama yapan özel ve tüzel kişilere tanınması gerekçesinin mantığını kavramak önemlidir. Çünkü mer'aların gelir getirici özellikleri nedeniyle devlete rant sağlama potansiyeli, mer'aların gerçek kullanım amacına zarar vermekte ve ortadan kaldırmaktadır. Tablo 2.1' de mer'alarda 6443 sayılı Yasa ile yapılan değişiklikten sonra 2013 ve 2014 yılları için kiralanan alanların artışı bu değişimin mer'a varlığı açısından değişimini göstermektedir. Yasa'ya göre, ıslah edilerek mer'a olarak kullanılabilen alanların gerekli işlemlerini gerçekleştirmeyi üstlenen özel ve tüzel kişilere kiralanabilmesi kuralının verimli mer'a alanlarının artışına katkısı bu alanların izlenmesi ve denetlenmesinin etkin yapılabilmesine bağlıdır. Ancak bu kuralın yaygın bir uygulama alanının olmadığı da bir gerçektir.

Tablo 2.1. Mer'a Yasası'na göre kiralanan mer'a alanları (Anonim, 2022 b)

Yıllar	Kiralanan İl Sayısı	Kiralanan Alan (Ha)
2006	23	175.411
2007	30	205.936
2008	30	199.951
2009	31	200.809
2010	36	161.161
2011	35	137.339
2012	29	121.958
2013	24	392.092
2014	33	365.526
2015	30	208.551
2016	27	230.621
2017	32	251.565
2018	34	263.700
2019	33	257.974
2020	33	288.951
2021	35	351.172
Toplam		3.745.793

Yasa'nın uygulayıcı kuruluşu Tarım ve Orman Bakanlığı olmasına rağmen, mer'a alanlarının belirlenmesi, sınırlandırılması ve özelleştirilmesi için her ilde bir mer'a komisyonu oluşturulması ve çalıştırılması valiliklerin sorumluluğundadır. Komisyonlar, bölgenin ekonomik durumunu, iklim özelliklerini, toprak işleme esaslarını, toprak kullanma şekillerini



ve kullanma yetenek sınıflarını dikkate alarak mevcut mer'aları ve bu amaçla kullanılabilen diğer alanları sulama ve geçit yerlerini belirlemek ve harita üzerinde işaretlemekle görevlidir. Muhtarlar ve belediye başkanları, mer'aların ve sınır işaretlerinin korunmasından ve özelleştirme amacına uygun şekilde en iyi şekilde kullanılmasından sorumlu tutulmaktadır. Bu amaçla, ilgili köy ve belediyelerde Mer'a Yönetim Birlikleri kurulması öngörülmüştür. Yasa, mer'aların sürdürülebilir kullanımını ve korunmasını, köylülerin katılımıyla ilişkilendirme amacını doğru bir kural olarak belirlemiştir. Bu birliklerin görevleri arasında otlatma planlarının en iyi şekilde uygulanması, bakım, ıslah çalışmalarının organizasyonu, gereksinim fazlası ürünlerin satılması, otlatma ücretlerinin toplanması ve harcanması, ayni ve nakdi katkıların toplanarak mer'a ıslah ve geliştirme işlerinde kullanımı, mer'a sınırlarının korunması, tecavüzlerin önlenmesi ve bu tecavüzlerin ilgililere bildirilmesi yer almaktadır (Anonim, 1998b). Ancak, kırsal alanlarda etkin ve işlevsel bir birlik yapısının oluşturulması ne kadar zor olduğu da bilinmektedir. Bu birliklerin sayısının 1.232 olduğu (Anonim 2013b) dikkate alındığında, sayısal yetersizlik sorunu bir de etkin çalışma koşullarının yetersizliği ile birleşince, Yasa'nın birlikler aracılığıyla mer'aların korunması ve yönetimi konusunda yeterince başarılı olamadığı görülmektedir.

Yasa gereğince mer'alardan yararlanma hakkı sınırsız değildir ve bu hak yükümlülüklerle birlikte tanınmıştır. Mer'alardan yararlananların bakım ve ıslah çalışmalarına ait giderlere katılımlarını ve ayrıca otlatma haklarına göre her yıl belirlenecek otlatma bedelini ödemelerini sağlayıcı kurallar getirilmiştir. Bu nedenle, mer'alardan bedelsiz olarak yararlanma hakkı ortadan kaldırılmaktadır. Mer'alara komisyonca belirtilen miktardan fazla hayvan sokulmayacağı kuralı da diğer bir yükümlülüktür. Ancak, mer'alarda ağır bir otlatmanın yapıldığı dikkate alındığında bu kuralın uygulanması pek olası değildir.

Yasa'nın en önemli bölümü, en çok değişikliğe uğrayan ve uygulamada mer'a topraklarının daha da azalmasını sağlayacak olan özgülemenin kaldırılmasını kolaylaştırıcı ilkeleri içeren 14. maddedir. Bu madde gereğince, durumu ve sınıfı çok iyi veya iyi olan mer'alarda kullanım amacı değişikliği yapılmayacaktır (a, f, g, ğ ve h bentleri hariç). Bu madde değişiklikleri ile birlikte incelendiğinde tahsis kararının kaldırılmasının kolaylaştığı ve mer'aların amaç dışı kullanım kapsamının genişletildiği net bir biçimde izlenebilmektedir.

27.5.2004-5178,3. madde:

a) Enerji ve Tabii Kaynaklar Bakanlığı'nın talebi üzerine, arama faaliyetleri sonunda rezervi belirlenen maden ve petrol faaliyeti ile jeotermal kaynak ve doğal mineralli sular için zaruri olan,



- b) Kültür ve Turizm Bakanlığı'nın talebi üzerine, turizm yatırımları için zorunlu olan,
- c) Kamu yatırımları yapılması için gerekli bulunan,
3.7.2005 – 5403,27. madde:
- d) Köy yerleşim yeri ile uygulama imar planı veya uygulama planlarına ek imar planlarının hazırlanması, toprak koruma, gen kaynaklarının korunması, milli park ve koruma ormanı kurulması, doğal, tarihi ve kültürel varlıkların korunması, sel kontrolü, akarsular ve kaynakların düzenlenmesi, bu kaynaklarda yapılması gereken su ürünleri üretimi ve termale dayalı tarımsal üretim faaliyetleri için gereksinim duyulan,
- e) 442 sayılı Köy Yasası'nın 13. ve 14. maddeleri kapsamında kullanılmak üzere gereksinim duyulan,
- f) Ülke güvenliği ve olağanüstü hal durumlarında gereksinim duyulan,
- g) Doğal afet bölgelerinde yerleşim yeri için gereksinim duyulan,
26.3.2008-5751,3. madde, 9.7.2008-5784,26. madde:
- ğ) Enerji Piyasası Düzenleme Kurumunun talebi üzerine, petrol iletim faaliyetleri ile elektrik ve doğal gaz piyasası faaliyetleri için gerekli bulunan,
26.3.2008-5751,3. madde:
- h) Jeotermal kaynaklı teknolojik seralar için ihtiyaç duyulan,
10.9.2014-6552,112. madde:
- ı) Cumhurbaşkanınca kentsel dönüşüm ve gelişim proje alanı olarak ilan edilen yerler,
28/11/2017-7061,53. madde:
- i) Endüstri bölgeleri, teknoloji geliştirme bölgeleri, organize sanayi bölgeleri ve serbest bölgeler için kuruluş ve genişleme aşamalarında ihtiyaç duyulan,
15/2/2018-7099,11. madde:
- j) Elektronik haberleşme altyapıları için ihtiyaç duyulan, yerler amaç dışı kullanıma ayrılacak mer'a alanlarıdır.

Hayvansal üretim ve doğal denge için son derece önemli olan mer'a alanlarının kullanım koşullarını belirleyen Mer'a Yasası'nın, ilk düzenlemesinde, özgüleme kararını kaldırma yetkisi Tarım ve Orman Bakanlığı'na tanınmıştı. Ancak bu yetki 21.06.2004 tarih ve 5178 sayılı Yasa ile yapılan değişiklikle Mera Komisyonlarına devredilmiştir. Her ilde farklı uygulamaların ve bu komisyonların siyasi ve bürokratik açıdan 14. maddenin uygulanmasına yönelik olarak baskı altında kalma olasılığı mer'a alanlarının azalmasının diğer bir nedenidir. Aslında Mera Komisyonları, teknik olarak çalışmaları gereken oluşumlardır ve mer'a alanlarının belirlenmesi, sınırlandırılması gibi konularda uzmanlaşmışlardır. Bu nedenle,



Bakanlığın bu yetkisinin devri sorgulanmalıdır. Tablo 2.2.'de özgülleme kararı değiştirilen mer'aların % 82.2'sinin 2005-2015 yılları arasında gerçekleşmesi yetki devrinin sonuçlarını ortaya koymaktadır. Bu madde gereğince 2015 yılından sonraki yıllar için amaç dışı kullanım verilerini Tarım ve Orman Bakanlığı yayınlamayı bırakmıştır. Ancak, Sayıştay'ın Bakanlığa ilişkin denetim raporunda, 2019 yılı sonunda 14. madde uyarınca özgülleme amacı değişikliğine ilişkin verilen 337 250,47 hektar genişlik artan bir şekilde mera alanlarının yok oluş sürecinin devam ettiğini göstermektedir(Anonim 2020). Ayrıca, aynı kurumun 2017 yılı denetim raporunda, toplam 107 816 hektar mer'a yaylak ve kışlak alanda bina, ahır, taşocağı, turizm alanı, konut, fabrika vb. kaçak yapılaşma yapıldığı, ayrıca tarla, zeytinlik, bahçe, sera gibi tarımsal amaçlı kullanıma dönüştürüldüğü bildirilmektedir(Anonim 2018). Mer'a alanlarının korunması ve sınırlanması konusunda, doğru kararlar alınması ve bunların uygulanması son derece önemlidir. Tarım ve Orman Bakanlığı, bu konuda daha aktif ve koruyucu bir rol üstlenmelidir.

Kamu kurumları ve işletmeciler, amaç dışı kullanım kapsamında faaliyetlerini çevreye ve kalan mer'a alanlarına zarar vermeyecek şekilde yürütmek ve kullanım süresi bitiminde eski haline getirmekle yükümlüdürler(9.7.2008-5784, 26. madde). Ancak kentsel dönüşüm ve gelişim alanları, imar ve uygulama planları alanları, turizm yatırımları, köy yerleşim yerleri ve endüstri bölgeleri, teknoloji geliştirme bölgeleri, organize sanayi bölgeleri ve serbest bölgeler olarak kullanılan mer'aların geri dönüşümü söz konusu olmadığı için yok olacaklardır. Mer'aların kentsel dönüşüm için kullanımı için 20 yıllık ot bedeli ödenerek süresiz olarak yok edilmesi ise Yasa'nın eleştirilen diğer bir uygulamasıdır. Bu nedenle, koruma öngörüsü kapsamında düzenlenen Mer'a Yasası'nın, farklı kullanım amacı için izin veren bir düzenleyici yasa haline geldiğini belirtmek önemlidir. Kırsal veya kentsel dönüşüm için kullanılan mer'a alanlarının arsa statüsüne dönüştürülmesi köylülerin hayvanlarını olatma ve doğal çevre için önemli olan bu alanların kaybolmasına yol açmaktadır. Türkiye'deki tarım ve orman alanlarında yaşanan benzer süreçlerden mer'aların da payını aldığı görülmektedir.



Tablo 2.2. Mer'a Yasası'na göre 14. madde kapsamında özgüleme amacı değiştirilen alanlar
(Anonim,2016)

Yıllar	Genel Toplam (da)
1998	12.325,1
1999	25.430,9
2000	30.365,3
2001	69.236,7
2002	23.393,0
2003	95.935,5
2004	176.773,4
2005	221.131,1
2006	256.278,0
2007	223.099,4
2008	412.074,3
2009	147.520,9
2010	169.764,8
2011	175.103,5
2012	132.074,5
2013	86.397,2
2014	108.844,6
2015	67.684,0
Genel Toplam	2.433.432,4

3. 6360 SAYILI YASADA MER'A TOPRAKLARI

6360 sayılı On Dört İlde Büyükşehir Belediyesi Ve Yirmi Yedi İlçe Kurulması İle Bazı Kanun Ve Kanun Hükmünde Kararnamelerde Değişiklik Yapılmasına Dair Yasa ile Türkiye'de mülki idare sınırları ile belediye sınırlarını eşleştirilmiştir (Anonim, 2012b). Bu illerde kırsal alanın kentsel alan kapsamına alınması ile 30 ilde 16,220 köy tüzel kişiliğini kaybederek mahalleye dönüşmüştür (Anonim, 2022c). Köylerin hukuksal varlıkları ortadan kaldırılmış olsa da var olma gerçeği açısından köy yapıları aynı şekilde devam etmektedir. Tüzel kişiliklerine son verilen köylerin hakları büyükşehir belediye yönetimlerine verilmiştir ve bunun sonucunda belediyelerin yetki alanı kırsal alanı da kapsayacak şekilde genişlemiştir. 2001 yılında yapılan tarım sayımına göre, 30 ilde toplam mer'a alanlarının %46.5'i artık belediyelerin yetki alanına girmiştir (Anonim, 2022d).

Hazinenin özel mülkiyetinde veya devletin denetim ve tasarrufunda bulunan taşınmazlardan köy tüzel kişiliklerine tahsis edilen meralar yasaya göre mahallenin bağlı olduğu belediyeye devredilmiştir. Yasa'nın 16. maddesi gereğince bir belediyeye katılarak mahalleye dönüşen köy, köy bağılısı ve belediyelerce kullanılan mer'alardan mahallede yerleşmiş bulunan nüfusun ve varsa diğer hak sahiplerinin yararlanmaya devam edeceği ilke olarak



benimsenmiştir. Mer'a Yasası kuralları gereğince meralarda hak sahibi olanların köylünün olduğu bilinmesine rağmen, 6360 sayılı Yasa'da atıfta bulunulan "diğer hak sahipleri"nin kimler olduğu, içeriği açıklanmadığı için netlik kazanmamıştır. Mer'aların kiralanabilmesi kuralına göre, mer'a kiracıları diğer hak sahipleri olarak kabul edilebilir. Bu alanlar için idari yapı değişmiş olsa da, 4342 Sayılı Mer'a Yasası çerçevesinde köyden mahalleye dönüşen yerlerdeki hak sahiplerinin meralardan yararlanmaya devam edecek olması, kullanım şeklinin değişmediği sonucunu doğurmaktadır. Ancak mahalle yönetiminin tüzel kişiliğinin olmaması, meraların kullanımı ve korunmasında köylüyü tamamen etkisiz hale getirmektedir. Köy tüzel kişiliklerine tahsis edilen veya uzun süre bu amaçla kullanılan meralar ile belediye sınırları içinde yer alan meraların aynı hukuki koşullara sahip olmadığına dair Anayasa Mahkemesi kararı bu açıdan önemlidir (Anonim, 2004). Buradaki temel sorun, büyükşehir belediyeleri tarafından hazırlanan imar planları ve yatırımlar doğrultusunda amaç dışı kullanıma karar verme sürecinin kolaylaşacağı ve mera alanlarının korunmasının giderek zorlaşacağıdır (Gün S, 2014). 2014 yılında kentsel dönüşüm ve gelişim proje alanları için mer'a alanlarının kullanımına ilişkin yapılan düzenleme, mer'aların kentsel alanlar lehine terk edildiğini açık bir şekilde göstermektedir. Kırsal kesimde köyün ve köylünün yasal yetkilerinin yok edilmesinin, belediyelerin ekonomik ve siyasi kazanımları doğrultusunda meraları kullanmalarına ve yönetmelerine olanak tanıyacağını öngörmek tamamen yanlış olmayacaktır.

Türkiye'nin tarihsel olarak en eski yerleşim birimleri olan köylerin yasal olarak mahallelere dönüşmesi, bu yerleşimleri fiziksel olarak bir kentin parçası yapmamaktadır (Gözler K, 2013). Kentsel alan yönetimi için kurulan belediyelerin doğal olarak kırsal alanı yönetim politikaları imar ve yerleşimin düzenlenmesi şeklinde olacaktır. Köyün ve köylünün yaşam tarzı, ekonomik ilişkileri, sosyolojik yapısı, kırsalın sadece bir yerleşim alanı olmayıp, su kaynakları, ormanlar, tarım alanları, mer'alar gibi doğal kaynakları da içinde barındırması, kırsal alanın belediyelerin görev ve yetki alanlarının kapsamına sığamayacak kadar çok yönlü bir yapısı olduğunu göstermektedir. Mer'a Yasası'nda sıkı kurallarla korunmayan ancak doğal ve çevresel değeri yüksek olan mer'alar, rant amaçlı kullanımlara dönüştürülecek en kolay alanlar olacaktır. Belediyelerin alan kullanımında korumaya öncelik vermek yerine imara dayalı planlamalar yapan kuruluşlar olması nedeniyle, mer'alar yerleşim ve diğer hizmet alanlarına dönüştürülecektir.

Türkiye'de devletin hüküm ve tasarrufu altındaki bulunan mer'aları koruma konusunda etkili ve sürdürülebilir bir politikasının olmaması nedeniyle Mer'a Yasası yeni düzenlemelerle işlevsiz bir hale getirilmiştir. Devletin köylünün yararlanmasına terk edilen mer'aların amacına



uygun kullanılması için gereken yükümlülüklerini üstlenmemesi ve bu alanların yerel yönetimlerin imar amaçlı kullanımına zemin olarak sunulması, mer'aların yok oluş sürecini hızlandıracak bir ortam oluşturmaktadır. Bu nedenle köylerin mahalleye dönüştürülmesi sürecinin toplumsal, yönetsel ve ekolojik açıdan olumlu sonuçlar doğurmasını beklemek güçtür (Zengin O, 2015).

4. SONUÇ

Meralar, Türkiye'de küçük aile işletmelerinin sürdürülmesinde önemli katkıları olan doğal alanlardır. Bu toprakların, ülkenin yerli hayvansal gen kaynaklarının ve biyolojik çeşitliliğinin korunmasında, iklim değişikliği ve küresel ısınmaya karşı mücadelede, toprak çeşitliliğinin sağlanmasında önemli bir rolü bulunmaktadır. Ayrıca, bu alanlar hukuki özellikleri ve mülkiyet ilişkileri açısından geleneksel bir yapıya sahiptir ve Türkiye'ye özgü nitelikleri olan topraklardır. Ancak, meraların korunması ve sürdürülebilir kullanımı konusunda birçok risk faktörü bulunmaktadır. Aşırı ve yanlış kullanım, verimsizleşme ve erozyon gibi nedenlerle, koruma ve kullanma dengesi sağlanamayan mera alanları çoğunluktadır. Bu alanların yeterli bakım ve koruma önlemleri ile kullanım amacına yönelik olarak yeniden kullanılabilmesini sağlamak için uygun önlemlerin alınması, planlama, izleme ve denetimde tutarlılık sağlanması gerekmektedir. Bununla birlikte, Mer'a Yasası da bu sorunların bir parçasıdır. Yasadaki sürekli değişiklikler, mer'aların özgüleme amacının neredeyse bütün kullanım amaçlarına açık hale getirilmesine neden olmuştur. Kamusal planlamalar da mer'a alanlarını koruyucu ve dokunulmaz olarak ele almamaktadır. Özgüleme amacının kaldırılması kararı, kolayca ve çoğunlukla bedelsiz ya da 20 yıllık ot bedeli karşılığı ile elde edilmektedir.

Meraların korunması ve geliştirilmesi için yapılması gerekenler arasında, Mera Yasası'nda özgüleme amacı değişikliğini kolaylaştıran düzenlemelerin yürürlükten kaldırılması ve amaç dışı kullanımlar için zorunluluk koşullarının ayrıntılı olarak belirlenmesi yer almaktadır. Ayrıca, köy tüzel kişiliğinin kaldırıldığı illerde yer alan meraların büyükşehir belediyelerinin gerçekleştireceği kentsel yerleşim politikalarından uzak tutulması için yasal kurallar oluşturulması gerekmektedir. Kentsel alan yönetiminde uzmanlaşmış olan belediyelerin meraların ve köylerin yönetimine öncelikli politikalar oluşturması beklenmemelidir. Bu nedenle, uygulama imar planları ve kentsel oluşum kapsamı içinde kalan meraların doğal ve yeşil alan olarak ayrılmasını sağlayacak ve üzerinde her tür yapılaşmanın engellenmesini sağlayacak yasal düzenlemeler yapılmalıdır. Böylece, bu alanlar doğal özelliklerini koruyucu ve iyileştirici önlemlerle kentin yeşil alan gereksinimini karşılayacak ve küresel ısınma ve iklim değişikliği ile mücadelede ekosistem dengesi içindeki yerini koruyacaktır.



Kurumsal ve yasal yapılanmalarına rağmen mer'a alanlarının yıllar içinde giderek azalması korumadaki politik istekliliğin ve önceliğin bulunmadığını açıkça göstermektedir. Ayrıca yasada yer alan amaç dışı kullanım alanlarının yıllar içindeki artışı ve kamu yararı gerekçelendirilmesinin yapılma kolaylığı bulunmaktadır. Mer'a alanlarının doğal varlık özelliği öncelikli hale getirilmeli ve Mer'a Yasası bu çerçevede yeniden düzenlenmelidir.



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**LAVANTADA (*Lavandula x intermedia* Emeric ex Loisel. var. Super A)
GİBBERELLİK ASİT UYGULAMASININ VERİM VE KALİTE
ÖZELLİKLERİ ÜZERİNE ETKİSİ**

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ÖZET

Bu araştırma 2018 yılında Isparta Uygulamalı Bilimler Üniversitesi Gül ve Aromatik Bitkiler Uygulama ve Araştırma Merkezinde (GÜLAB) yürütülmüştür. Araştırmada 8 yaşında lavandin bitkileri materyal olarak kullanılmıştır. Bitkilere iki farklı dönemde (yapraklanma & tomurcuklanma dönemi) 1'er hafta arayla 2 defa olmak üzere 100, 200, 300 ppm dozlarında gibberellik asit (GA_3) büyüme düzenleyicisi sabah erken saatlerde sprey şeklinde püskürtülmüştür. Araştırma tesadüf blokları deneme deseninde iki faktörlü düzenlemeye göre 3 tekerrürlü olarak yürütülmüştür. Dozlar ve dönemler arasındaki farklılıklar çiçek başakçık sayısı hariç hepsinde önemli iken, doz \times dönem interaksyonunda ise çiçek başakçık sayısı, uçucu yağ içeriği ve verimi hariç diğer özellikler önemli bulunmuştur. Taze çiçek ve kuru drog verimi en yüksek yaprak uygulamasında 100 ve 200 ppm GA_3 dozlarında elde edilirken, çiçekten GA_3 uygulamasında 200 ppm dozundan alınmıştır. Uçucu yağ oranı en yüksek çiçekten GA_3 uygulamasında edilmiştir. Ancak doz artışına paralel olarak her iki uygulamada da uçucu yağ oranı azalmıştır. GA_3 'ün yapraktan uygulanması uçucu yağda linalool oranı 100 ppm dozunda (%37.54) kontrole (%43.80) göre azalırken, doz artışı ile birlikte %42.49'a kadar yükselmiştir. Ancak çiçek uygulamasında artan doz ile birlikte linalool oranı %33.82'ye kadar gerilemiştir. Kontrol uygulamasında linalyl acetate oranı %14.42 olarak belirlenirken, çiçeklere uygulanan 300 ppm GA_3 ile birlikte %31.83'e yükselmiştir. Camphor oranı ise kontrole (%6.23) göre sadece yapraktan 100 ppm uygulamasında (%5.47) daha düşük bulunmuştur. Sonuç olarak; 100 ppm GA_3 'ün yaprak uygulamasında en yüksek taze çiçek verimi alındığı için önerilebilir. Ancak GA_3 uygulaması uçucu yağ sentezini azalttığı için uçucu yağ verimi bakımından kontrol ile 100-200 ppm uygulamalarında farklılık gözlenmemiştir.

Anahtar Kelimeler: Lavanta, *lavandula x intermedia*, gibberellik asit, verim, uçucu yağ ve bileşenleri



EFFECT OF GIBBERELLIC ACID APPLICATION ON YIELD AND QUALITY CHARACTERS IN LAVANDIN (*Lavandula x intermedia* Emeric ex Loisel. var. Super A)

ABSTRACT

This research was carried out at Isparta University of Applied Sciences Rose and Aromatic Plants Application and Research Center (GÜLAB) in 2018. 8-year-old lavandin plants were used as material in the study. The plants were sprayed with gibberellic acid (GA₃) growth regulator in the early morning hours at doses of 100, 200, 300 ppm, 2 times with 1 week intervals, in two different periods (foliation & budding periods). The research was carried out in randomized blocks design with three replications according to two-factor arrangement. While the differences between doses and periods were significant except for the number of floret, all features were significant in the dose × period interaction except the number of floret, essential oil content and yield. While the highest yield of fresh flowers and dried drugs was obtained at 100 and 200 ppm GA₃ doses in leaf application, 200 ppm dose was obtained from flower in GA₃ application. The highest essential oil content has been obtained from the flower in GA₃ application. However, in parallel with the dose increase, the essential oil content decreased in both applications. Foliar application of GA₃ decreased the linalool content in the essential oil at 100 ppm (37.54%) compared to the control (43.80%), but increased to 42.49% with the increase in dose. However, with the increasing dose in flower application, the rate of linalool decreased to 33.82%. However, with the increasing dose in flower application, the linalool content decreased to 33.82%. While the linalyl acetate ratio was determined as 14.42% in the control application, which increased to 31.83% with 300 ppm GA₃ applied to the flowers. Camphor content was found to be lower (5.47%) in 100 ppm application only from the leaf compared to the control (6.23%). As a result; it can be recommended because the highest fresh flower yield is obtained in foliar application of 100 ppm GA₃. However, since GA₃ application reduces essential oil synthesis, no difference was observed between control and 100-200 ppm applications in terms of essential oil yield.

Keywords: Lavandin, *lavandula x intermedia*, gibberellic acid, yield, essential oil and composition



INTRODUCTION

The genus *Lavandula* (*Labiatae*, syn. *Lamiaceae*) is fundamentally grown for their essential oils, which are used in perfumery, cosmetics, food processing and nowadays also in aromatherapy products. The dried flowers have also been used from time immemorial in pillows, sachets etc. for promoting sleep and relaxation. Lavandin is known in the United States as *L. hortensis*: Lavandin is a hybrid, produced by crossing true lavender (*Lavandula angustifolia* P. Miller) with spike lavender (*Lavandula latifolia* L.) (Lis-Balchin, 2003).

Lavender oil is one of the most produced oils in the world, and an average of 200 tons of lavender and 1200 tons of lavandin oil is produced annually according to its types (Karaparanzova et al., 2012). The most lavandin varieties (80%) are grown in the world and Bulgaria and France dominate 80% of the world lavender production areas. In France, 80% of lavender production areas are lavandin and 20% are lavender, while in Bulgaria all production is lavender. Lavender/lavandin crops and commerce are substantial in China, Russia, Ukraine, Spain, and certain Eastern European and North African nations (Giray, 2018). Lavandin is mostly produced in the region of Isparta in Turkey. Lavandin has adapted very well to the non-irrigated, barren and sloping lands of this region. Lavandin (*Lavandula intermedia* var. Super A) agriculture has reached a production area of approximately 5.600 da in Kuşçular, Aydoğmuş, Çukurören and Ardıçlı villages, especially in the Kuyucak village of Keçiborlu district (Anonymus, 2022a). On the other hand, lavender production in our country has gained importance in recent years and has reached 22.168 da.

The economically used part of lavender is its flowers (*Flores Lavandulae*). The most important active ingredient of lavender flowers is the colorless or slightly yellow essential oils found in the glandular hairs of the flowers (Werker, 1993; Sudria et al., 1999; Smigielski et al., 2009). The oils are easily separated from these hairs in the flowers during distillation. The qualitative and quantitative composition of essential oils in lavender varies according to genotype, location, reproduction and morphological characters of the plant (Lawrence, 1993).

According to ISO 3515:2002 lavender oil quality standards, it is required to contain at least 25% in lavender oil to be used in the perfume industry. However, standards specific to Abrial (ISO 3054) and Grosso (ISO 8902) varieties have been determined in lavandin oils. The most important essential oil components that determine the quality of lavender oil; linalyl acetate, linalool, 1,8-cineole and camphor. Although it varies according to the species, studies have reported that the main components of lavender essential oil are linalyl acetate, linalool, ocimene



and lavandulyl acetate, and lavandin essential oil is linalool, linalyl acetate, camphor, 1,8-cineole and borneol (Beetham and Entwistle, 1982; Boelens, 1995; Kulevanova, 2000; Karapandzova, 2012). Camphor is the most emphasized compound in lavender oils in terms of quality and market value, and although it is found in low rates, they are sold at high prices. Among lavender varieties, lavender oils are generally of higher quality as they have lower camphor content than lavandin oils. The camphor content, which should be at most 0.5% in high quality lavender oil, is between 0.5-1% in the essential oil of lavender varieties and 5-10% in lavandin oils (Erbaş et al., 2017).

Many environmental factors such as salinity, drought and temperature affect the development, growth and secondary metabolite biosynthesis and accumulation of medicinal and aromatic plants (Hassanpouraghdam et al., 2008). Phytohormones and plant growth regulators are defined as factors affecting the growth of plants and their primary and secondary metabolites (Taiz and Zeiger, 2006). Gibberellins (GAs), a kind of 6-5-6-5 tetracyclic diterpenoid, are certain phytohormones for plant growth and development (Eriksson et al., 2006). Geranylgeranyl Diphosphate (GGPP) is the precursor to a number of terpenoid compounds such as carotenoids and many essential oils. Scientific studies have shown significant impact of gibberellins on leaf yield of certain medicinal plants (Hassanpouraghdam et al., 2011). Fresh and dry leaf of *Coleus amboinicus* Lour leaf affected weights after GA₃ application (Pablo Morales-Payan, 2005).

In this study; the effects of gibberellic acid treatments on yield and quality characteristics of lavandin (*Lavandula × intermedia* Emeric ex Loisel. var. Super A) plant cultivated in Isparta were investigated.

MATERIAL AND METHODS

This research was carried out in Isparta University of Applied Sciences Rose and Aromatic Plants Implementation and Research Center in 2018. In the study, 8-year-old lavandin species (*Lavandula × intermedia* Emeric ex Loisel. var. Super A) lavender plants were used as material. Rowell's (1996) method was used to examine the soil parameters of the research region. The soil texture was clay loam; the lime content was 7.2 percent by Schiebler calcimeter; the organic matter content was 1.1 percent by Walkley-Black method; exchangeable K was 119 mg kg⁻¹ by 1N NH₄OAc; total salt was 0.38 percent; pH in a soil saturated extract was 7.5; and extractable P was 3.9 mg kg⁻¹ by 0.5N NaHCO₃ extraction. Table 1 shows the total precipitation, mean humidity, lowest and maximum temperatures, and long-term averages for the experimental region. When the climatic data were evaluated, there were no extremely high or low



temperatures or precipitation throughout the vegetative season (March-August) that would have adversely harmed the plants' regular growth and development.

Table 1. The climatic data for long years and 2018 in Isparta (Anonymous, 2022b)

Month	Total Precipitation, L m ²		Mean temperature, °C				Mean humidity, %	
	1950-2018	2018	1950-2018	Min.	Max.	Mean	1950-2018	2018
March	57.3	69.3	6.1	-1.6	20.4	9.2	65.6	65.9
April	51.6	6.3	10.7	0.0	28.3	14.2	60.8	51.0
May	55.7	62.9	15.2	5.8	29.6	16.8	58.7	62.3
June	32.6	69.4	19.8	10.3	32.6	20.0	52.1	62.4
July	16.5	4.1	23.3	13.8	38.6	25.2	45.4	46.9
August	13.4	14.2	23.1	12.1	34.4	24.3	46.3	47.6
TOTAL	227.1	226.2						
MEAN			16.4	6.5	29.9	18.1	54.8	56.0

Lavandin plants were sprayed with gibberellic acid spray at 100, 200 and 300 ppm doses, 2 times with 1 week intervals, separately in two different periods (foliation & budding periods). The area of a parcel is 25.0 m² (4.5 × 5.0 m). The plots were planted at a planting norm of 1.5 × 1.0 m, and there are 15 plants in each plot. The experiment was carried out in randomized blocks design with three replications according to two-factor arrangement. Weed control was controlled manually. Due to sufficient rainfall, irrigation was not applied to the trial area. Diammonium phosphate (DAP) (18:46:0) fertilizer at 5 kg da⁻¹ phosphorus was applied to the trial plots in mid-March, and ammonium nitrate (%33) fertilizer was applied at 10 kg da⁻¹ pure nitrogen during the period when the plants were forming buds (mid-May).

After the lavender flowers have fully opened (end of July), the plants were harvested by sickle mowing from the leaf surface. The following observations in treatment plots were made: branch length (cm), flower length (cm), number of floret, fresh flower yield (kg da⁻¹), fresh drog yield (kg ha⁻¹), dry drog yield (kg da⁻¹), and essential oil content (%) and composition (%).

The essential oils of fresh flowers (100 g) were extracted by distillation for 3 hours under continuous steam using a neo-Clevenger apparatus (European Pharmacopoeia, 1975) and the essential oil contents of the flowers were measured as v/w. After the essential oils had been dried over anhydrous sodium sulphate, they were stored at 4 °C until they were used for gas chromatography-mass spectrometry (GC-MS) analyses. The oil samples were weighed (7.5 mg) and diluted in 1.5 mL of dichloromethane, and 1 µL of this sample was injected into GC-MS, and the constituents of the oil samples were detected. The GC-MS analysis was performed on QP5050 GC-MS equipped with a Quadrapole detector. The GC-MS analysis was carried out as follows: capillary column, CPWax 52 CB (50 m × 0.32 mm i.d., film thickness, 0.25 µm);



oven temperature was kept at 60 °C for 10 min and programmed to 220 °C at a rate of 10 °C min⁻¹, and then kept constant at 220 °C for 10 min; total run time, 60 min; injector temperature, 240 °C; detector temperature, 250 °C; and flow rate for helium, 20 mL min⁻¹. Identification of the constituents was carried out by the help of the retention times of standard substances by composition of mass spectra with the data given in the NIST library and our created library.

The results obtained were evaluated according to the randomized complete block design according to two-factor with three replications. All data were analyzed with the analysis of variance (ANOVA) using GLM producers of SAS (1999) program, and the differences among treatments were compared with the LSD test (p<0.05).

RESULT AND DISCUSSION

The results of analysis of variance of the agronomic and quality characteristics examined in the study are given in Table 2. According to the ANOVA results, while the differences between doses and periods were significant except for the number of floret, all features were significant in the dose × period interaction except the number of floret, essential oil content and yield (Table 2).

Table 2. The ANOVA results of effects of gibberellic acid treatment on yield and quality characteristics in lavandin.

Sources of variation	DF	Branch length	Flower length	Number of floret	Fresh flower yield	Fresh drog yield	Dry drog yield	Essential oil content	Essential oil yield
Block	3	1.76 ^a	1.89	0.04	59.54	7.41	2.68	0.004	0.10
Periods	1	54.86**	12.50**	0.63	12403.12**	1520.76**	547.80**	0.037**	0.63
Doses	3	71.18**	2.95*	0.12	11051.37**	1354.34**	487.42**	0.157**	5.37**
Periods × Doses	3	47.45**	3.69*	0.27	2468.87**	303.28**	108.94**	0.011	0.86
Error	21	5.72	0.94	0.20	439.97	53.94	19.47	0.004	0.39
CV (%)		5.84	11.30	5.75	3.46	7.41	2.68	0.004	0.10

^a: Values are mean of squares. DF, degree of freedom; CV, coefficient of variation; *p<0.05; **p<0.01

According to the gibberellic acid treatments, the branch height and the flower height were 36.5 cm, and 7.8 cm on average in the control treatment, respectively, while with the GA₃ application, the values of both characters increased. According to the application periods, the longest branch length (42.3 cm) was obtained from the GA₃ application. While the highest branch length was obtained with 100 ppm GA₃ application to the leaf, the branch length decreased in parallel with the dose increase. However, even in 200 and 300 ppm applications, higher branch length was measured compared to the control application (Table 3).



In our study, floret length varied between 7.2-10.1 cm. According to the GA₃ applications, as the application doses increased, the flower size increased compared to the control. Although the effect of GA₃ application to the flower on the branch length was weaker, longer flower length (9.2 cm) was obtained with this application compared to the application to the leaf. It is thought that the main reason for this is that the application to the leaves increases the branch length and the effect on the internal structure of the plant for the flower length weakens in the future, and the application of the same dose to the flower and the application of higher concentrations of GA₃ to the flowers are thought. In the study, the number of florets was not found to be significant in any source of variation and their interaction. The number of florets varied between 7.4-8.2 according to the whole application period and doses.

Increasing the yield of fresh flowers is one of the most important goals in lavandin cultivation. Because the increase in fresh flower yield will positively affect dry drug yield and essential oil yield (Erbaş et al., 2017). In our study, the yield of fresh flowers showed significant differences according to the treatment periods and doses. While the average fresh flower yield was 625.3 kg da⁻¹ with the application of GA₃ to the leaf, 585.9 kg da⁻¹ was obtained in the application to the flower. According to GA₃ applications, the highest fresh flower yield was determined in 100 and 200 ppm applications. In the GA₃ application to the leaf, the highest fresh flower yield was obtained from 680.5 kg da⁻¹ and 100 ppm dose, while 596.3 kg da⁻¹ and 200 ppm application was obtained in the GA₃ application to the flower. Despite the decrease in fresh flower yield in the following doses at these doses, higher yield was still obtained from the control application. The fresh drug yield varied between 195.7-238.2 kg da⁻¹ according to the application periods and doses. As with the fresh flower yield, the highest fresh drug yields were obtained from 100 and 200 ppm applications in both periods. Dry drugs obtained by drying fresh drug flowers varied between 117.4-142.9 kg da⁻¹ according to the applications. Again, the highest dry drug yield was obtained from the application to the highest leaf (131.3 kg da⁻¹). Studies have reported that GA₃ applications increase the vegetative production of the plant, thus improving the parameters affecting the yield. Khan et al (2015) reported that plant height, leaf area and herb yields increased in *Cymbopogon martini* plant with GA₃ applications. Farooqi et al. (1994) and Saffari et al. (2004) noted that the highest plant height in oil rose was in the application of 50 ppm GA₃. It was reported that the bud diameter and length reached the highest values and the flower weight increased with the application of 100-200 ppm GA₃ in different ornamental rose species (Hashemabadi and Zarchini, 2010; Muthukumar vd. 2012). Sadanand et al. (2000) reported that plant height, shoot length, number of leaves per plant and bud



diameter and length reached the highest values with 200 ppm GA₃ application. Rani and Singh (2013) reported that the application of 150 ppm GA₃ gave the best results in improving the whole flower (spike length, flower/head number, flower length) and bulb characteristics in tuberose. Hassanpouraghdam et al. (2011) examined the effect of GA₃ application on yield and quality in lavender plant, and applied GA₃ at doses of 0, 100, 200 and 300 ppm to plants in potted medium. On the 40th day after planting and on the 30th day after planting (70th day after planting), GA₃ solution was applied to the plants twice by foliar spraying. According to the data obtained as a result of the application; they reported that 300 ppm GA₃ application increased the fresh and dry herb yield and the fresh and dry drug yield (146.6 g, 54.5 g, 5.3 g and 2.6 g, respectively) compared to the control. In conclusion; GA₃ application is thought to increase plant growth and internode length by increasing cell division and expansion, thus improving yield characteristics.

Table 3. The effect of gibberellic acid treatment on yield and quality characters in lavandin

GA ₃ Dose	Branch length			Floret length			Number of floret			Fresh flower yield		
	Leaf	Flower	Mean	Leaf	Flower	Mean	Leaf	Flower	Mean	Leaf	Flower	Mean
0	36.5 c ^a	36.5 c	36.5 B	7.8 bc	7.8 bc	7.8 B	7.9	7.9	7.9	559.0 d	559.0 d	559.0 C
100	47.1 a	37.7 c	42.4 A	8.9 ab	9.2 ab	9.1 A	7.9	8.0	7.9	680.5 a	596.3 bc	638.4 A
200	44.2 ab	41.4 b	42.8 A	8.1 bc	9.9 a	9.0 A	8.0	8.2	8.1	654.8 a	610.3 b	632.5 A
300	41.3 b	42.9 b	42.1 A	7.2 c	10.1 a	8.7 AB	7.4	8.2	7.8	606.8 bc	578.0 cd	592.4 B
Mean	42.3 A	39.6 B		7.9 B	9.2 A		7.8	8.1		625.3 A	585.9 B	
GA ₃ Dose	Fresh drug yield			Dry drug yield			Essential oil content			Essential oil yield		
	Leaf	Flower	Mean	Leaf	Flower	Mean	Leaf	Flower	Mean	Leaf	Flower	Mean
0	195.7 d	195.7 d	195.7 C	117.4 d	117.4 d	117.4 C	1.92	1.92	1.92 A	10.7	10.7	10.7 A
100	238.2 a	208.7 bc	223.4 A	142.9 a	125.2 bc	134.1 A	1.80	1.72	1.76 B	11.7	10.8	11.3 A
200	229.2 a	213.6 b	221.4 A	137.5 a	128.2 b	132.8 A	1.73	1.71	1.72 B	11.2	10.6	10.9 A
300	212.4 bc	202.3 cd	207.4 B	127.4 bc	121.4 cd	124.4 B	1.66	1.50	1.58 C	9.1	9.6	9.4 B
Mean	218.9 A	205.1 B		131.3 A	123.0 B		1.77 A	1.74 B		10.7	10.4	

^aDifferences between means denoted by the same letters are not statistically significant.

Despite the increase in yield characteristics (fresh flower yield, fresh and dry drug yield), the essential oil content decreased after gibberellic acid treatments. While 1.92% essential oil was obtained in the control application, the essential oil ratio decreased in parallel with the increase in dose and decreased to 1.58% in the 300 ppm GA₃ application. According to the application periods, higher essential oil content (1.77%) was obtained in the application of GA₃ to the leaves. However, essential oil yield was included in the same statistical group in control, 100 and 200 ppm applications (10.7, 11.3, 10.9 kg da⁻¹, respectively). The essential oil yield decreased with 300 ppm GA₃ application. While the increase in fresh flower yield caused a decrease in essential oil synthesis, it preserved the essential oil yield up to 200 ppm compared to the control. It was also reported by Farooqi et al (1994) and Saffari et al (2004) that GA₃ application reduces the essential oil content.



Table 4. ISO standards in lavandin and the effect of gibberellic acid application on essential oil components in lavandin

RT	Component	Lavender		Lavandin		Leaf			Flower			Control
		(ISO 3513)	Spike lavender Spanish Type (ISO 4719)	Abrial (ISO 3054)	Grosso (ISO 8902)	100 ppm	200 ppm	300 ppm	100 ppm	200 ppm	300 ppm	
7.136	α -Pinene					0.17	0.16	0.21	0.13	0.14	0.17	0.28
8.060	Camphene					0.20	0.20	0.25	0.19	0.17	0.20	0.32
9.076	β -Pinene					0.16	0.17	0.17	0.15	0.12	0.13	0.22
9.356	Sabinene					0.14	0.12	0.14	0.11	0.12	0.11	0.16
10.210	δ -3-Caren					0.03						0.04
10.464	Myrcene	-	-	0.4-0.9	0.3-1	1.45	1.16	1.72	1.20	0.87	0.92	1.73
11.886	Limonene	0-1	0.5-3	0.5-1.5	0.5-1.5	1.30	1.12	1.38	1.14	1.13	0.94	1.41
12.313	Eucalyptol	0-3	16-39	6-12.5	4-8	6.08	6.49	5.79	6.12	5.40	5.03	7.65
13.079	<i>cis</i> -Ocimene		-	1.4-3	0.5-1.5	1.76	1.25	1.74	1.57	0.20	1.30	1.94
13.820	β -Ocimene	0.5-6	-	2.5-6	0-1	1.35	1.11	1.87	1.43	0.10	1.13	2.05
13.923	3-Octanone	0-3	-	-	-	0.50	0.55	0.50	0.51	0.60	0.55	0.67
14.675	Hexyl Acetate					0.36	0.37	0.45	0.38	0.42	0.46	0.51
14.774	<i>p</i> -Cimene					0.05	0.09	0.10	0.07	0.10	0.05	0.08
15.391	Terpinolene					0.27	0.16	0.31	0.26		0.20	0.40
18.099	Hexyl Isobutyrate					0.08	0.07		0.12		0.10	0.08
18.399	Hexanol								0.07		0.07	0.05
19.940	Octenly acetate					0.21	0.21	0.25	0.23	0.26	0.32	0.22
22.048	Hexyl butanoate					0.31	0.34	0.41	0.29	0.31	0.36	0.34
22.724	Hexyl 2- methylbutyrate					0.02					0.08	
23.480	<i>trans</i> -linalool oxide					0.14	0.14		0.25	0.21	0.13	0.11
23.741	Octen-3-ol						0.10		0.08	0.14	0.15	0.11
24.652	<i>Trans</i> -Sabinene hydrate					0.05			0.07			
25.079	<i>cis</i> -Linalool oxide					0.10	0.10	0.14	0.23	0.16	0.07	
27.817	Camphor	0-1.5	8-16	7-11	6.5-8	5.47	8.00	7.65	6.76	6.37	7.07	6.23
29.576	Linalool	20-43	34-50	28-38	24-37	37.54	37.59	42.49	36.74	37.53	33.82	43.80
30.295	Linalyl acetate	25-47	0-1.6	19-29	25-38	20.04	21.34	17.56	22.43	25.46	31.83	14.42
31.349	Bornyl formate					0.09	0.09		0.10	0.09	0.07	0.11
31.665	α -Frenchyl acetate					0.10	0.08		0.07	0.08	0.08	
32.708	Caryophyllene	-	-	1.5-2.5	-	0.71	0.58	0.52	0.64	0.46	0.88	0.55
33.105	Lavandulyl acetate	0-8	-	1-2	1.5-3.5	2.51	2.58	2.47	2.41	2.66	2.29	2.28
33.971	<i>hexyl</i> -Tiglate					0.08	0.08				0.15	0.06
36.570	Crypton					0.81	0.74	0.47	0.79	0.85	0.34	0.25
37.102	Lavandulol	0-3	-	0.4-1.2	0.2-1	0.35	0.45	0.24	0.38	0.40	0.38	0.28
38.211	α -Terpineol	0-2	0.2-2	0.3-1.2	0.3-1.3	4.52	3.80	4.18	3.95	3.56	1.93	3.75
38.515	Borneol	-	0.5-3	1.5-3.5	1.5-3.5	4.26	3.25	2.99	3.46	5.02	3.14	4.22
39.131	Germacrene D					0.31	0.21	0.12	0.29		0.43	0.19
40.022	Neryl acetate					1.15	0.98	0.97	1.00	1.04	0.65	1.04
41.774	Geranyl acetate					2.23	1.89	1.86	1.95	1.81	1.31	1.91
41.912	Geranyl isovalerate					0.20	0.21	0.09	0.19	0.29	0.32	0.05
42.893	Cuminaldehyde					0.15	0.15		0.16	0.12	0.11	0.11
44.122	Nerol					0.73	0.61	0.62	0.67	0.48	0.31	0.56
46.712	<i>trans</i> -Geraniol					2.16	1.75	1.62	1.92	1.50	0.88	1.45
54.059	Caryophyllene oxide					0.19	0.18		0.12	0.33	0.16	
59.932	Cumic alcohol					0.06				0.09		
63.499	α -Muurolol					0.26	0.28	0.09	0.29	0.28	0.21	
65.666	α -Bisabolol					1.20	1.25	0.63	1.08	1.13	1.17	0.37
75.952	Coumarin					0.15						
Component count						45	41	33	43	39	43	39

RT: Retention time



In this study, while the number of essential oil components increased in 100 ppm GA₃ application from the leaf compared to the control, the number of components decreased depending on the dose increase. On the other hand, higher essential oil component was found in 100 and 300 ppm GA₃ application from the flower compared to the control, while it was the same as the control in the application from 200 ppm flower the essential oil components of our study and ISO standards of lavender varieties are listed in Table 4. Due to peak areas of most of the compounds were omissible, lavandin's major components were considered. The four major components were linalool, linalyl acetate, camphor and eucalyptol. The amount of linalyl acetate increased after foliar and flower application of GA₃ compared to control. As the dose was increased in leaf application, the amount of the components decreased, while the amount of the components increased after the application from the flower. When the ISO standards of lavandin cultivars were examined, it was below the control and foliar application dose standards of 300 ppm for Linalyl acetate. While the application dose of 300 ppm from the flower remained above the ISO standards of Abrial variety, it entered the ISO standards of Grosso variety. Other applications have been observed to comply with Abrial ISO standards (ISO 3054; ISO 8902). Leaf and flower GA₃ applications decreased the amount of linalool component compared to the control. The closest amount of linalool to the control was obtained from 300 ppm foliar application (42.49%). In the study, the 300 ppm GA₃ dose applied to the foliage and the control linalool component were found to be above the ISO standards in terms of the component. While the other doses are in accordance with Abrial standards, the 100 ppm and 300 ppm doses applied from the flower are within the ISO standards of Grosso (ISO 3054; ISO 8902).

100 ppm GA₃ application (5.47 %) from camphor leaf, which causes irritation in the smell of lavandin essential oil, was lower than the control. GA₃ application from the flower increased the amount of camphor in the plant. When the ISO standards of the lavandin species are examined, it is among the ISO standards in terms of all flower and leaf applications and control Camphor component, except for GA₃ application from 100 ppm leaves (ISO 3054; ISO 8902). Which reduced the camphor component below the standards, but this component is required to be in lavender standards (ISO 3513).

Although eucalyptol, the last of the main components of lavandin, remained at low levels compared to the control, 200 ppm application (6.49 %) from the leaf gave the highest component amount. In flower applications, the amount of Eucalyptol decreased depending on the dose increase When the ISO standards of the lavandin species are examined, the applications and control are in accordance with the ISO standards of the Grosso variety in terms of



Eucalyptol component. While 200 ppm and 300 ppm GA₃ applications from flowers remained below the ISO standards of Abrial variety, other applications and control were found to be in accordance with Abrial standards (ISO 3054; ISO 8902) (Table 4). It has been determined that the application of GA₃ from leaves or flowers in lavender can bring the main components of lavender into conformity with ISO standards.

CONCLUSION

As a result of the study, 100 ppm GA₃ application is recommended in order to increase the stem flower length, fresh flower yield, fresh and dry drug yield, and to include the essential oil composition within the scope of ISO standards in the lavandin type.



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CHAMAZULENE KAYNAĞI BİTKİLER VE ÜRETİMİ

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ÖZET

Chamazulene (C₁₄H₁₆) bisiklik seskiterpenoid polialken yapısında olup, bitkisel ilaçlarda ve kozmetik ürünlerde anti-inflamatuar ajan olarak kullanılan bir önemli bir bileşiktir. Chamazulene doğal bir ürün değildir, ancak bulunan bitkilerin buharla damıtılması sırasında öncüsü olan matricin'in parçalanması ile oluşur. Chamazulene içinde bulunduğu uçucu yağda konsantrasyonuna göre mavi tonlarında renk vermektedir. Uçucu yağda düşük konsantrasyonda ise açık mavi, yüksek konsantrasyonda ise koyu mavi renk oluşturmaktadır. Dünyada chamazulene kaynağı bitkiler sınırlıdır. Chamazulene kaynağı olarak en fazla üretilen bitki alman papatyası (*Matricaria recutita*)'dır. Bu türün α -bisabolol oxide A/(E)- β -farnesene (Mısır) kemotipinde 3.4%, α -bisabolol oxide A (Mısır, Almanya, Hollanda) kemotipinde 2.7-7.6%, α -bisabolol oxide A/ α -bisabolol oxide B (Brezilya) kemotipinde 8.2%, Farnesene/chamazulene (Bulgaristan) 17.6%, α -bisabolol/(E)- β -farnesene (Finlandiya) kemotipinde 10.8-21.8% ve α -bisabolol oxide A/chamazulene (Almanya) kemotipinde 23.4% oranında chamazulene bulunmaktadır. Dünyada en fazla üretim yapılan ülkelerin başında Almanya, Macaristan, Slovakya, Arjantin, Mısır, Şili, Rusya, Polonya, Çek Cumhuriyeti, Belçika, Brezilya, Fransa, İspanya ve Yunanistan gelmektedir. Papatyada hem tarımsal üretim yapılmakta, hem de doğadan toplanmaktadır. Tarımsal ürün olarak Mısır, Almanya, Arjantin, Polonya ve daha az ölçüde Şili, Çek Cumhuriyeti, Slovakya, İspanya ve birkaç Balkan ülkesindeki (Bosna Hersek, Bulgaristan, Hırvatistan ve Sırbistan) ülkelerinde yetiştiriciliği yapılmakta, Macaristan, Arnavutluk, Bulgaristan, Hırvatistan, Kosova ve Makedonya gibi ülkelerde de doğadan toplanmaktadır. Diğer taraftan papatyanın diğer bir türü olan Roman papatyasında (*Chamaemelum nobile* L.) 0-4.4%, civanperçeminde (*Achillea millefolium* L.) 19.7%, solucanotunda (*Tanacetum annuum* L.) 7.0-38.3%, Sarı çamda (*Pinus sylvestris* L.) 0-1.7%, Pelinotunda (*Artemisia arborescens* L.) 22.4%, Kuzey Kıbrıs çamında (*Callitris intratropica* L.) 5.6% oranında chamazulene bulunmaktadır.

Anahtar Kelimeler: Chamazulene, C₁₄H₁₆, alman ve roman papatyası, civanperçemi, solucanotu, pelinotu, tarımı



CHAMAZULENE SOURCE PLANTS AND THEIR CULTIVATION

ABSTRACT

Chamazulene (C₁₄H₁₆) is a bicyclic sesquiterpenoid polyalkene and is an important compound used as an anti-inflammatory agent in herbal medicines and cosmetic products. Chamazulene is not a natural product, but is formed by the decomposition of its precursor, matricin, during steam distillation of plants. Chamazulene gives colour to the essential oil in blue tones depending on its concentration. In the essential oil, it creates a light blue colour at low concentration, and a dark blue colour at high concentration. The plants that supply chamazulene in the world are limited. The most produced plant as a source of chamazulene is German chamomile (*Matricaria recutita*). This species has 3.4% chamazulene in α -bisabolol oxide A/(E)- β -farnesene (Egypt) chemotype, 2.7-7.6% in α -bisabolol oxide A (Egypt, Germany, Netherlands) chemotype, α -bisabolol oxide A/ α -bisabolol oxide 8.2% in B (Brazil) chemotype, 17.6% in Farnesene/chamazulene (Bulgaria), 10.8-21.8% in α -bisabolol/(E)- β -farnesene (Finland) and 23.4% in α -bisabolol oxide A/chamazulene (Germany) chemotype. Germany, Hungary, Slovakia, Argentina, Egypt, Chile, Russia, Poland, Czech Republic, Belgium, Brazil, France, Spain and Greece are among the countries with the highest production in the world. In chamomile, both agricultural production is made and it is collected from nature. As an agricultural product, it is cultivated in Egypt, Germany, Argentina, Poland and to a lesser extent in Chile, Czech Republic, Slovakia, Spain and a few Balkan countries (Bosnia and Herzegovina, Bulgaria, Croatia and Serbia), Hungary, Albania, Bulgaria, Croatia, Kosovo and it is also collected from nature in countries such as Macedonia. On the other hand, chamazulene contains 0-4.4% in Roman chamomile essential oil (*Chamaemelum nobile* L.), 19.7% in yarrow (*Achillea millefolium* L.), 7.0-38.3% in blue tansy (*Tanacetum annuum* L.), 0-1.7% in Scots pine (*Pinus sylvestris* L.), 22.4% in mugwood (*Artemisia arborescens* L.) and 5.6% in Northern Cyprus pine (*Callitris intratropica* L.).

Keywords: Chamazulene, C₁₄H₁₆, german and roman chamomile, yarrow, blue tansy, mugwood, cultivation



1. INTRODUCTION

Chamazulene (C₁₄H₁₆), a bicyclic sesquiterpenoid polyalkene compound, is found in a limited number of plant structures in the world. Chamazulene is an important compound used as an anti-inflammatory agent in herbal medicines and cosmetic products. Chamazulene is not a natural product obtained from plants; it is formed by the decomposition of matricin in plants as a result of exposure to heat. The chamazulene compound gives a blue color to the essential oil it contains, depending on its concentration. The most produced plant as a source of chamazulene in the world is German chamomile (*Matricaria recutita* L.). On the other hand, another type of chamomile, Roman chamomile (*Chamaemelum nobile* L.), yarrow (*Achillea millefolium* L.), blue tansy (*Tanacetum annuum* L.), Scots pine (*Pinus sylvestris* L.), mugwood (*Artemisia arborescens* L.) and Northern Cyprus pine (*Callitris intratropica* L.) are other plants containing chamazulene. This review was prepared on the production of plants containing chamazulene.

2. SYNTHESIS OF CHAMAZULENE

The other synonyms of chamazulene, also known as the systematic name "1,4-Dimethyl-7-ethylbicyclo[0.3.5]deca-1,3,5,7,9-pentaene", are dimethylulene and 1,4-Dimethyl-7-ethylazulene. In 1863, French chemist Piesse isolated a blue substance from chamomile essential oil. He described the compound as a hydrocarbon and named it azulene (Piesse, 1863). It was known long before the structure of chamazulene was found to be 1,4-dimethyl-7-ethylazulene in 1953 (Meisel, 1953; Sorm, 1953). Identification of the compound was actually made on chamazulene isolated from *Artemisia arborescens* L. (Meisels and Weizmann, 1953). The presence of Chamazulene precursors had been reported for quite some time, until Cekan and colleagues finally isolated a substance. The structure of the compound they named the matrix was determined as (3S,3aR,4S,9R,9aS,9bS)-4-acetyloxy-3a,4,5,9,9a,9b-hexahydro-9-hydroxy-3,6,9-trimethylazuleno[4,5-b]furan-2(3H)-one. Matricin is found in the ligulate flowers and tubular flowers of chamomile, but not at the base of the flower heads. In 1982, the structure of the matrix was confirmed by Flaskamp et al. (1982) using modern spectrometric methods (Figure 1).

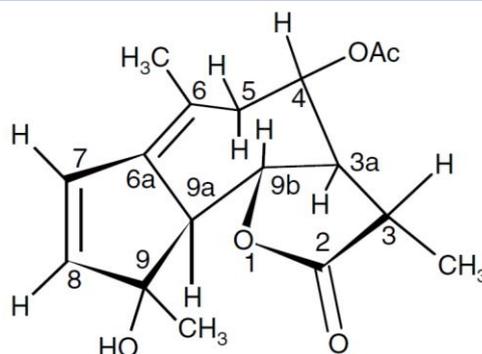


Figure 1. Molecular structure of the matricin

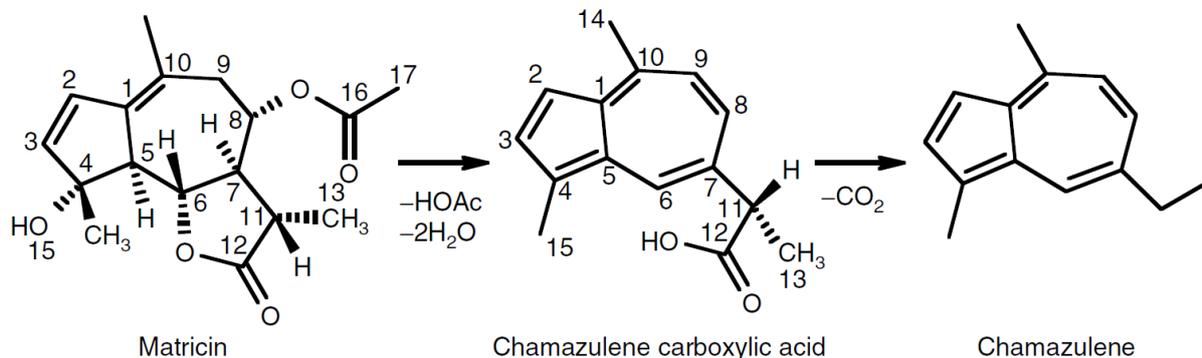
The stereochemical assignment of matricin rests on these NMR data and a normal x-ray analysis of 4-epimatricin and of the adduct of 4-epimatricin with 3 β -hydroxydihydrocostunolide, both isolated from *Artemisia arborescens* L. (Appendino et al., 1985). The absolute configuration was assigned on the basis of the assumption that 7-H always has α -orientation in guaianolides (Barrero et al., 1987; Calderon et al., 1989; Cox et al., 1975). This assumption was shown to be true for matricin when Goeters et al. determined the absolute configuration of chamazulene carboxylic acid (Goeters et al., 2001; Imming, 2001).

They also published a detailed analysis of the ^1H and ^{13}C NMR spectra of matricin and matricin epimers (Goeters et al., 2001; Imming, 2001). Matricin is very unstable and decomposes, turning visibly blue after a short time, especially in aqueous solution (Schmidt and Ness, 1991; Schmidt et al., 1991). This color reaction also occurs during steam distillation of chamomile oil (Schilcher, 1987). It results from the decomposition of Chamazulene. Matricine transition to chamazulene can be easily demonstrated by steam treatment of a thin layer chromatography (TLC) spot (Schilcher, 1987). The matricin content of chamomile varies considerably between cultivars. Of all chamomile preparations, the extract made with supercritical carbon dioxide has the highest matricin content (about 0.2%) (Ness et al., 1996. Schmidt et al., isolation of very pure matrix (Schmidt and Ness, 1993) and development of a matrix-rich chamomile preparation. (Ness and Schmidt, 1995; Schmidt and Ness, 1992; Schmidt and Ness, 1991) They also isolated and identified 8-desacetylmatrix, the product of the first degradation step of matrixin (Ness et al., 1996).

The immediate precursor of chamazulene is chamazulene carboxylic acid (CCA). It is formed from the matrix of water and acetic acid and decarboxylates, possibly by the separation of chamazulene via an electrocyclic reaction (Figure 2). Chamazulene carboxylic acid was first



isolated from chamomile and yarrow (*Achillea millefolium*) by E. Stahl in 1954 (Stahl, 1954). Its structure was confirmed by Cuong et al using mass spectrometry and NMR.



Şekil 2. Hydrolytic degradation of matricin to chamazulene carboxylic acid and further decarboxylation to chamazulene.

The development of Chamazulene is highly dependent on the duration of sunlight and daytime temperatures from the formation of flower buds. Chamazulene is not a natural product, but is formed by the decomposition of its precursor, matricin, during steam distillation of blue chamomile oil.

3. USES OF CHAMAZULENE

Cosmetics: It is widely used in skin and hair care products due to its anti-inflammatory and antioxidant properties. In particular, it helps reduce skin irritation and inflammation. In addition, it maintains the moisture balance of the skin and helps hair grow in a healthy way. Since it is blue in color, it can be used as a colorant in cosmetics.

Aromatherapy: It is a compound frequently used in essential oils and aromatherapy products. This compound is thought to help reduce and calm stress. It is also effective against ailments such as headaches, migraines and insomnia.

Food industry: Found in some plant species, chamazulene can be used as a flavoring and coloring agent in food products. In particular, it is widely used in the production of cakes, pastries, confectionery and ice creams.

Medicine: Chamazulene is used in some alternative medicine applications. In particular, due to its anti-inflammatory and pain-relieving properties, it is used in the treatment of rheumatic diseases, as well as in the treatment of skin irritations and wounds. It is also used in the treatment of respiratory ailments such as asthma, bronchitis, allergic reactions.

Agriculture: Chamazulene in some plant species can be used as a natural pesticide used to control insects and harmful organisms. In particular, it is widely used in the control of pests in agricultural products and in the agricultural industry. Therefore, chamazulene is a versatile



compound used for different purposes in the cosmetics, aromatherapy, food, medicine, and agricultural industries.

The pharmacological effect of chamazulene: The essential oil contained chamazulene has anti-inflammatory, deodorant, bacteriostatic, antimicrobial, carminative, sedative, antiseptic, anticatarrhal and spasmolytic properties (Newall et al., 1996; Blumenthal, 1998). Chamazulene inhibits the formation of inflammatory prostaglandins and leukotriene B₄, essential oils containing it can be therapeutic in allergic asthma or rhinitis (Safayhi ve ark. 1994).

Antioxidant/pro-oxidant activity: Chamazulene is a powerful antioxidant. It inhibited lipid peroxidation in a concentration and time dependent manner, presenting an IC₅₀ of 18 mM (3.31 mg/mL) after 45 minutes incubation. It also weakly inhibited the autoxidation of DMSO (33 mM; 6.07 mg/mL) by 76% at 25 mM (4.60 mg/mL) (Rekka et al 1996). In two antioxidant assays, deoxyribose degradation and non-enzymatic lipid peroxidation, chamazulene had IC₅₀ values of 0.042 mL/mL and 0.0021 mL/mL, respectively (Burits et al 2001).

Acute toxicity: Blue chamomile oil acute oral LD₅₀ in rats >5 g/kg; acute dermal LD₅₀ in rabbits >5 g/kg (Opdyke 1974 p. 851–852). Mouse LD₅₀ 3.5 g/kg oral, 2.95 g/kg ip (Kudrzycka-Bieloszabska & Glowniak 1966). *Antioxidant/pro-oxidant activity:* An Iranian blue chamomile oil, high in (E)-b-farnesene, chamazulene and guaiazulene, was an efficient inhibitor of lipid peroxidation (Owlia et al 2007). *Carcinogenic/anticarcinogenic potential:* Blue chamomile oil was cytotoxic to human prostate, lung and breast cancer cells with an IC₅₀ of 0.07% (Zu et al 2010). Blue chamomile oil is antimutagenic. It demonstrated a dose-dependent inhibitory effect on SCE formed by daunorubicin and methyl methanesulfonate with no toxic effects (Hernandez-Ceruelos et al 2002). Chamomile oil (type unspecified) significantly induced glutathione S-transferase activity in mouse tissues (Lam & Zheng 1991). The oil contains no known carcinogens.

Drug interactions: Since chamazulene, farnesene and abisabolol inhibit CYP2D6, there is a theoretical risk of interaction between all blue chamomile oil CTs and drugs metabolized by this enzyme. The α -bisabolol/(E)-b-farnesene CT may also inhibit CYP1A2, CYP2C9 or CYP3A4. The α -bisabolol oxide A CT may inhibit CYP1A2.

4. CHAMAZULENE SOURCE PLANTS

4.1. Chamomile

Chamomile is cultivated in large areas as a medicinal and aromatic plant in many parts of the world. Germany, Hungary, Slovakia, Argentina, Egypt, Chile, Russia, Poland, Czech Republic, Belgium, Brazil, France, Spain and Greece are among the countries with the highest production



in the world. In chamomile, both agricultural productions made and it is collected from nature. As an agricultural product, it is grown in Egypt, Germany, Argentina, Poland and to a lesser extent in Chile, Czech Republic, Slovakia, Spain and a few Balkan countries (Bosnia, Herzegovina, Bulgaria, Croatia and Serbia). However, it is also collected from nature in countries such as Hungary, Albania, Bulgaria, Croatia, Kosovo and Macedonia. In our country, the chamomile plant is collected entirely from nature. In our country, there are 3 varieties of *M. chamomilla* (*Matricaria recutita*) species (var. *chamomilla*, var. *recutita* and var. *populosa*) and these species grow naturally (Davis, 1975). The presence of chamazulene was not found in the essential oil of Turkey-origin varieties; the essential oils contain high levels of bisabolone and are usually yellow in color.

However, chamomiles with chamazulene content are accepted in the global chamomile market. On the other hand, there are about 50 *Anthemis* species of daisies in Turkey, these are known by names such as İzmir chamomile, wild chamomile, white chamomile and are collected from nature (Davis, 1975). In our country, chamomile cultivation has started to gain importance in recent years and has entered our agricultural fields. Generally, varieties that have been bred abroad and comply with the standards and pharmacopeias in the world market are used in production. Since there is no official record of chamomile production in our country, there is no data on the production area and amount. However, it is known that there are farmers dealing with chamomile cultivation in Balıkesir, Afyonkarahisar and Samsun. On the other hand, according to OGM records, the last chamomile picking record was recorded as 1 ton in 2018 (OGM, 2020).

German (Blue) Chamomile Essential Oil: Blue chamomile (*Matricaria recutita* L.) oils are produced in many parts of the world and in a wide variety of compositions. They are ranked by percentage of chamazulene. Chemotypes with high α -bisabolol content are generally preferred for treatment. Below are six examples of essential oil components that vary by country. The oil of German chamomile is dark blue or inky blue in color and has a characteristic sweet, grassy scent.

α -Bisabolol oxide A/(E)- β -farnesene chemotype (Egypt): α -Bisabolol oxide A 38.7%, (E)- β -Farnesene 25.7%, α -Bisabolol 5.0%, α -Bisabolol oxide B 4.4%, Chamazulene 3.4%, α -Bisabolone oxide 1.6%, Germacrene D 1.6%, Decanoic acid 1.3% (Shaath and Azzo, 1993).

α -Bisabolol oxide A kemotipi (chemotype, Germany): α -Bisabolol oxide A 44.7%-53.6%, α -Bisabolol oxide B 9.5-13.5%, α -Bisabolone oxide 8.5-12.0%, (E)- β -Farnesene 7.7-



8.9%, Chamazulene 2.7-7.6%, (Z) & (E)-Spiroethers 5.9-7.0%, α -Bisabolol 1.6-2.9% (Piccaglia and Marotti, 1993).

α -Bisabolol oxide A/ α -bisabolol oxide B chemotype (Brazil): α -Bisabolol oxide B 23.5%, α -Bisabolol oxide A 16.9%, (Z)- β -Farnesene 16.0%, α -Bisabolol 13.2%, Chamazulene 8.2%, α -Bisabolone oxide 5.2%, en-yn-Dicycloether isomers 4.7% (Matos et al., 1993)

Farnesene/chamazulene chemotype (Bulgaria): Farnesene 27.7%, Chamazulene 17.6%, α -Bisabolol oxide B 11.2%, α -Bisabolol 9.6%, α -Bisabolol oxide A 8.9%, δ -Cadinene 5.2%, α -Muurolene 3.4%, (E)- β -Ocimene 1.7, γ -Muurolene 1.3% (Tsutsulova and Antonova, 1984)

α -Bisabolol/(E)- β -farnesene chemotype (Finland): α -Bisabolol 32.4-60.1%, (E)- β -Farnesene 11.6%-43.8%, Chamazulene 10.8%-21.8%, α -Bisabolol oxide B 0-7.5%, α -Bisabolol oxide A 0-6.2% (Hyvönen et al., 1991)

α -Bisabolol oxide A/chamazulene chemotype (Germany): α -Bisabolol oxide A 57.7%, Chamazulene 23.4%, α -Bisabolol oxide B 4.4%, α -Bisabolone oxide 4.1%, (E)- β -Farnesene 2.9%, Germacrene D 1.0% (Brunke et al., 1992)

Roman Chamomile Essential Oil: There is great variation in the reported components of Roman chamomile (*Chamaemelum nobile*) oil, but the majority of the oil is always composed of esters of angelate and butyrate. Roman chamomile oil is a clear liquid with a colorless or yellowish color, a blue tint, and a fruity, ethereal and herbal green odour. The essential oil yield is between 0.3-1.0%. In general, the components of essential oil;

Isobutyl angelate 0-37.4%, Butyl angelate 0-34.9%, 3-Methylpentyl angelate 0-22.7%, Isobutyl butyrate 0-20.5%, Isoamyl angelate 8.4-17.9%, 2-Methyl-2-propenyl angelate 0-13.1%, 3-Methylpentyl isobutyrate 0-12.5%, 2-Methyl-2-propyl angelate 0-7.4%, Camphene 0-6.0%, Borneol 0-5.0, α -Pinene 1.1-4.5%, α -Terpinene 0-4.5%, Chamazulene 0-4.4%, (E)-Pinocarveol 0-4.4%, α -Thujene 0-4.1%, Hexyl butyrate 0-3.9%, Terpinolene 0-3.9%, Isobutyl isobutyrate 0-3.7%, Anthemol 0-3.2%, γ -Terpinene 0-3.2%, Isoamyl isobutyrate 0-3.1%, δ -3-Carene 0-2.8%, Isoamyl 2-methylbutyrate 0-2.8%, 2-Methylbutyl 2-methylbutyrate 0-2.7%, Isoamyl butyrate 0%- 2.6, Pinocarvone 0-2.4%, β -Myrcene 0-2.1%, p-Cymene 0-2.0%, β -Pinene 0.2-1.6%, Isoamyl methacrylate 0-1.5%, β -Phellandrene 0-1.4%, Propyl angelate 0-1.1% (Chialva et al., 1982; Srinivas 1986; Zani et al., 1991; Lawrence, 1998).

4.2. Yarrow

There is no production data on yarrow farming in the world. However, it is known that important chamomile producing countries such as Germany, Poland and the Czech Republic practice yarrow farming. In studies, high amounts of chamazulene were found in the volatile



components of yarrow. In general, the volatile profiles of yarrow oil are defined as follows; Sabinene 26.2%, Chamazulene 19.7%, β -Myrcene 7.0%, Germacrene D 6.2%, β -Pinene 4.6%, Camphor 3.3%, Camphene 3.2%, b-Caryophyllene 2.5%, β -Phellandrene 2.0%, α -Pinene 2.0% , Borneol 1.9%, b-Thujone 1.8%, Bornyl acetate 1.7%, γ -Terpinene 1.7%, 1,8-Cineole 1.5%, β -Thujone 1.1%, (D)-Limonene 1.0% (Rondeau, private communication, 1999) On the other hand, Baczec et al. (2015) reported that chamazulene varies between 0.55-40.67% in 20 different yarrow populations in Poland.

4.3. Blue Tansy

As in Yarrow, the production data of the Blue Tansy plant is very limited in the world. However, it is known that it is produced intensively in Morocco. Studies have reported that there is a significant amount of chamazulene in the blue tansy plant. Greche et al. (1999) determined the essential oil yield of the *Tanacetum annuum* plant grown in Morocco as 0.5% and found that the main components of the essential oil were chamazulene (38–17%), myrcene (14–1%), sabinene (8.6–4%), β -eudesmol. (7–3%) and camphor (18–4%). According to Greche et al. (1999), Seasonal variation of the oil composition suggested that the chamazulene content decreases and the myrcene content increases from June to October.

4.4. Mugwood

Today, *Artemisia* species are widely used in food, medicine, cosmetics and agriculture. However, *Artemisia arborescens* L. species is mostly evaluated as a source of chamazulene. Tucker et al. (1993) found β -Thujone content as 34.0%, Chamazulene content as 22.4% and Camphor content as 11.8% in *A. arborescens*. In another study, it is reported that the main components of *A. arborescens* found in the natural flora of Algeria are chamazulene (30.2%), β -thujone (27.8%), β -eudesmol (8.1%) and catalponol (5.5%) (Abderrahim et al., 2010)

4.5. Northern Cyprus pine

Northern Cyprus pine (*Callitris intratropica*) is a type of pine native to the Mediterranean region. This pine species grows naturally in Cyprus, Turkey, Syria and Lebanon. Chamazulene is the essential oil of this pine species and is found in the needles and bark of the pine tree. In addition, the resin of this pine is also used in pharmaceutical and cosmetic products. In a study, the essential oil components of this species are presented as follows: β -Eudesmol 14.4%, Dihydrocolumellarin 14.0%, Guaiol 13.7%, γ -Eudesmol 9.1%, α -Eudesmol 7.6%, Guaiazulene 6.2%, Chamazulene 5.6%, Columellarin 2.9%, Callitrisin 2.4%, Cadalene 2.3%, β -Selinene 2.2%, α -Selinene 1.5%, Callitrisin 1.4% and Elemol 1.3% (Doimo, 2001)



4.6. Scots pine

Pinus sylvestris L. (Scots pine) is the most widespread pine in the world. Scots pine's native land is Eurasia and it is adapted to different climatic conditions and grows on a wide variety of soil types. Scots pine is rich in monoterpene hydrocarbons such as α - and β -pinene, δ -3-carene, limonene, α - and γ -terpinene, (Z)- β -ocimene, myrcene, camphene, sabinene and terpinolene (Schulz et al., 1998). Other constituents include bornyl acetate, borneol, 1,8-cineole, citral, terpineol, α -cadinol, α -muurolol, (β)-caryophyllene, chamazulene and some acids (Leung and Foster, 1998). The results of Scots pine essential oil composition research published in 70s and 80s years were reviewed by Lawrence (1991). Lawrence (1993) and Orav et al. (1996) reported that the Chamazulene compound in scots pine plant varies between 0-1.7%.



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DÜNYADA VE TÜRKİYE'DE REZENE (*Foeniculum vulgare*) TARIMI, SORUNLARI VE GELECEĞİ

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ÖZET

Günümüzde rezenenin oldukça geniş bir kullanım alanı olup özellikle gıda, kozmetik, parfümeri ve sağlık sektörlerinde değerlendirilmektedir. Dünyada 2.698.095 ha alanda 2.698.095 ton anason, yıldız anason, rezene ve kişniş üretimi yapılmaktadır. Hindistan, Suriye, Türkiye, Çin ve Mısır üretim alanı ve miktarı bakımından öncü ülkelerdir. Dünyada ihracat miktarına göre Türkiye 11. Sırada (9.895 ton) ve ihracat değerine göre 4. sırada (32.1 milyon \$) yer almaktadır. Ülkemizde rezene üretim alanı son 5 yılda %113 oranında artarak 33.857 da'a ulaşmıştır. Burdur ilinde 18 bin da üretim alanı ile en fazla rezene tarımı yapılırken, bu ili 12.9 bin da ile Konya ve 2.5 bin da ile Antalya takip etmiştir. Ülkemizde rezenenin üretim alanı ve miktarında ciddi artışlar yaşanmıştır. Her ne kadar ürün miktarında artış yaşansa da uzun yıllardır rezene tarımı yapılan Burdur ve Antalya illerinde verim, pazarlama, tanıtım, fiyatlandırma gibi sorunlar ile karşılaşmaktadır. Türkiye'de rezene üretim alanı yaklaşık 34.000 da'a ulaşmasına rağmen halen tescil edilmiş bir çeşit mevcut değildir. Rezenenin populasyon olarak üretilmesi standart bir verim ve kalite alınmasının önüne geçmektedir. Rezene üretiminin temel sorunlarından birisi hasat sonrası fiyatlandırma politikasıdır ve pazar ağının dar olmasından kaynaklı yaşanan olumsuzluklardır. Ürün pazarlaması ve özellikle stabil bir fiyat politikası için kooperatiflerin kurulması rezene tarımının gelişmesine pozitif bir katkı sunacaktır. Rezenenin baharat olarak kullanımının dışında uçucu ve sabit yağ olarak da değerlendirilebilir. Rezene tohumunun sabit yağları içerdiği özel yağ asitlerinden dolayı (petroselinik asit) halen değerlendirilmeyi beklemektedir. Katma değeri yüksek olan rezene balının tanıtımının yapılması ile pazarlama imkânları arttırılabilir.

Anahtar Kelimeler: Rezene, foeniculum vulgare, üretim, tarım, ıslah, sorunlar ve çözüm önerileri



FENNEL (*Foeniculum vulgare*) AGRICULTURE, PROBLEMS AND FUTURE IN THE WORLD AND IN TURKEY

ABSTRACT

Fennel has a very wide usage area and it is evaluated especially in food, cosmetics, perfumery and health sectors. 2,698.095 tons of anise, star anise, fennel and coriander are produced on an area of 2,698.095 hectares in the world. India, Syria, Turkey, China and Egypt are the leading countries in terms of agricultural area and product amount. Turkey ranks 11th (9,895 tons) in terms of export amount in the world and 4th place (32.1 million \$) in terms of export value. In our country, the agricultural area of fennel has increased by 113% in the last 5 years and reached 33,857 decares. While the most fennel cultivation was carried out in Burdur with an agricultural area of 18 thousand hectares, this province was followed by Konya with 12.9 thousand hectares and Antalya with 2.5 thousand hectares. In our country, there has been a serious increase in the agricultural area and production amount of fennel. Although there is an increase in the amount of production, problems such as yield, marketing, promotion and pricing are encountered in the provinces of Burdur and Antalya, where fennel has been cultivated for many years. Although the fennel production area in Turkey has reached approximately 34.000 da, there is still no registered variety. Producing fennel as a population prevents obtaining a standard yield and quality. One of the main problems of fennel production is the post-harvest pricing policy and the negativities experienced due to the narrow market network. The establishment of cooperatives for product marketing and especially for a stable price policy will make a positive contribution to the development of fennel agriculture. Apart from the use of fennel as a spice, it can also be evaluated as an essential and fixed oil. Due to the special fatty acids (petroselinic acid) contained in the fixed oils of fennel seeds, they are still waiting to be evaluated. Marketing opportunities can be increased by promoting fennel honey, which has a high added value.

Keywords: Fennel, *foeniculum vulgare*, production, agriculture, breeding, problems and solutions



GİRİŞ

Foeniculum vulgare is one of 300 genera belonging to the Apiaceae family and this family includes about 3000 species (Davis 1978). Fennel is known by different names according to cultures from past to present in the world. Fennel; In Turkey, it is known with names such as "Tangle, Irziyan, Mayana, Raziyan and Tatlı Rezene" (Baytop, 1999). Fennel is an annual or perennial herb. It has a thickened taproot. In this root, especially in the second year, strong lateral roots are formed. Roots can go 1-2 m deep. The stem can reach 60-200 cm in length. Branching in the plant takes place especially in the upper part of the plant. The leaves are stalked in the lower parts and seated on the body in the upper parts. Leaf colors range from dark green to blue green. In fennel, the flowers are quite small and the petals of the flowers are yellow. These flowers are andromonoic. In other words, there are both male and hermaphrodite flowers on the same plant. Here, protandria are present in hermaphrodite flowers. Hermaphrodite pollens that open first and have protandria fertilize the flowers that have opened before and have reached the fertilization maturity, and typical geitonogami are observed. Since fennel is a member of the classical *umbelliferae* family, its flowers are in the umbella state. The diameter of the flower community is 15 cm on average. The fruit is 4-10 cm long, 2-4 mm wide, brown-green in color. The plant has two subspecies. These; *Foeniculum vulgare* Miller subsp. *vulgare* and *Foeniculum vulgare* Miller subsp. *piperitum* (Ucria) Coutinho. *F. vulgare* Miller subsp. *vulgare* has 4 sub-varieties (Davis, 1978). Two of them, *F. vulgare* var. *vulgare* (bitter fennel) and *F. vulgare* var. *dulce* (Miller) Thellung (sweet fennel) is pharmaceutically important and therefore registered in pharmacopoeias and monographs (European Pharmacopoeia, 2002 - Blumenthal et al., 2000), the other two being *F. vulgare* var. *azoricu* and *F. vulgare* var. *piperitum* is the variety used as a vegetable (Arslan, 1986). The reason why fennel is divided into sweet and bitter is the ratio of secondary metabolites contained in its fruits. Fenkon causes it to be bitter and Anethole causes it to be sweet. The amounts of these compounds vary according to the growing place and conditions (Kan et al., 2006). In the European pharmacopoeia (6.0), the lower limit values for essential oil are specified as 40 ml/kg (4%) for bitter fennel and 20 ml/kg (2%) for sweet fennel. According to the Pharmacopoeia (6.0), bitter fennel oil must contain at least 60% anethole, at least 15% fencon and sweet fennel must contain at least 80% anethole. It is a sweet and one-year variety of fennel cultivated in Turkey (Akgül, 1993). Although Davis (1972) published that there is a distribution of fennel belonging to a



single species in his study on the flora of Turkey, it was found that the presence of fennel in other subspecies and its use in studies in later studies (Özcan and Chalchat, 2006).

PRODUCTION STATUS OF FENNEL AND ITS PRODUCTS IN THE WORLD

According to world statistical data, fennel production status data are not given alone, but are given as the sum of anise, star anise, fennel and coriander data. According to these data, anise, star anise, fennel and coriander production is carried out in 22 countries (Table 1). 2.698.095 tons of anise, star anise, fennel and coriander are produced on an area of 2.698.095 hectares in the world. India has 78.16% of the production area and 66.43% of the production amount, followed by Syria (4.3%), China (3.4%), Turkey (2.9%) and Egypt (1.3%) in terms of production area; In terms of production, China (4.1%) is followed by Syria (2.78%), Turkey (1.35%), Egypt (1.18%) and Morocco (1.13%) (Table 1) (FAO, 2023).

Table 1: Production status of anise (*Pimpinella anisum*), star anise (*Illicium verum*), coriander (*Coriandrum sativum*), cumin (*Carum carvi*), Cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare*) and juniper (*Juniperus communis* L.) fruits in the world (FAO 2023)

Country	Area harvested (ha)	Yield (hg/ha)	Production (tonnes)
Afghanistan	26.287	7.379	19.398
Argentina	7.879	8929	7.035
Australia	997	11.589	1.155
Bosnia and Herzegovina	736	10.689	786
Canada	14.494	8.386	12.154
China	40.829	12.554	51.258
China, mainland	40.829	12.554	51.258
Egypt	32.507	8.883	28.877
Ethiopia	6.072	7.999	4.856
Guatemala	1.025	19.781	2.027
India	1.826.000	9.984	1.823.000
Iran (Islamic Republic of)	6.971	86.314	60.172
Kenya	209	3.753	78
Mexico	8.553	155.407	132.914
Morocco	25.844	10.746	27.772
North Macedonia	1.501	11.053	1.658
Russian Federation	83.323	10.809	90.062
Syrian Arab Republic	101.076	6.737	68.098
Tunisia	14.190	7.917	11.234
Türkiye	69.909	47.535	332.310
United Republic of Tanzania	1.388	9.494	1.317
Viet Nam	25.817	6.443	16.632
Total	2.336.436	474.935	2.288.224



The export status of anise, star anise, fennel and coriander in the world in 2018 is presented in Table 2. World anise, star anise, fennel and coriander trade volume is 527 thousand tons and export value is approximately 1 billion dollars. In terms of export amount and value, India ranks first with 259,351 tons and \$521.5 million, followed by Russia, China, Syria, Italy and Bulgaria. In the world ranking, Turkey ranks 11th (9,895 tons) in terms of export amount and 4th place (32.1 million \$) in terms of export value (FAO, 2020).

Table 2. Export status of anise, star anise, fennel and coriander in the world in 2018 (FAO 2023)

Line	Country	Quantity (tons)	Price (1000 \$)	Line	Country	Quantity (tons)	Price (1000 \$)
1	India	259.351	521.576	50	Oman	158	407
2	Russia	42.265	17.730	51	Kazakhstan	150	41
3	Chinese	29.494	102.271	52	Croatia	139	725
4	Syria	28.106	63.603	53	Uruguay	136	67
5	Italy	15.194	19.082	54	Thailand	130	335
6	Bulgaria	14.464	11.015	55	Dominican Rep.	123	159
7	Iranian	12.252	7.001	56	Guatemala	112	315
8	United Arab Emirates	11.789	20.128	57	Mexican	94	196
9	Vietnamese	10.921	28.763	58	Bolivia	87	54
10	Sweetcorn	9.900	27.487	59	Sri Lanka	87	324
11	Turkey	9.895	32.175	60	Indonesia	79	97
12	Afghanistan	9.456	22.735	61	Montenegro	64	122
13	Ukraine	9.005	4.002	62	North Africa	63	198
14	Argentina	7.205	4.661	63	Guyana	62	84
15	Spain	6.919	18.659	64	Colombia	51	153
16	Morocco	6.155	7.562	65	New Zeland	50	334
17	Canada	5.407	6.939	66	Switzerland	46	304
18	Holland	5.294	16.528	67	Denmark	45	188
19	Germany	4.606	23.544	68	Lebanon	30	61
20	Poland	2.842	5.452	69	Tajikistan	29	19
21	Lithuania	2.369	3.428	70	Costa Rica	26	125
22	Romania	2.240	2.530	71	Belarus	23	18
23	Pakistan	2.081	4.215	72	Cayman Islands	22	12
24	USA	2.061	7.292	73	Kenya	21	67
25	Singapore	1.627	2.557	74	Peru	19	58
26	Macedonia	1.489	2.933	75	Tobago	14	59
27	United Kingdom and Ireland	1.397	7.561	76	Kuwait	13	82
28	France	1.339	6.032	77	Portugal	13	234
29	Austria	1.272	5.228	78	Madagascar	12	7
30	Serbia	1.069	2.329	79	Equator	11	3
31	Czech's republic.	990	2.116	80	Caribbean	10	28
32	Bangladesh	918	1.546	81	Greece	8	35
33	Malaysia	852	1.599	82	Ireland	8	32
34	Saudi Arabia	696	1.313	83	Israel	7	39
35	Moldova	609	297	84	Bahrain	6	38
36	Belgium	568	2.018	85	Salvador	6	95
37	Australia	497	852	86	Fiji	6	21
38	Jordan	403	881	87	Honduras	6	71
39	Myanmar	331	100	88	Brazil	5	45
40	Latvia	312	656	89	Ghana	5	6
41	Estonia	301	870	90	Korea	5	12
42	Sudan	296	468	91	Train	3	18
43	Hungary	286	1.051	92	Tunisia	3	11
44	Bosnia and Herzegovina	254	504	93	Algeria	2	1
45	Slovakia	249	1.009	94	Georgia	2	7
46	Uzbekistan	239	164	95	Palestine	2	6
47	Yemen	177	88	96	Finland	1	6
48	Slovenia	173	349	97	Japan	1	13
49	Sweden	164	1.579	98	Luxembourg	1	19



The import status of anise, star anise, fennel and coriander in the world in 2018 is given in Table 3. Vietnam is the country that imports the highest amount of anise, star anise, fennel and coriander in the world. Vietnam was followed by India, Bangladesh, USA, Pakistan and Malaysia. World anise, star anise, fennel and coriander import volume is 498,559 tons and import value is 969 million \$. Our country ranked 22nd with an import amount of 5,138 tons and an import value of 10.1 million dollars. The USA meets the majority of its fennel needs from Egypt, India and Turkey. At the same time, our country exports fennel to Germany, France, Brazil and the Netherlands (FAO, 2020).

Table 3. Import status of anise, star anise, fennel and coriander in the world in 2018 (FAO 2023)

Line	Country	Quantity (tons)	Price (1000 \$)	Line	Country	Quantity (tons)	Price (1000 \$)
1	Vietnamese	69.906	178.735	38	Rusya	1.975	4.402
2	India	35.086	60.793	39	Ekvator	1.855	4.930
3	Bangladesh	32.933	73.506	40	Ürdün	1.840	3.852
4	USA	32.714	83.199	41	Bulgaristan	1.773	2.835
5	Pakistan	23.676	13.079	42	Peru	1.713	4.409
6	Malaysia	23.569	34.372	43	Kolombiya	1.642	4.530
7	Sri Lanka	22.575	23.464	44	Bahreyn	1.415	2.337
8	Indonesia	21.641	14.315	45	İran	1.413	2.979
9	Germany	20.388	47.091	46	Somali	1.215	2.240
10	B. Arab Emirates	18.859	29.265	47	Romanya	1.210	1.768
11	Saudi Arabia	17.372	29.627	48	İsviçre	1.113	5.715
12	B. The Kingdom and Ireland	14.428	36.119	49	Myanmar	1.111	1.265
13	Sweetcorn	13.101	42.423	50	Kore	1.016	2.451
14	Nepal	12.716	22.833	51	Trinidad ve Tobago	996	1.796
15	Brazil	11.570	21.874	52	İsveç	988	3.916
16	Morocco	7.537	17.366	53	Mauritius	973	1.557
17	Japan	7.402	19.945	54	Paraguay	906	2.175
18	South Africa	7.386	10.539	55	Slovakya	884	1.400
19	Holland	7.148	17.794	56	İsrail	866	2921
20	Yemen	5.668	9.353	57	Belçika	833	3.057
21	Poland	5.514	6.326	58	Küba	788	3.057
22	Turkey	5.138	10.155	59	Şili	768	1.977
23	France	4.588	14.133	60	Gürcistan	704	376
24	Chinese	4.099	10.091	61	Tunus	691	1.474
25	Thailand	3.994	7.248	62	Çek Cumh.	690	2.849
26	Mexican	3.812	7.524	63	İrak	668	1.109
27	Spain	3.412	8.770	64	Kenya	656	882
28	Canada	3.325	11.036	65	Yunanistan	648	1.191
29	Singapore	3.144	5.539	66	Yeni Zelenda	576	2.065
30	Oman	3.066	4.836	67	Honduras	558	1.379
31	Austria	2.533	6.483	68	Ukrayna	558	753
32	Train	2.493	3.156	69	Guyana	557	895
33	Uzbekistan	2.486	2.354	70	Macaristan	553	1.581
34	Australia	2.376	6.827	71	Letonya	547	977
35	Algeria	2.353	6.704	72	Etiyopya	511	1.406
36	Kuwait	2.203	3.923	73	Litvanya	509	801
37	Italy	2.123	5.868	74	Fiji	506	831



PRODUCTION STATUS OF FENNEL AND ITS PRODUCTS IN TURKEY

In 2014, while the production areas in Karamanlı (5,000 decares) and Tefenni (10,000 decares) districts of Burdur province gained intensity; While Tefenni (11.900 da) and Karamanlı (6.000 da) were produced in Burdur province in 2019, it is seen that the production areas increased in Antalya province Korkuteli district (2.500 decare) and Konya province Çeltik (10.200 decare) (TUIK, 2020).

Table 4. Fennel production areas in our country (da)

Production zones		2014	2015	2016	2017	2018	2019
Afyonkarahisar	Dazkırı	48	10				
	Sultandağı				125		
Ankara	Polatlı						362
Antalya	Korkuteli			1.500	1.600	1.600	2.500
Burdur	Karamanlı	5.000	5.000	5.500	5.500	5.500	6.000
	Tefenni	10.000	10.000	10.203	9.200	9.200	11.900
	Çavdır	800	500	300	100	100	125
Konya	Altınekin						680
	Kadınhanı						20
	Tuzlukçu						570
	Yunak						1.500
	Çeltik					7.000	10.200
Malatya	Darende		2				
TOTAL		15.848	15.512	17.503	16.525	23.400	33.857

The amount of fennel production (tons) between 2014-2019 in our country is presented in Table 5. The total amount of fennel production in our country was determined as 2. In 2018 and 2019, there was an increase in the amount of production in parallel with the increase in the production areas of fennel.289 tons in 2014, and there was no significant increase in production until 2017. While the total fennel production of our country was 3,067 tons in 2018, it increased to 4,738 tons in 2019 (TUIK, 2020).

Table 5. Fennel production amounts in our country (tons)

Production zones		2014	2015	2016	2017	2018	2019
Afyonkarahisar	Dazkırı	4	1				
	Sultandağı				5		
Ankara	Polatlı						130
Antalya	Korkuteli			225	240	240	375
Burdur	Karamanlı	750	625	688	385	385	480
	Tefenni	1.500	800	1.530	1.380	1.380	1.963
	Çavdır	35	35	21	12	12	15
Konya	Altınekin						68
	Kadınhanı						1
	Tuzlukçu						86
	Yunak						90
	Çeltik					1.050	1.530
Malatya	Darende		0				
TOTAL		2.289	1.461	2.464	2.022	3.067	4.738



The highest production amount in 2019 was in Tefenni district of Karaman province (1,963 tons), followed by Konya province Çeltikçi district (1.530 tons), Burdur province Karamanlı district (480 tons) and Antalya province Korkuteli district (375 tons). Fennel production, which was 750 tons in 2014 in Tefenni district of Burdur province, decreased to 385 tons in 2017 and 2018 and increased to 480 tons in 2019. In the Tefenni district of Burdur province, although there were fluctuations in production from 2014 to 2019, the amount of production generally tended to increase. In the Çeltikçi district of Konya province, the production amount, which was 1,050 tons in 2018, increased by 480 tons in 2019 and reached 1,530 tons in 2019. In Antalya Korkuteli district, the amount of fennel production has increased continuously since 2016. The production amount in Korkuteli district, which was 225 tons in 2016, increased by 150 tons in 2019 and reached 375 tons (TUIK, 2020).

When the seed yields in 2019 are examined; Burdur province Tefenni district (165 kg/da) has the highest seed yield; it has been determined that this district is respectively Tuzlukçu district of Konya province (151 kg/da), Çeltik district of Konya province (150 kg/da), Korkuteli district of Antalya province (150 kg/da) and Çavdır district of Burdur province (120 kg/da). Seed yield in Korkuteli district of Antalya province did not vary according to years. In the Karamanlı district of Burdur province, the seed yield, which was 150 kg/da in 2014, decreased to 80 kg/da in 2019. The seed yield, which was 150 kg/da in Tefenni district of Burdur province and 70 kg/da in Çavdır district in 2014, increased to 165 kg/da in Tefenni district and 120 kg/da in Çavdır district in 2019 (TUIK, 2020).

Table 6. Seed yield (kg/da) in fennel production areas in our country

Production zones	2014	2015	2016	2017	2018	2019
Afyonkarahisar						
Dazkırı	75	55				
Sultandağı				40		
Ankara						
Polatlı						47
Antalya						
Korkuteli			150	150	150	150
Burdur						
Karamanlı	150	125	125	70	70	80
Tefenni	150	80	150	150	150	165
Çavdır	70	70	70	120	120	120
Konya						
Altınekin						100
Kadınhanı						50
Tuzlukçu						151
Yunak						60
Çeltik					150	150
Malatya						
Darende		85				
AVERAGE	111	83	124	106	128	107



In our country, fennel is not evaluated under the Anise Customs Tariff Statistics Position (GTİP) numbers alone and is included as ground or unground anise and Chinese anise seeds, Karaman cumin seeds, juniper berries or as fresh/chilled fennel. Import volume data of ground and unground anise and Chinese anise seeds, Karaman cumin seeds, fennel seeds, juniper berries in our country are presented in Table 7. When the import values are examined; While the highest import amount was 4,865 tons in 2017, the lowest was 2,515 tons in 2015. While the highest import value in Turkish Lira was 46.3 million TL in 2020, the lowest was 16.0 million TL in 2015. On the dollar basis, the highest import was \$11.4 million in 2017 and the lowest was \$5.7 million in 2015 (TUIK, 2020).

Table 7. Import volume of ground and unground anise and Chinese anise seeds, Karaman cumin seeds, fennel seeds, juniper berries in our country

Years	Imports (\$)	Imports (TL)	Quantity (Kg)
2015	5.721.383	15.987.497	2.515.163
2016	7.025.121	21.280.398	3.519.410
2017	11.375.772	41.139.165	4.862.657
2018	6.779.006	33.058.540	3.372.129
2019	7.973.081	45.292.330	4.112.099
2020	6.740.154	46.329.996	2.976.995

Export volume data of our country's milled and unground anise and Chinese anise seeds, Karaman cumin seeds, fennel seeds, juniper berries and fennel (fresh or chilled) are presented in Table 8. The highest export product of our country was the product made in unground form, followed by crushed and ground product and fresh/chilled product. When the export data from 2015 to the present are analyzed, it is seen that the export amount has decreased. While 4,235 tons of products were exported in 2015, this amount decreased to 2,926 tons in 2020. Despite the decrease in product exports, the value of imports increased in TL terms. While the export value was 38.5 million TL in 2015, it increased to 78.1 million TL in 2020. In dollar terms, a fluctuating change was observed according to years, and the highest export was 14.3 million dollars in 2016. In addition to being evaluated as an aromatic plant, fennel is also consumed as a fresh vegetable. The amount of export in the form of fennel vegetable, fresh or chilled, varies from year to year. While the highest export amount for this product was 23.5 tons in 2019, 252.7 thousand TL of input was provided to our country (TUIK, 2020).



Table 8. Export volume data of our country for ground and unground anise and Chinese anise seeds, Karaman cumin seeds, fennel seeds, juniper berries and fennel (fresh or chilled)

Year	Export products	Export Dollar	Export TL	Quantity (Kg)
2015	Unground *	13.726.049	36.958.900	4.234.934
	Crushed or Cround **	579.740	1.603.745	168.071
	Fennel (fresh or chilled) ***	19.699	51.421	7.303
	Total	13.726.648	38.562.696	4.235.109
2016	Unground	14.254.324	43.338.293	4.530.821
	Crushed or Cround	884.046	2.618.334	224.213
	Fennel (fresh or chilled)	2.155	6.278	452
	Total	14.255.210	45.956.633	4.531.497
2017	Unground	9.940.169	36.449.979	3.153.359
	Crushed or Cround	936.604	3.434.205	237.846
	Fennel (fresh or chilled)	4.477	15.784	929
	Total	9.941.110	39.884.200	3.154.526
2018	Unground	13.611.214	64.273.115	3.607.690
	Crushed or Cround	831.706	4.060.318	211.708
	Fennel (fresh or chilled)	15.568	85.670	8.546
	Total	13.612.061	68.333.519	3.607.910
2019	Unground	11.048.245	62.635.873	3.170.007
	Crushed or Cround	1.409.372	8.044.816	355.020
	Fennel (fresh or chilled)	43.674	252.784	23.473
	Total	12.457.661	70.680.942	3.170.385
2020	Unground	9.238.080	62.772.771	2.925.926
	Crushed or Cround	2.192.311	15.302.457	513.719
	Fennel (fresh or chilled)	13.273	84.202	8.354
	Total	11.430.404	78.075.312	2.926.448

FENNEL OIL AND SPICE STANDARDS

While the whole and ground standards of fennel seeds are determined according to ISO 7927-1:1987 and the bitter fennel oil standards are determined according to ISO 17412:2007 standards, in our country the whole and ground standards are determined according to the TS 7418 standard accepted in 2016. TS 7418 fennel standards in our country have been determined according to the Turkish Food Codex Spices Communiqué (Communiqué No: 2013/12) (Table 9). It is aimed to determine the characteristics that the spice should have in the stages of producing, preparing, processing, storing, transporting and placing on the market in accordance with the technique and hygienically. There are no quality standards for fennel essential oil in our country.



Table 9. Whole and ground standards of fennel seeds according to Turkish Food Codex Spices Communiqué (Communiqué No: 2013/12)

	Foreign matter (% m/m)	Total ash k.m. (% m/m)	Insoluble in 10% HCl km.m. most (% m/m)	Essential oil km.m. least (ml/100g)	Moisture most (%)
Whole	2	12	1	1	12
Ground	not found	11	1	0.5	

Standards include whole or ground seeds of fennel (*Foeniculum vulgare* Mill.var. *dulce*) which are collected while green before maturation and dried according to the technique. halini kapsamaktadır. According to these principles, fennel has its own unique taste, smell and color; It should not have foreign taste and odor and should not contain any bad grains, and should not contain live insects, visible or invisible dead insects and their remains and the remains of other pests.

In India, where fennel cultivation is most common, the standards of fennel seeds are determined based on IS 3796:1993 standards (Table 10).

Table 10. Grade definitions and requirements of fennel whole in India

Characteristic	Necessity			Test Method (IS1797:1985)
	Special	Good	Fair	
Humidity, (%), Max	10.0	10.0	10.0	9
Essential oil, (%), Min	1.75	1.50	1.00	15
Foreign matter*, (%), Max	1.0	2.0	4.0	4
Damaged, discolored, (%), Max	1.5	3.0	5.0	4
Shrunken and immature seeds, (%), Max	1.5	3.0	5.0	4
Other edible seeds, (%), Max	-	-	5	4

*Inorganic impurities shall not be more than 2% by mass.

Foreign Matter: Contains organic matter such as calyx fragments, stems, loose tops, straw, straw, or other vegetable matter. It also includes inorganic materials such as dust, dirt, stones, soil, sand and gravel.

Damaged, Discolored and Sore Seeds: This includes fennel seeds that have been damaged or discolored to affect the quality of the material, as well as seeds that show hole marks in the seeds as a result of being eaten by weeds or insects.

Shrunken and Immature Seeds: These are seeds that are not fully developed.

Color: Seeds will be yellowish green to drak green, and of the species or variety with a characteristic size and shape. The seeds will be quite dry.

Taste and Flavor: The taste and aroma of fennel seeds will be fresh and unique to the type and variety. The material will be free of foreign taste and aroma as well as any musty odor.

In the USA, product purity standards (Cleanliness Specifications) of fennel seeds and quality standards for whole/ground fennel are determined according to the standards of the American Spice Trade Association (ASTA-American Spice Trade Association) and the USFDA-Food and Drug Administration. (Table 11).



Table 11. Fennel quality standards of ASTA and FDA

Parametre	Status	Parametre	Status
ASTA standards		FDA standards	
Dead insect or parts	*	Adulteration (mg/lb)	3
Mammalian feces (mg/lb)	*	Essential oil (% min)	1.5
Other feces (mg/lb)	*	Moisture (% maks)	10.0
Mold (%)	1	Ash (% maks)	9.0
Foreign matter (5)	0.5	Acid soluble ash (% maks)	1.0
Live insect (%)	1		

US essential oil standards are based on GRAS 2481 for bitter fennel oil and GRAS 2483 for sweet fennel oil. On the other hand, according to the standards of USDA (National Nutrient Database for Standard Reference), the nutritional contents of 100 g fennel seeds were also defined (Table 12).

Table 12. Nutritional standards of fennel seeds according to USDA standards

Nutrients	100 g'daki değeri	Besin	100 g'daki değeri
Water (g)	8.81	Vitamin B-6 (mg)	0.470
Energy (kcal)	345	Vitamin B-12 (mg)	0.00
Protein (g)	15.80	Vitamin A, (mcg RAE)	7
Total oil (g)	14.87	Vitamin A, (IU)	135
Carbohydrate (g)	52.29	Vitamin C, total ascorbic acid (mg)	21.0
Fiber, total (g)	39.8	Fatty acids, total saturated (g)	0.480
Calcium, Ca (mg)	1,196	Fatty acids, total monounsaturated (g)	9.910
Vitamin D (IU)	0	Fatty acids, total polyunsaturated (g)	1.690

Source: USDA National Nutrient Database for Standard Reference, Release 24 (2011)

NUTRITIONAL CONTENTS OF FENNEL

Fennel is one of the highest plant sources of potassium, sodium, phosphorus and calcium. According to USDA data, fennel is the richest in dietary fiber and vitamins for human needs (Table 9). They have lesser amounts of other nutrients. Fennel (49mg/100g), apple (7.14mg/100g), banana (3.88mg/100g), dates (25.0mg/100g), grapes (10.86mg/100g), oranges (40.25mg/100g), prunes (18.0 mg/100g), raisins (40.0mg/100g) and strawberries (14.01mg/100g) have been reported to contain more calcium compared to fruits (Barros et al., 2010) (Table 10).



Table 13. Nutritional values in dried fennel (*Foeniculum vulgare*) (USDA, USA)

Nutrients found in dried fennel		(USDA, USA)
Composition	Quantity (per 100 g)	
Average		
Moisture	90.21 g	
Energy	31 kcal	
Protein	1.24 g	
Total fat	0.2 g	
Carbohydrate	7.3 g	
Total dietary fiber	3.1 g	
Sugar	3.93 g	
Minerals		
Calcium (Ca)	49mg	
Iron (Fe)	0.73mg	
Magnesium (Mg)	17mg	
Phosphorus (P)	50 mg	
Potassium (K)	414mg	
Sodium (Na)	52mg	
Zinc (Zn)	0.2mg	
Vitamins		
Vitamin C	12mg	
Thiamine B-1	0.01mg	
Riboflavin Vitamin B2	0.032mg	
Niacin B-3	0.64mg	
Vitamin B-6	0.047mg	
Folate	27 µg	
Vitamin A	48 µg	
Vitamin E	0.58mg	
Vitamin K	62.8 µg	
Oils		
Fatty acids, total saturated	0.09 g	
Fatty acids, total monounsaturated	0.068 g	
Fatty acids, total polyunsaturated	0.169 g	
Essential Amino Acids		
Leucine	0.63 g	
Isoleucine	0.73 g	
Phenylalanine	0.45 g	
Tryptophan	0.53 g	
Unnecessary Amino Acids		
Glycine	0.55 g	
Proline	0.53 g	

FIXED OIL

Fennel seeds contain 12-15% fixed oil. 80-85% of this fixed oil consists of petroselinic acid (C18:1 n6c). In addition, the remaining components of the oil occurs palmitic acid (C16:0), Stearic acid (C18:0), Oleic acid (C18:1 n9c), cis-Vassinic acid (C18:1 n11c), Linoleic acid (C18:2 n6c), Linolenic acid (C18:3). Oils rich in petroselinic acid can be used in the edible oil and biodiesel industry with their high melting points. It can also be evaluated in the food and



perfumery industry due to its antimicrobial effect (Baydar, 2016). On the other hand, due to the special fatty acids (petroselinic acid) that fennel seed contains in fixed oils, it is still waiting to be evaluated. Besides the fixed oil, the market value of fennel honey is also unknown.

PROBLEMS AND SOLUTION SUGGESTIONS

There is no variety or line registered by the seed registration and certification institution in our country. Breeding studies on fennel plant in our country are about increasing yield and quality, and all of them were left incomplete without being registered. Using high quality and high yield varieties registered by the seed registration and certification institution will save our country's fennel producers from producing randomly from the population. They will have obtained a standard yield and quality product.

The establishment of cooperatives for product marketing and especially for a stable price policy will make a positive contribution to the development of fennel agriculture. Apart from the use of fennel as a spice, it can also be evaluated as an essential and fixed oil. Although there is a narrow market in our country, fennel essential oil can find buyers in the foreign market. With a distillation facility to be established in the region, essential oil can be obtained and the market network can be expanded by distilling certain amounts of product annually or in years with marketing problems as spices. On the other hand, due to the special fatty acids (petroselinic acid) that fennel seed contains in fixed oils, it is still waiting to be evaluated. One of the fields that can be evaluated in fennel agriculture is the production of fennel honey. Marketing opportunities can be increased by promoting fennel honey, which has a high added value. In order to increase the marketing network for fennel agriculture and industry, it is necessary to carry out promotional activities with events such as fairs, advertisements, periodicals, billboards and festivals. On the other hand, the market share can be increased by classifying the products as standardized regional products with geographical indications.



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IPARD PROGRAMI İLE DESTEKLENEN HAYVANCILIK İŞLETMELERİNİN MERA VE YEM BİTKİSİ TARIMI BAKIMINDAN ETKİLERİNİN DEĞERLENDİRİLMESİ

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ÖZET

Türkiye ile Avrupa Birliği (AB) arasında 2005 yılından bu yana devam ettirilen katılım öncesi sürecin önemli fasıllarından biri de 11 numaralı fasıl olan; Tarım ve Kırsal Kalkınmadır. Bu fasıl kapsamında 2008'den itibaren uygulanmaya başlanılan ve Tarım ve Kırsal Kalkınmayı Destekleme Kurumu (TKDK) tarafından yürütülen IPARD Programı; modern tarımsal üretim ile kırsal alanlarının kalkınmasına katkı sağlanması hedefiyle proje bazlı yatırımlara destek sağlamaktadır. IPARD Programıyla birçok sektör ve alt sektör desteklenmekte; bunlar arasında özellikle küçük ve orta ölçekli hayvancılık işletmeleri öne çıkmaktadır. Yeni kurulan ya da kapasitesi geliştirilen bu işletmelerde yem ihtiyacı bakımından çayır-meralar ile yem bitkisi tarımından elde edilen yem kaynağının önemi artmaktadır. IPARD destekleri ile kurulan veya modernize edilen hayvancılık işletmeleri yapım işleri, makine-ekipman varlıkları ve danışmanlık hizmetleri için %50-65 hibe oranlarında desteklenmektedir. Yem bitkisi üretimi için bazı makine ve ekipmanlar desteklenen kalemler arasında yer almaktadır. IPARD I Programı ile desteklenen hayvancılık işletmeleri fiziki yapı ve hayvansal varlık olarak önemli bir gelişim göstermiştir. Ancak bu süreçte işletmelerin meralar üzerine etkisi proje süreçlerinde yer alamamış, yem bitkisi üretimi ise yalnızca kapsamı dar bir makine-ekipman desteği ile sınırlı kalmıştır. Dolayısıyla işletme-mera ilişkisi, işletmelerin istifade edebilecekleri mera kapasiteleri, meraların amenajman ilkelerine uygun olarak kullanılmaları ve gerekli ise mera ıslah faaliyetlerinin desteklenmesi gibi unsurlar programda yer almamıştır. Bununla birlikte işletmelerin yem ihtiyacının karşılanması amacıyla planlı ve bölgeye uygun yem bitkileri üretimi de teşvik edilmemiştir. Bu bilgiler ışığında ciddi bir finans kaynağı ile desteklenen IPARD destekli projelerde meralara yönelik doğrudan bir destek başlığının oluşturulması ve yem bitkisi üretiminin güçlü biçimde teşvik edileceği bir modelin geliştirilmesinin faydalı olacağı değerlendirilmektedir.

Anahtar Kelimeler: IPARD, mera, yem bitkisi tarımı, TKDK.



EVALUATION OF THE EFFECTS OF LIVESTOCK ENTERPRISES SUPPORTED BY IPARD PROGRAM ON RANGELAND AND FORAGE CROPS CULTIVATION

ABSTRACT

One of the important chapters of the pre-accession period, which has been going on between Turkey and the European Union (EU) since 2005, is Agriculture and Rural Development chapter 11. Within the scope of this chapter, the IPARD Program which has been implemented since 2008 and is carried out by the Agriculture and Rural Development Support Institution (TKDK), It provides support to project-based investments with the aim of contributing to the development of rural areas with modern agricultural production. Small and medium-sized livestock enterprises are supported by the IPARD Program, and the importance of rangeland-pasture and forage crop production increases in terms of feed requirement in these newly established enterprises or whose capacity has been developed. Livestock enterprises established or modernized with IPARD are supported at 50-65% grant rates for construction works, machinery-equipment and consultancy services. Some machinery and equipment for forage crop cultivation are among the supported items. Livestock enterprises supported by the IPARD Program have shown a significant development in terms of physical structure and animal assets. However, the impact of the enterprises on the rangelands could not be included in the project processes, and the forage crops cultivation was limited only to the support of machinery and equipment in this process Therefore, factors such as the enterprise-rangeland interaction, the capacity of the rangeland that the enterprise can benefit from, their use in accordance with the management principles and, if necessary, supporting the rangeland improvement activities were not included in the program. In addition, it was not possible to meet the feed needs of the enterprises with the production of forage crops that are planned and suitable for the region. In the light of this information, it is considered that it would be beneficial to establish a direct support title for rangelands and to develop a model that will strongly encourage forage crop production in IPARD projects supported by a serious financial resource.

Keywords: IPARD, rangeland, forage crops cultivation, TKDK.



1. GİRİŞ

Türkiye ile Avrupa Birliği (AB) arasında 2005 yılından bu yana devam ettirilen katılım öncesi süreç “Katılım Öncesi Mali Yardım Aracı (Instrument for Pre-Accession Assistance)” ile yönetilmektedir. “IPA” olarak kısaltılan yardım aracı; kurumsal kapasite, bölgesel ve sınır ötesi işbirliği, bölgesel kalkınma, insan kaynakları ve kırsal kalkınma olmak üzere 5 bileşenden meydana gelmektedir (Avrupa Birliği Başkanlığı, 2023). Toplam 35 fasıl üzerinden devam eden katılım öncesi sürecin önemli fasıllarından biri 11 numaralı fasıl olan; Tarım ve Kırsal Kalkınmadır (Anonim, 2008). Bu fasıl kapsamında 2008’den itibaren uygulanmaya başlanılan ve Tarım ve Kırsal Kalkınmayı Destekleme Kurumu (TKDK) tarafından yürütülen IPARD (Instrument for Pre-Accession Assistance Rural Development) Programı; modern tarımsal üretim ile kırsal alanlarının kalkınmasına katkı sağlanması hedefiyle proje bazlı yatırımlara destek sağlamaktadır (Tarım Reformu Genel Müdürlüğü, 2023). IPARD Programıyla tarım ve kırsal kalkınma odaklı birçok sektör ve alt sektör proje bazlı olarak desteklenmektedir. Bu sektörlerin başında küçük ve orta ölçekli hayvancılık işletmeleri yer almaktadır. Yeni kurulan ya da kapasitesi geliştirilen bu işletmelerde oluşan kaba yem ihtiyacı bakımından çayır-meralar ile yem bitkisi tarımında elde edilen yemin önemi artmaktadır. Zira iklim değişikliğinin olumsuz etkileri ve başta yem kaynakları olmak üzere girdi maliyetlerinin yükselmesi nedeniyle küçük ve orta ölçekli hayvancılık işletmeleri yem temininde güçlük çekmektedirler. Dolayısıyla işletmelerin kaba yem ihtiyaçlarını ekonomik ve sürdürülebilir şekilde karşılayabilecekleri kaynaklara erişebilmeleri günümüzde daha büyük önem kazanmıştır. Bu çalışmayla IPARD (I) fonları ile desteklenen hayvancılık işletmelerinin bölgelerinde yer alan meralarla ilişkileri ile yem bitkisi üretimi bakımından etkileri değerlendirilmiştir.

2. KABA YEM KAYNAKLARI

Kaba yem; doğal durumunda % 14’ten daha fazla su içeriği ya da kuru maddede % 16-18’den daha fazla ham selüloz ihtiva eden her tür materyal olarak tanımlanabilir (Özkan ve Şahin Demirbağ, 2016). Hayvansal üretimin önemli yem kaynakları olan kaba yemler, yetiştiricilikte yem rasyonlarının ana kısmını oluşturmaktadır. Çayır-meralar, yem bitkisi tarımı ile üretilen bitkiler ile bitkisel üretim artıkları başlıca kaba yem kaynakları olarak sıralanabilir. Bu kaynaklar arasında hayvansal üretimin en ucuz kaba yem kaynağı çayır ve meralardır. Dünya alanının yaklaşık 32,3 milyon km²’si gerçek çayır ve mera alanları ile kaplıdır (FAO, 2020). Türkiye’de ise toplam 1,4 milyon hektar çayır, 13,2 milyon hektar mera arazisi bulunmaktadır (TÜİK, 2021). Türkiye’nin sahip olduğu çayır alanlarından 4,2 milyon ton, mera alanlarından



ise 8,7 milyon toplam olmak üzere toplam 12,9 milyon ton kaliteli kaba yem elde edilmektedir (Altın vd., 2011; Gökkuş, 2019). Türkiye’de yem bitkisi tarımı için ayrılan tarım arazisi miktarı 2,7 milyon hektardır ve yem bitkisi tarımında yonca, silajlık mısır, fiğ (adi), korunga ile yulaf (yeşil ot) en fazla yetiştirilen bitkilerdir (TÜİK, 2022). Yem bitkileri kaliteli kaba yeme ulaşmanın ekonomik yollarından birisi olmanın yanı sıra, hayvanların rumen faaliyetleri için ihtiyaç duyulan besin maddelerini içermeleri, mineral-vitamin kaynağı olmaları, hayvanlarda üreme gücünün artırılmasına yardım etmeleri ve kaliteli hayvansal üretimin sağlanması bakımından da oldukça önemlidirler (Tan, 2018). Çayır-meralar ile yem bitkisi tarımından elde edilen yemler kaliteli kaba yem kaynaklarıdır ve üreticilik açısından kullanılmaları önemli fayda sağlamaktadır. Ancak bu kaynakların ülkedeki toplam hayvan varlığını beslemekte yeterli olmamaları nedeni ile bitkisel üretim artıkları da kaba yem olarak kullanılmaktadır. Hasat sonrasında geriye kalan sap ve saman gibi artıkların yem olarak kullanılması, hayvan beslemede mevcut olan yem açığını kapatma anlamında katkı sağlamaktadır. Ancak daha çok dolgu maddesi olan bu kaba yemlerin kullanımını sınırlayan başlıca etmenler; yüksek düzeyde selüloz ve lignin ile düşük miktarda ham protein içermeleri nedeniyle sindirilebilirlik oranlarının düşük olmasıdır (Ak ve Akbay, 2018).

3. TÜRKİYE’DE IPARD ROGRAMI

Türkiye’nin AB’ye üyelik müzakereleri sürecinde uygulanmakta olan Katılım Öncesi Mali Yardım Aracı (IPA)’nın beş bileşeninden birisi “Kırsal Kalkınma” başlığıdır. AB’ye katılım öncesi süreçte, Avrupa Birliği mevzuatına uyumun sağlanması ve oluşturulan yeni mevzuat sisteminin yürütülebilmesi için gerekli kurumsal kapasitenin tesis edilmesi gerekmektedir. Bu çerçevede katılım müzakerelerinin 11 nolu Tarım ve Kırsal Kalkınma faslının müzakerelere açılabilmesi için belirlenen gerekliliklerden biri AB kriterlerine uygun olarak akredite edilmiş bir IPARD Ajansı’nın kurulması olmuştur (TKDK, 2019). Bu şartın yerine getirilmesi için 18 Mayıs 2007 tarih ve 5648 Sayılı “Tarım ve Kırsal Kalkınmayı Destekleme Kurumu Kuruluş ve Görevleri Hakkında Kanun” ile Tarım ve Kırsal Kalkınmayı Destekleme Kurumu (TKDK) kurulmuştur. TKDK kırsal kalkınma için katılım öncesi süreçte tahsis edilen IPARD (Instrument for Pre-Accession Assistance Rural Development Programme-Katılım Öncesi Yardım Aracı Kırsal Kalkınma Programı) fonları ile ilgili süreçleri yönetmektedir. Türkiye’nin katılım öncesi dönemdeki önceliklerini ve ihtiyaçlarını dikkate alınarak sürdürülebilir kırsal kalkınmayı sağlayacak şekilde tarımsal işletmeleri AB standartlarına yükseltmeyi amaçlayan IPARD programı, Türkiye’nin 42 ilinde yürütülmektedir. Program ile tarım, hayvancılık, gıda, balıkçılık ve alternatif tarım alanlarında faaliyet gösteren işletmelere, üretici bireylere,



kooperatiflere ve üretici birliklerine hibe programları aracılığı ile finansman desteği sağlanmaktadır (TKDK, 2019).

3.1. IPARD ile Desteklenen Sektörler

IPARD Programı ile tarım ve kırsal kalkınma odaklı bazı tedbir ve alt tedbirler hibe-bazlı olarak desteklenmiştir. IPARD (I) ile desteklenen tedbirler-sektörler Çizelge 1’de yer almaktadır.

Çizelge 1. IPARD I Programı ile desteklenen tedbir-alt tedbirler*

Tedbir	Alt Tedbir
Tarımsal İşletmelerin Yeniden Yapılandırılması ve Topluluk Standartlarına Ulaştırılmasına Yönelik Yatırımlar	Süt Üreten Tarımsal İşletmeler
	Et Üreten Tarımsal İşletmeler (Kırmızı et)
	Et Üreten Tarımsal İşletmeler (Beyaz et)
Tarım ve Balıkçılık Ürünlerinin İşlenmesi ve Pazarlanmasının Yeniden Yapılandırılması ve Topluluk Standartlarına Ulaştırılmasına Yönelik Yatırımlar	Süt ve Süt Ürünlerinin İşlenmesi ve Pazarlanması
	Süt Toplama Merkezleri
	Et ve Et Ürünlerinin İşlenmesi ve Pazarlanması (Kırmızı et)
	Et ve Et Ürünlerinin İşlenmesi ve Pazarlanması (Beyaz et)
	Meyve ve sebzelerin İşlenmesi ve Pazarlanması
	Su Ürünlerinin İşlenmesi ve Pazarlanması
Kırsal Ekonomik Faaliyetlerin Çeşitlendirilmesi ve Geliştirilmesi	Çiftlik Faaliyetlerinin Çeşitlendirilmesi ve Geliştirilmesi
	Yerel Ürünler ve Mikro İşletmelerin Geliştirilmesi
	Kırsal Turizm
	Kültür Balıkçılığının Geliştirilmesi
Teknik Destek	-

*Tarım ve Kırsal Kalkınmayı Destekleme Kurumu 2019-2023 Stratejik Planı, 2019

Çizelge 1 incelendiğinde IPARD (I) Programıyla toplamda 14 alt tedbiri içeren yatırımların desteklendiği görülmektedir. Hali hazırda yürütülmekte olan IPARD II Programında bu tedbirlerde değişiklikler yapılmıştır. Ancak çalışma özelinde yalnızca IPARD I ile tamamlanmış yatırımlar dikkate alınmış, IPARD II programı değerlendirmede dikkate alınmamıştır. Hibe desteği sağlanan tedbirler arasında küçükbaş ve büyükbaş sektöründe hayvansal üretimi destekleyen “Tarımsal İşletmelerin Yeniden Yapılandırılması ve Topluluk Standartlarına Ulaştırılmasına Yönelik Yatırımlar” başlığı öne çıkmaktadır. Nitekim IPARD (I) Programı ile bu sektörde tamamlanan 1490 projeye %50 ile %65 arasında değişen oranlarda hibe desteği sağlanmış; toplam 1,55 milyar TL’den fazla hibe ödemesi yapılmıştır. Bu tutar program genelinde yapılan toplam 3,15 milyar TL’lik ödemenin yaklaşık %49’na denk



gelmektedir (TKDK, 2019). Tamamlanan bu projelerde “Makine-Ekipman Alımı”, “Yapım İşleri”, “Hizmet Alımı (Mimarlık, mühendislik ve diğer danışmanlık ücretleri, lisans ve patent haklarının devralınmasına yönelik genel maliyetler ve İş Planı Hazırlığı)” ve “Görünürlük Harcamaları” desteklenmiştir. Destek kalemleri incelendiğinde doğrudan meralarla ilgili bir kalem bulunmadığı görülmektedir. Yem bitkileri açısından ise makine-ekipman alımı başlığı altında yem bitkisi tarımında kullanılabilecek; ot/çayır biçme makinesi, ot dağıtma tırmığı, ot toplama/namlu yapma tırmığı ile silaj yapımında kullanılan mısır-ot silaj makineleri, silaj paketleme makinesi, balya yükleme ekipmanı ve römorku gibi bazı makinelere destek verilmiştir. Söz konusu makine-ekipmanlar değerlendirildiğinde, destek verilen ekipmanların üretimden ziyade daha çok yem hazırlama-depolama odaklı olduğu söylenebilir.

3.2. Et ve Süt Üreten İşletmelerde Değerlendirme Sürecinde Dikkate Alınan Sıralama Puanları

IPARD Programı kapsamında sunulan ve ön değerlendirme sürecini geçen projeler, belirlenen “Proje Seçimine Esas Sıralama Kriterlerine” göre tekrar değerlendirilmiş ve puanlanmıştır. IPARD programında et ve süt üreten işletmeleri için belirlenmiş kriterler çerçevesinde, projelere Çizelge 2 ve Çizelge 3’de yer alan kriterlere göre puanlar verilmiştir. IPARD programı sıralama kriterlerine göre yapılan değerlendirmeden elde edilen puan, projelerin nihai sıralamasını belirlemiş ve projeler için en yüksek puandan başlanarak destek kararı verilmiştir (TKDK, 2013a; TKDK, 2013b).

Sıralama kriterleri incelendiğinde et ve süt üretim için kurulması planlanan hayvancılık işletmeleri için mera hayvancılığı veya yem bitkisi üretimi ile ilgili bir kriter bulunmadığı görülmektedir. Projelerin değerlendirme sürecinde, işletmenin yem ihtiyacı için yem bitkileri üretim durumu ya da meraya dayalı hayvancılık planlanıyor ise yatırım adresinin bulunduğu bölge meralarının durumu ve işletmenin hayvan sayısındaki artışın meralara etkisinin ne olacağı konusunda bir değerlendirme yapılmamaktadır.



Çizelge 2. Süt üreten tarımsal işletmeler için puan tablosu*

Kriter	Puan
Tarımsal işletmenin üretilen sütünü, 103- 1 Süt ve Süt Ürünlerinin İşlenmesi ve Pazarlanması alt tedbiri altında “pilot entegre süt toplama ve işleme ağı” kurmak üzere IPARD Programı’ndan faydalanan süt işleyen işletmeye satması	30
Tarımsal işletmedeki süt ineklerinin en az %50’sinin saf ya da melez ırk olması	20
Ürünlerin en az %60’ının tedarik sözleşmesi yolu ile işleme işletmelerine veya kayıtlı süt toplama merkezlerine pazarlanması	20
Başvuru sahibinin kendi faaliyeti ile ilgili bir üretici grubuna üye olması	10
Tarımsal işletmenin organik tarımla ilişkili olması	10
Başvuru sahibinin, (Gerçek kişi olması halinde kendisi, tüzel kişilerde ise tüzel kişiliği temsil ve ilzama sahip kişinin) başvuru sunulma tarihinde 40 yaş altında olması	10
Toplam	100

*Tarım ve Kırsal Kalkınmayı Destekleme Kurumu, Süt Üreten Tarımsal İşletmelere Yatırım Başvuru Çağrı Rehberi, 2013

Dolayısıyla mera ve yem bitkisi tarımı odaklı bir planlama yapmayı tercih eden, işletmenin üretime başladığı dönemde yem darboğazına düşme riskini öngören ve buna hazırlık yapmak isteyen başvuru sahiplerine, herhangi bir finansman desteği sunulmadığı gibi proje değerlendirme sürecinde de herhangi bir öncelik tanınmamıştır.

Çizelge 3. Et üreten tarımsal işletmeler için puan tablosu*

Kriter	Puan
Başvuru sahibinin yatırımında yarı açık ya da açık ahır kullanıyor veya inşa etmeyi planlıyor olması	30
Başvuru sahibinin yatırımının, IPARD Programı Bölüm 3, Kısım 3.2.4 altında tanımlanan dağlık alanlarda yer alması	30
Başvuru sahibinin, (Gerçek kişi olması halinde kendisi, tüzel kişilerde ise tüzel kişiliği temsil ve ilzama sahip kişinin) başvuru sunulma tarihinde 40 yaş altında olması	20
Tarımsal işletmenin organik tarımla ilişkili olması	20
Toplam	100

*Tarım ve Kırsal Kalkınmayı Destekleme Kurumu, Et Üreten Tarımsal İşletmelere Yatırım Başvuru Çağrı Rehberi, 2013

4. SONUÇ ve ÖNERİLER

Uygulaması tamamlanan IPARD I Programı ile destek verilen süt ve et üreten hayvancılık işletmelerinde, yem bitkisi işlemeye yönelik bazı inşaat kalemleri ile yem bitkisi tarımına yönelik az sayıda makine-ekipmanın desteklendiği görülmektedir. Ancak mera hayvancılığı



açısından projelerde bir planlama sunulma zorunluluğu olmamıştır. Zira proje bazlı olarak desteklenen bu yatırımlarda doğrudan yem üretimini zorunlu kılan ya da bir üretim deseni sunulmasını isteyen bir mekanizma bulunmadığı gibi işletmelerin meralardan istifade etme durumları ya da meralara etkileri değerlendirme sürecinde de dikkate alınmamıştır. İşletmeler proje aşamasında yetiştiricilik modellerine göre ihtiyaç duyulacak yem miktarı ile yem rasyonlarını teknik proje ve iş planlarında sunmuş, yem giderlerinin hangi finansman kaynakları ile karşılanacağını beyan etmiştir. Ancak işletmenin yem ihtiyacı için yem bitkileri üretim durumu ya da meraya dayalı hayvancılık planlanıyor ise yatırım adresinin bulunduğu bölge meralarının durumu ve işletmenin hayvan sayısındaki artışın meralara etkisinin ne olacağı konusunda bir değerlendirme yapılmamıştır. Suni mera tesislerinin planlanması veya kurulmasına ise herhangi bir destek sağlanmamıştır.

Sonuç olarak tamamlanan IPARD I ve halen uygulanan IPARD II Programları ile desteklenen hayvancılık işletmeleri fiziki yapı ve hayvan varlığı olarak önemli bir gelişim göstermiştir. Ancak bu süreçte işletmelerin meralar üzerine etkisi proje süreçlerinde yer alamamış, yem bitkisi üretimi ise yalnızca dar kapsamlı makine-ekipman desteği ile sınırlı kalmıştır. Bu bilgiler ışığında ciddi bir finans kaynağı ile desteklenen bu işletmelerde;

- İşletme-mera ilişkisi, işletmelerin istifade edebilecekleri mera kapasiteleri, meraların amenajman ilkelerine uygun olarak kullanılmaları ve gerekli ise mera ıslah faaliyetlerinin desteklenmesi gibi unsurların programa ve proje değerlendirme süreçlerine eklenmesi,
- Suni mera planlama ve kurulumuna destek sağlanması,
- Projelerde planlı ve bölgeye uygun yem bitkileri üretiminin teşvik edilmesi-desteklenmesi,
- Yem bitkisi üretimi yapacağını-suni mera tesisini kuracağını beyan eden işletmelere proje değerlendirme süreçlerinde ek puan verilmesi,
- Başta üniversiteler olmak üzere paydaş kuruluşlar ile meralar ve yem bitkilerinin yeni işletmeler açısından önemlerinin anlaşılması için ortak çalışmalar yapılmasının faydalı olacağı değerlendirilmektedir.



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HAVALİMANLARI ÇEVRESEL ETKİLERİNİN KIRSAL ALANLAR ÜZERİNDE DEĞERLENDİRİLMESİ

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ÖZET

Günümüzde ulaşım endüstrisi içerisinde önemli bir gelişim gösteren sivil havacılık sektörü, bölgesel kalkınma üzerinde de önemli etkiler yaratmaktadır. Özellikle havalimanlarının farklı iş kollarını bünyesinde barındırması ile bölgelerin kalkınma süreçlerinde önemli bir itici güç açığa çıkartma kapasitesine sahiptir. Bu sebeple ülkeler yeni havalimanları inşa etmekte veya mevcut havalimanları üzerinde iyileştirme ve geliştirme faaliyetlerinde bulunmaktadır. Havalimanları, etki alanı içerisine aldıkları bölgeler üzerinde sadece ekonomik ve sosyal açıdan etkilerde bulunmamaktadır. Ekonomik kalkınmanın ötesinde şehir yapıları ve sosyal yaşantılar üzerinde de doğrudan veya dolaylı etkilerde bulunmaktadır. Ulaşım sektörü üzerindeki yatırımlar şehirlerin ve bölgelerin ana dinamikleri üzerinde de değişimlere sebebiyet vermekte, bölgesel ölçekte farklı boyutlar üzerinde yeniden oluşumları gerekli kılmaktadır. Ancak havacılık sektörünün küresel boyutta olumlu etkileri olmasına karşın, özellikle bölgesel ölçekte bazı olumsuz sosyal ve çevresel etkilere de sebebiyet vermektedir. Havalimanlarının varlıkları, özellikle de yapım aşamalarındaki planlama safhasında, kırsal alanlar üzerinde oluşacak olumsuz etkileri belirlemektedir. Havalimanlarının çevresel etkileri gürültü kirliliği, hava kirliliği, su kirliliği, atık yönetimi, halk sağlığı, vahşi yaşama karşı etkileri, inşaat faaliyetleri ve arazi kullanımı olarak karşımıza çıkmaktadır. Havacılık alanındaki gelişmelerin pandemi dönemi sonrasında yeniden hız kazanması ve 2040 yılına kadar sektöre dayalı talep artışının hızla artacağı düşünülmektedir. Bu artık ile birlikte ekonomik olarak ilerleme kaydedilirken denetimsiz ve kontrolsüz bir gelişme gösterme riskine karşılık oluşabilecek çevresel etkilerde de artış yaşanması kaçınılmaz olacaktır. Özellikle de karmaşık şehir yaşantısından ve yoğun çevresel etkilerden uzakta bulunan kırsal bölgeler üzerinde yaşanabilecek olumsuz etkiler kendisini sosyal hayat içerisinde daha yoğun bir şekilde gösterecektir. Yapılan bu çalışma ile havalimanlarının çevresel etkileri kırsal bölgeler üzerinde değerlendirilmektedir. Literatür taraması ile toplanan bilgiler ve veriler derlenerek sivil havacılık sektörünün sağlayacağı getirilerin yanında toplumsal ve çevresel olarak olumsuzluklara sebep olabilecek tehditler de ele alınmıştır.

Anahtar Kelimeler: Havalimanı, Çevresel Etkiler, Kırsal Bölgeler



EVALUATION OF THE ENVIRONMENTAL IMPACTS OF AIRPORTS ON RURAL AREAS

ABSTRACT

Today, the civil aviation sector, which has made a significant development within the transportation industry, also has important effects on regional development. It has the capacity to unleash an important driving force in the development processes of the regions, especially with the airports incorporating different business lines. For this reason, countries are building new airports or carrying out improvement and development activities on existing airports. Airports do not only have economic and social effects on the regions they are in their sphere of influence. Beyond economic development, it also has direct or indirect effects on city structures and social life. Investments in the transportation sector also cause changes in the main dynamics of cities and regions, necessitating re-formation on different dimensions on a regional scale. However, although the aviation sector has positive effects on a global scale, it also causes some negative social and environmental effects, especially on a regional scale. The assets of airports, especially during the planning phase of construction, determine the negative impacts that will occur on rural areas. The environmental impacts of airports appear as noise pollution, air pollution, water pollution, waste management, public health, effects against wildlife, construction activities and land use. It is thought that the developments in the field of aviation will gain momentum after the pandemic period and the sector-based demand increase will increase rapidly until 2040. With this surplus, while making economic progress, it will be inevitable to experience an increase in the environmental effects that may occur in response to the risk of an uncontrolled and uncontrolled development. In particular, the negative effects that can be experienced on rural areas, which are far from complex city life and intense environmental effects, will show themselves more intensely in social life. With this study, the environmental effects of airports are evaluated on rural areas. By compiling the information and data collected through the literature review, the threats that may cause social and environmental negativities as well as the benefits to be provided by the civil aviation sector are also discussed.

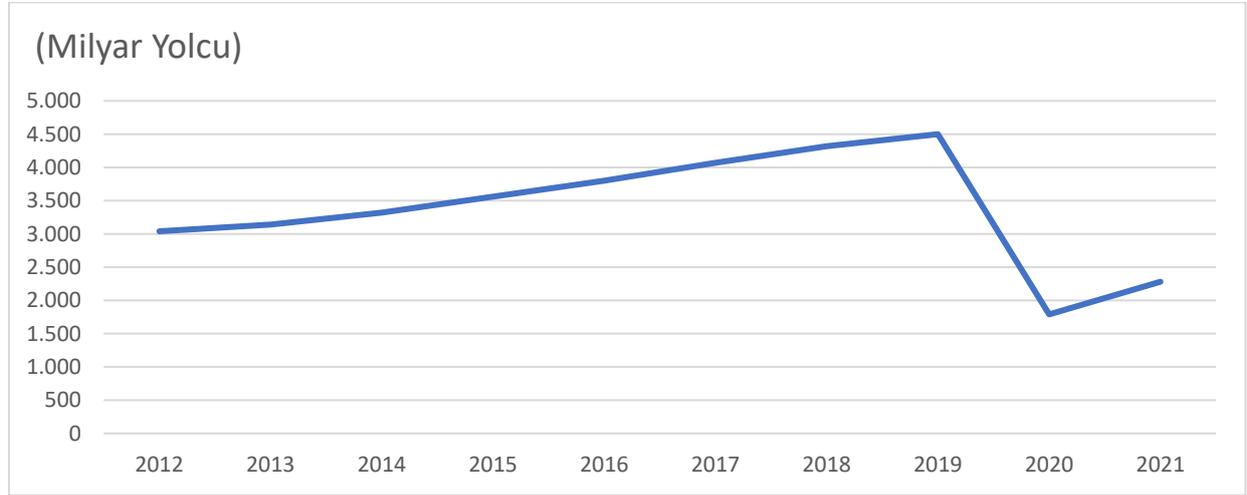
Keywords: Airport, Environmental Impacts, Rural Areas



GİRİŞ

Sivil havacılık sektörü 21. yüzyılın en çok gelişme gösteren sektörlerinden birisi olarak dikkat çekmektedir. Modern hayat içerisinde gerçekleşen yaşayış hızına erişim için en önemli bileşenlerden birisi olan ulaşım hizmetlerini oluşturmaktadır. Wright kardeşlerin ilk motorlu uçuşu gerçekleştirmelerinden sadece bir asır geçmiş olmasına rağmen havacılık sektörü her yıl milyonlarca uçuş sayısı ile milyarlarca yolcunun ihtiyaçlarını karşıladığı bir sektör olarak günümüzde etkinliğini sürdürmektedir (Aksoy ve Dursun, 2018). Sivil havacılık sektörünün yıllara göre gelişimi Tablo 1’de gösterilmektedir.

Tablo1. 2012-2021 Yılları Arasındaki Dünya Geneli Yolcu Trafığı



Kaynak: TOBB, Türkiye Sivil Havacılık Meclisi 2021 Yılı Sektör Raporu.

Küresel ölçekte artan rekabet ortamı ve küresel dinamik etkiler ile birlikte sivil havacılık sektörü, geride bıraktığı dönemler boyunca artış gösterme eğilimindedir. Yüksel (2014), sivil havacılığın gelişimi ve küreselleşmeye olan etkisini ele aldığı çalışmasında 1950 yılında 100 milyon olan tarifeli yolcu sayısının 1973-1979 Petrol krizleri, 1990-1991 Kuveyt Savaşı, 1997 Asya Finans Krizi, 2001 ABD Dünya Ticaret Merkezi saldırıları gibi farklı küresel ölçekteki krizlerin yaşanmasına rağmen 2010 yılında 5,126 milyara ulaştığını göstermektedir. Tablo 1’de 2019 yılında yaşanan Pandemi etkilerinin havacılık sektöründe yoğun bir şekilde yaşandığı ve önemli bir gerileme yaşandığı da görülmektedir. Ancak dünya genelinde daha önceleri yaşanan krizlerde olduğu gibi havacılık sektörü pandemi dönemi sonrasında yeniden bir ilerleme göstermeye başlamıştır.



Bu gelişim göstergeleri ile birlikte sivil havacılık sektörü ülkelerin en önemli yatırım kalemlerinden birisi haline gelmiş, kamu yatırımları içerisinde ulaşıma ayrılan yatırım miktarları diğer sektörler göre ön planda tutulmuştur. Türkiye'nin kamusal yatırımları incelendiğinde 1963 yılı içerisinde ulaştırma sektörü toplam kamusal yatırımlar içerisinde %28'lik bir pay alarak en önemli kamusal yatırım alanı kabul edilmiştir. Bazı dönemlerde imalat ve enerji sektörlerine yapılan yatırımlar ilk sırayı alsa da 1984 yılından itibaren ulaştırma ve haberleşme sektörü ilk sıradaki yerini korumuştur (Bakırcı, 2012). 2022 yılında ulaştırma ve haberleşme sektörü toplamda 49.7 milyar TL yatırım ile 2022 yılı kamu yatırımları içerisinde ilk sırada yer almaktadır (T.C. Cumhurbaşkanlığı Strateji ve Bütçe Başkanlığı, 2022).

Ulaşım sektörüne yönelik büyük ölçekli yatırımların gerçekleştirilmesi ekonomik gelişme, ticaret ve turizm gibi faaliyetler açısından vazgeçilmezdir. Ülkeler bazından büyük yatırımların gerçekleştirildiği havacılık sektörü çok büyük bir hızla gelişmekte ancak büyüme hızına aynı oranda çevresel etkilerinin de büyük olabileceği düşünülmektedir. Bu sebeple havalimanlarının yapım, planlama ve işletimi ile ilgili olarak uluslararası tavsiyeler ve uygulamaların beraberinde her ülkenin uygun çevre stratejilerini ve hedeflerini belirlemesi gerekmektedir (Oto, 2011). Özellikle de ekonomik yapısı tarıma dayalı ve doğal ortamların varlığına ihtiyaç duyan kırsal alanlarda havalimanları tarafından oluşabilecek çevresel etkiler daha hissedilebilir olacaktır.

İLGİLİ ALANYAZIN

Havayolu ulaşımında artan bir talep görülmekte ve havacılık sektörünün gelişimi hızlı bir şekilde artmaktadır. Havacılık sektörünün küresel ekonomiye, sosyal ve kültürel açıdan bölgesel gelişmelere katkı sağlamasına rağmen havalimanlarının buldukları bölgeler içerisinde bazı olumsuz çevresel koşullar yarattığı da görülmektedir (Korul, 2003). İnsanların faaliyetlerinden dolayı ortaya çıkan sera gazlarının büyük bir bölümü ulaşım sektöründen kaynaklanmaktadır. Dünya genelinde karbondioksit emisyonlarının yaklaşık olarak %25'ini ulaştırma sektörü oluşturmaktadır. Bu sebeple havacılık sektörü ile çevre ilişkisi göz ardı edilmemelidir (Keskin ve Yalçiner Ercoşkun, 2021).

Havalimanı Çevresel Etkileri

Havalimanları pist alanları, bakım-ikmal hizmetleri, kendi sit alanları içerisindeki yolları ve geniş alanları kapsayan yapılarıdır. Geniş alanları kapsamı sebebiyle çevreye vereceği etkiler de aynı oranda büyükmektedir. Havalimanları hava kirliliği, su kirliliği, gürültü kirliliği, katı atık ve doğal hayata etki gibi çevresel etkilere sebep olmaktadır (Erdoğan ve Yalçiner Ercoşkun, 2021).



Hava Kirliliği: Karbondioksit, metan ve diazot monoksit gazlarının özellikle uçaklardan kaynaklanması, bu gazların küresel ısınmaya etkilerinin büyük ölçekli olması ve havalimanlarında uçakların iniş-kalkış işlemleri sırasında yüksek miktarda meydana gelmesi havalimanları çevresindeki hava kalitesini büyük oranda etkilemektedir (Keskin ve Yalçın Ercoşkun, 2021). Havacılık sektörü uçak motorlarından salınan egzoz gazları, yakıt ikmal sistemleri, yer hizmetlerinde kullanılan araçlar, havalimanları ısıtma ve soğutma sistemleri, inşaat çalışmaları ve yolcuların hizmetindeki araçlar gibi birçok faaliyeti ile hava kirliliğine sebebiyet vermektedir (Ankaya vd., 2018).

Su Kirliliği: Su, insan vücudunun en temel bileşenlerini oluşturmakta ve fizyolojik faaliyetlerimizin yürütülmesine katkıda bulunmaktadır. Yaşamsal olguların devamlılığını sağlamak için insanlara, içerisinde zararlı kimyasal maddeler ve hastalık yapıcı canlılar içermeyen su kaynağı sağlanması gerekmektedir (Güler ve Çobanoğlu, 1994).

Havalimanlarındaki birçok farklı faaliyet su kirliliğine sebebiyet verebilmektedir. Pistlerden, aprondan, otopark ve ulaşım yollarından kaynaklı su yollarına sızabilecek yüzey suyu akıntıları, uçaklara uygulanan buz çözücü ve buz giderici kimyasallarının su kaynaklarına karışabilmesi, uçak bakım ve eğitim gibi faaliyetler sonucunda su kirliliğine sebebiyet verebilecek tehlikeler bulunmaktadır (Dursun ve Aksoy, 2017).

Gürültü Kirliliği: Bireyler üzerinde istenmeyen, arzu edilmeyen, fizyolojik ve psikolojik olarak olumsuz etkilere sebebiyet veren gürültü kirliliği, söz konusu çevre ve sağlık sorunlarından birisi olarak karşımıza çıkmaktadır (Cansaran, 2019). Uçakların çevreye yaydıkları gürültü iniş, kalkı, uçuş yüksekliği ve uçak tiplerine göre değişiklik göstermektedir. Fısıltı sesinin 20-30 desibel, ortalama bir erkek sesinin 60-65 desibel olduğu düşünüldüğünde jet motorlarının yaydığı 130-160 desibel aralığı ciddi bir gürültü kirliliği kaynağı oluşturmaktadır (Şenkal ve Aydın, 2013). Bu oranlar özellikle de kent yaşantısından uzakta olan kırsal alanlar için ciddi bir gürültü kirliliği teşkil etmektedir.

Katı Atık Yönetimi: Havalimanları katı atıklar ile çevreye ciddi zararlar verebilmektedir ve bu tehlikeyi önlemenin en etkili yollarından birisi de katı atık yönetimidir. Malzeme kullanımlarının belirlenmesinde atık yönetim sistemleri havalimanları için en önemli unsurlardan birisidir. Bina ve yapıların oluşturduğu, benzeri alanlardan kaynaklanan kirletici atıkların nasıl yok edildiği veya miktarının azaltılması sürdürülebilir bir çevre yaratmak için önemli bir gerekliliktir (Dalkıran, 2018).

Doğal Hayata Etki: Havalimanları buldukları alanlardaki doğal hayata ve tarımsal arazilere önemli ölçüde etki etmektedirler. Türkiye’de 32 adet havalimanı tarım alanlarının ortasında



kurulmuştur (Özür, 2018). Özellikle kırsal alanlarda yaşayan bireylerin başlıca istihdam kaynağının tarımsal faaliyetler olduğu düşünülünce bu durum kırsal alanlardaki tarım arazileri ve bu alanlara yakın bölgedeki canlı popülasyonu için önemli bir tehdit oluşturmaktadır. Yeni havalimanlarının yapımı veya mevcut havalimanlarındaki genişletme çalışmaları plansız bir şekilde oluşturulur ise bölgenin topografik yapısını etkileyecek, bölgedeki bitki örtüsünün değişimine sebep olacak ve bölgedeki canlı hayvan popülasyonunu olumsuz yönde etkileyebilecektir (Ankara vd., 2018).

SONUÇ

Havacılık sektörü her ne kadar bölgesel ve ülke çapındaki ekonomik ve sosyal gelişimi desteklese de plansız bir gelişim özellikle de doğal hayata derinden bağlı olan kırsal bölgelerde ciddi sorunlara sebebiyet verebilecek potansiyeli de beraberinde getirmektedir. Havalimanlarının kuruluş yerlerinin seçiminde birçok topografik ve hava koşulları gibi kriterler bulunmaktadır (Erdoğan ve Yalçın Ercoşkun, 2021).

Havalimanlarının çevreye vereceği zararı azaltabilmek için önemli sürdürülebilir uygulamalar bulunmaktadır. Havalimanı bünyesinde fosil yakıt tüketimi azaltmak ve özellikle de havalimanı hizmetlerinde kullanılan araçların elektrikli bir hale getirilmesi, karbon emisyonunda önemli bir azalma görülmesini sağlayacak ve havalimanı çevresindeki hava kirliliğini önleyecektir. Havalimanı bünyesinde atık su arıtma tesisleri kurmak ve havalimanı kaynaklı kirli suların çevreye dağılmasını önlemek özellikle de tarıma dayalı yaşamın sürdürüldüğü kırsal alanlarda hem toprağın hem de bölge sularının kirlenmesini önleyecektir (Greer vd., 2020). Tüm havalimanlarının buldukları bölge itibarıyla kendilerine has bazı sorumluluklara dahil oldukları düşünüldüğünde havalimanları için kendi çevresel yönetim sistemleri önem arz etmektedir. Özellikle de kırsal alanlarda yerel yönetimler ile işbirliği içerisinde karar alınması, bölge açısından sürdürülebilirliği destekleyici unsurlar ortaya çıkaracaktır. Uluslararası ölçekte ekonomik ve sosyal açıdan geniş etkilere sahip olan havacılık sektörü, her bileşeni ile doğal hayata etki etme kapasitesine sahiptir ve çevreye karşı ciddi sorumlulukları bulunmaktadır. Havacılık otoriteleri tarafından gerekli önlemler düşünülüp uygulamaya konmasına karşın havalimanları kendi sistemlerini oluşturmalı, çevreye duyarlı ve sürdürülebilirlik olgularını dikkate alarak faaliyetlerini gerçekleştirmelidir.



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AĞIR METAL TOKSİSİTESİNİN YEMEKLİK TANE BAKLAGİLLERDE ETKİLERİ

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ÖZET

Toprakta oluşan kirlilikler arasında en fazla sorun meydana getiren etmenlerin başında ağır metal kirlilikleri gelmektedir. Ağır metal kirliliği doğal çevre üzerinde her geçen süre boyunca daha büyük sorunlar ortaya çıkararak, tüm canlıların hayatlarını tehlikeye atmaktadır. Ağır metaller toprakta uzun süre kalması nedeniyle sadece çevre kirliliği neden olmakla birlikte yetiştiricilik yapılan alanlarda büyük bir tehdit oluşturmaktadır. Topraklarda aşırı ağır metal birikimi yemelik tane baklagillerde bitki büyümesini, metabolizmasını, fizyolojisini ve gelişimini ve verimini doğrudan etkilemektedir. Toprakta ağır metal kirliliğini gidermek için; izolasyon immobilizasyon, pirometalurjik, mekanik ayırma, toprağı yerinde (in-situ) temizleme ve biyoremediasyon teknolojileri teknikleri kullanılmaktadır. Tarımsal toprakta fazla miktarda bulunan ağır metaller, bitki yetiştiriciliği ve gıda güvenliği için kritik bir endişe kaynağı olmakla birlikte hayvan sağlığı için potansiyel tehlikeler oluşturur. Ağır metallerin topraklara ve bitkilere zararın yanısıra, beslenme ile birlikte insanlarda kronik hastalıklara (Kadmiyum alımı itai itai hastalığına, cıva alımı minamata hastalığına) sebep olabilmektedir.

Anahtar Kelimeler: Ağır Metal, Yemelik Tane Baklagiller, Toksikite, PGPR



EFFECTS OF HEAVY METAL TOXICITY IN EDIBLE LEGUMES

ABSTRACT

Heavy metal pollution is one of the most problematic factors among soil pollution. Heavy metal pollution poses greater problems in the natural environment with each passing time, putting the lives of all living things in danger. Heavy metals not only cause environmental pollution due to their long stay in the soil, but also pose a great threat in aquaculture areas. Excessive heavy metal accumulation in soils directly affects plant growth, metabolism, physiology and development and yield in legumes. To remove heavy metal pollution in the soil; techniques such as isolation immobilization, pyrometallurgical, mechanical separation, in situ cleaning and bioremediation technologies are used. Heavy metals in excess in agricultural soils are a critical concern for plant breeding and food security, but pose potential hazards to animal health. Heavy metals can cause chronic diseases (cadmium intake itai itai disease, mercury intake minamata disease) in humans, along with nutrition, as well as damage to soils and plants.

Keywords: Heavy Metal, Food Legumes, Toxicity, PGPR



Giriş

Baklagiller %22 protein, %32 yağ ve %7 karbonhidrat içeren ve dünya nüfusunun bitkisel protein ihtiyacını karşılayan önemli bir bitki türüdür (Abdelkader ve ark., 2017). Bu nedenle toprakların ağır metallere kirlenmesi ve baklagillerin azot fiksasyonu üzerinde önemli bir etkiye sahip olması kaçınılmazdır.

Doğada serbest yaşayan, bitki gelişimini teşvik eden, biyolojik mücadele veya biyolojik gübreleme amacıyla kullanılan bakterilere Bitki Gelişimini Teşvik Edici Bakteriler (Plant Growth Promoting Rhizobacteria=PGPR) adı verilmiş ve ilk defa 1978 yılında bu terim kullanılmıştır (Klepper ve Schroth, 1978). PGPR'ların bitki gelişimini uyarma etkilerinin dışında hastalıklara ve toprak kaynaklı patojenlere karşı biyolojik savaşta etki ettikleri bilinmektedir (Klopper, 1993; Lemanceau ve ark., 2000; Parmar ve Dadarwal, 2000). Ayrıca bazı PGPR'lerin bitkilerde toksisiteye neden olan Zn, Cd, Pb ve Ni gibi ağır metalleri içeren topraklarda ağır metalleri biriktirerek bitkiler üzerindeki olumsuz etkilerini engellediği belirtilmektedir (Varma ve ark., 2004; Barea ve ark., 2005). Bitkilerin kök bölgesinde yaşayan rizosfer bakterileri, çeşitli mekanizmalar yoluyla fitoremediasyon sürecinde önemli bir rol oynar. Rizosferde meydana gelen fiziksel ve kimyasal faaliyetlerin çoğu, kök sistemi üzerinde doğrudan bir etkiye sahiptir.

Yemlik tane baklagiller insan beslenmesinde ve hayvan beslenmesinde yoğun olarak kullanılmaktadırlar. Bunun yanı sıra kuru tanelerinde %18-36 oranında protein içerdikleri bilinmektedir. Baklagiller son derece sağlıklı besin grubu olup, protein kalitesi bakımından da hayvansal proteinlere yakındır (Shimelis ve Rakshit, 2005; Anonim, 2023). İnsan beslenmesinde protein ihtiyacının karşılanmasında hayvansal kaynaklı gıdalar önemli bir etkiye sahiptir. Fakat hayvansal kaynaklı gıdaların hem pahalı olması hem de muhafaza ve depolanması konusunda sorunlar yaşanmaktadır. Yemlik tane baklagiller ise içerdikleri protein oranı ve uzun süre muhafazanın, depolanmasının kolay olması bakımından oldukça önemlidir.

Hızlı bir şekilde artan nüfus, kentleşme, sanayileşme, motorlu araçların egzoz gazları, arıtma çamurları, tarım alanlarında uygulanan aşırı gübre ve ilaç kullanımı toprak ve su kaynakları üzerine olumsuz etki etmekte ve canlıların sağlığını tehdit eden ağır metal kirliliğine sebep olmaktadır (Yerli ve ark., 2020). Yoğunluğu 5 g/cm³'den fazla ve atom numarası 20'den büyük olan toksisite ve kirliliğe neden olan metaller, ağır metaller olarak tanımlanmaktadır (Apaydın, 2005). Yüksek yoğunluklara sahip olan ağır metaller, düşük konsantrasyonlarda bile zehirleyici etki gösterebilmektedirler. Bazı ağır metaller (Demir, bakır, molibden, çinko, nikel



ve mangan) izin verilebilir sınırı aşmadığı sürece bitkiler için mikro besin elementi olarak görev almakta, besin zinciri, insan ve hayvan metabolizmalarında önemli rolleri bulunmaktadır (Yerli ve ark., 2020).

Cd, Ni, As ve Cr gibi ağır metaller insanlar için birtakım tehlikeler oluşturmaktadır. Ağır metaller güçlü kanserojenlerdir. Kadmiyum alımı itai itai hastalığına, cıva alımı minamata hastalığına yol açar. As gibi diğer ağır metaller ise içme suyu kontaminasyonu nedeniyle zehirlenmelere neden olur (Sharma ve Agrawal, 2005).

İzin verilebilir sınırı aştıkları zaman ise bitki büyümesini, metabolizmasını, fizyolojisini ve gelişimini doğrudan etkileyebilir (Ghori, 2019). Ağır metal zehirlenmesi ile karşı karşıya kalan bitkilerde büyüme geriliği, kloroz, kök kararması, gerileme ve ölüm gibi gözle görülür semptomlar görülür (Öztürk ve ark., 2008). Ağır metaller grubuna demir (Fe), krom (Cr), cıva (Hg), kadmiyum (Cd), bakır (Cu), kobalt (Co), kurşun (Pb), nikel (Ni) ve çinko (Zn) gibi metaller dahildir (Özkan G., 2009). Ağır metaller atmosfere farklı kaynaklarla bırakılmaktadır. Atmosfere bırakılan ağır metaller kuru ve yağ çökeltme ile toprağa, yüzey sularına ve bunun devamında yer altı sularına karışarak doğal olan ekolojik dengeye önemli ölçüde zarar vermektedir. Farklı sektörlerden doğaya yayılan ağır metal kirleticileri Tablo 1' gösterilmektedir.

Tablo 1. Sektörel bazda ağır metal kaynakları (Özkan G., 2009)

Endüstri	Cd	Cr	Cu	Hg	Pb	Ni	Sn	Zn
Kağıt Endüstrisi	-	+	+	+	+	+	-	-
Petrokimya	+	+	-	+	+	-	+	+
Petrokimya	+	+	-	+	+	-	+	+
Gübre Sanayi	+	+	+	+	+	+	-	+
Demir- Çelik San	+	+	+	+	+	+	+	+
Enerji Üretimi (Termik)	+	+	+	+	+	+	+	+

Tüm ağır metaller biyolojik olarak parçalanamaz, yani olası herhangi bir doğal yolla ortamdaki doğal olarak temizlenemezler, fakat bazılarının hareketsiz olduğu yani biriktikleri yerden hareket edemediği bildirilse de, hareketli olanlarda vardır, yani difüzyon, endositoz veya metal taşıyıcılar yoluyla bitki kök sistemi tarafından alınabilirler (Dehghani ve ark. 2016; Alharbi ve ark. 2018; Basheer 2018; Burakova ve ark. 2018). Ağır metallerin bitkiler tarafından alınma miktarı değişiktir. Bütün bitkiler toprak ve sudan kendi büyüme ve gelişimleri için şart olan



ağır metalleri toplama kabiliyetine sahiptirler. Bu metaller Mg, Fe, Mn, Zn, Cu, Mo ve Ni içermektedirler (Langille ve MacLean, 1976).

Bazı bitkiler ise biyolojik fonksiyonları bilinmeyen ağır metalleri biriktirme kabiliyetine sahiptirler. Bunlar Cd, Cr, Pb, Co, Ag, Se ve Hg içermektedirler (Hana ve Grant, 1962; Baker ve Brooks, 1989).

Ağır metal stresi, çeşitli önemli enzimleri ve diğer proteinleri etkisiz hale getirir ve biyomoleküllerden temel metal iyonlarının ikame reaksiyonlarına müdahale eder. Bu reaksiyon, zarların bütünlüğünü bozarak fotosentez, solunum ve homeostaz gibi temel bitki metabolik reaksiyonlarının değişmesine neden olur (Hossain ve ark. 2012).

Toprak kirliliği bakımından ağır metaller en önemli kirleticiler arasındadır. Ağır metallerin toprağa karışması ile toprağın mikrobiyal aktivitesi, biyolojik çeşitlilik, toprak verimliliğine, canlı zehirlenmelerine ve bitkisel ürünlerde verim kayıplarına neden olmaktadır. Ağır metaller toprak mikroorganizma aktivitesini olumsuz etkileyerek, toprak faunasının bozulmasına neden olurlar. Toprağa bulaşan (pestisid kullanımı, endüstriyel atık, egzoz gazları vb...) ağır metallerin bitkiler vasıtası topraktan uzaklaştırılmasına fitoremediasyon olarak isimlendirilmektedir. Fitoremediasyon'un başarılı olarak yürütülebilmesi için bulaşmanın olduğu alanlarda biyokütle oluşurken önemli miktarda metal biriktiren hiperakümülatör bitki türlerinin kullanılması gerekmektedir (Çelim, 2018). Hiperakümülatör bitkilerinin ağır metal içerikleri ve gereksinimleri biriktirici olmayan türlere göre daha fazladır

Ağır Metal Toksisitesinin Yemeklik Tane Baklagillere Etkisi

Spesifik olarak, bu inceleme, bol miktarda literatür arasında nadir görülen ağır metal alımı ve translokasyonu ile ilişkili anatomik temeli ve ayrıca baklagil bitkilerinin bir özelliği olan simbiyotik rizosfer mikroplarının bu sürece dahil edilmesini vurgulamaktadır. Bu derleme çalışması, metal eğilimli topraklar altındaki baklagil bitkilerinin büyümesinin ve üretkenliğinin iyileştirilmesine rehberlik etmesi açısından değerli olacaktır.

Pb, Cd, Cr, Hg, Zn, Cu, As ve Ni gibi ağır metallerin rizosferde optimum düzeylerden daha yüksek konsantrasyonlarda bulunmaları hem tane verimini ve kalitesini düşürmekte hem de tanelerde birikerek sağlık sorunlarına yol açmaktadır (Lebrazi ve Fikri-Benbrahim, 2018; Karimi ve diğerleri, 2021). Pek çok farklı araştırmacı, başta Cd ve Pb olmak üzere ağır metallerin baklagil tanelerinde daha yüksek konsantrasyonda birikerek sağlık sorunlarına neden olduğunu bildirmiştir (Athar ve Ahmad, 2006; Wang vd., 2006; Alyemeni ve Almohisen, 2014). Biriken ağır metaller, ağır metal türlerine, konukçu bitkilere ve konukçu bitkilerin kısımlarına bağlı olarak farklılıklar göstermektedir. Yapılan incelemelere göre fasulye,



özellikle tanelerde ağır metaller biriktiriyor. Bezelye tohumu demir ve çinko biriktirirken, mercimek tohumu düşük konsantrasyonlarda kurşun içerir. Soya fasulyesi, diğer baklagiller veya tahıllardan daha toksik ağır metal birikimine eğilimlidir (Lavado ve diğerleri, 1995; Sajwani ve diğerleri, 1996; Angelova ve diğerleri, 2003; Shute ve diğerleri, 2006). Alyemeni ve Almohisen (2014), yaprak, bakla ve tane bezelye, bakla, soya fasulyesi ve börülce türlerinde iz element Cu, Mn, Pb ve Zn protein konsantrasyonlarını ölçerek incelemiştir.

Egzos gazlarına, endüstriyel faaliyetlere ve nüfus yoğunluğuna bağlı olarak ağır metal stresinin dane baklagillerin farklı kısımlarında ağır metal birikimine yol açtığını, dolayısıyla dane kalitesinin düşmesine ve sağlık sorunlarının artmasına neden olduğunu belirtmişlerdir. Baklagil taneleri tarafından metal alımının, doğrudan ağır metallerin konsantrasyonu ile ilişkili olduğu ve tane kalitesi üzerinde etkili olmaktadır (Athar ve Ahmad, 2006). Ayrıca farklı ağır metal stresleri farklı baklagil bitkilerinde protein, yağ ve yağ asidi konsantrasyonlarında azalmaya neden olmaktadır (Farooq ve ark., 2018).

Cd stresi ayrıca soya fasulyesi bitkilerinin büyüme ve verim parametrelerini, örneğin bitki boyu, dal ve yaprak sayısı, toplam yaprak alanı, sürgün kuru ağırlığı, bakla ve tohum/bitki sayısı, tohum verimi ve ağırlığını önemli ölçüde azaltmıştır (Abdo ve ark., 2012). Çalı fasulyede (*Phaseolus coccineus* L.), ise Cd fide yaprak alanını %39'a düşürürken, daha sonraki büyüme aşamalarında uygulanan Cd daha yumuşak bir etki göstermiştir [Skórzynska-Polit ve ark., 1995]. Fasulye (*Phaseolus vulgaris* L.)'de uygulanan Zn uygulamasının bitkide yaprak sayısı, toplam yaprak alanı ve kuru yaprak ağırlığında azalmalar meydana getirmiştir (Shukry ve Al-Osaimi, 2019).

Yapılan bir başka çalışmada ise Fasulye'ye uygulanan Cd konsantrasyonunun tohum çimlenmesini %68-98 oranında azalttığını bildirmişlerdir (El Hocine ve ark., 2020). Zornoza ve ark. (2020) ise Cd ile muamele edilmiş beyaz acı baklada sürgün ve kök kuru ağırlığının sırasıyla %38 ve %15 oranında azaldığını bulmuşlardır; bunun nedenin ise boğum arası uzunluk, bitki boyu ve yanal kök gelişiminin azalmasıdır.

Ekim öncesi bakla tohumuna uygulanan kalsiyum klorür (CaCl_2)'ün uygulamasının kadmiyum stresi altında gelişimi araştırılmıştır. Yüksek Cd ($50 \mu\text{M}$) dozunun kontrol ile karşılaştırıldığında nodül sayısında %63 ve kuru nodül ağırlığında ise %63-%67 arasında azalmaya neden olduğu tespit edilmiştir.

Çelim ve Gülser (2020), Farklı demir formlarının kadmiyum stresi altındaki Fasulye (*Phaseolus vulgaris* L. Var Nana) bitkisinin gelişiminde meydana getirdiği değişimlerini belirlemek için yaptıkları çalışmada, genel olarak artan Cd dozları bitki gelişim kriterlerini



olumsuz etkilediğini ve uygulanan demir formlarından en etkili olanın inorganik demir formu olduğu ve bitki gelişim kriterlerinde iyileşmeler sağlayabileceği bildirmişlerdir.

Sonuç

Dünya ve Ülkemizde toprakta ağır metal birikimi ve kirliliği önemli çevresel sorunların başında gelmektedir. Yemelik tane baklagiller yüksek protein, sindirilebilir/sindirilemez karbonhidratlar, polifenoller, antioksidanlar ve düşük maliyetleri nedeniyle tüketiciler tarafından tüketilmesi nedeniyle çok önemli bir rol oynamaktadır. Topraktaki ağır metal birikimi sadece toprak verimliliği değil, bitki kalitesini ve verimini düşürmekte, insan ve hayvan sağlığının da temel sorunları haline gelmiştir. Bitkilerin bünyesine nüfus eden ağır metaller bitkilerin fizyolojik aktivitelerini engellemektedir. Yemelik tane baklagillerde verim ve kalitenin iyileştirilmesine yönelik ıslah çalışmalarına odaklanılmasının gerekliliğinin ne kadar önemli olduğu bilinmektedir.

Sonuç olarak bitkisel ürün miktar ve kalitesinin artırılması hedeflendiği tarım sistemlerinde günümüz şartlarında ağır metaller ile kirlenmiş toprakların iyileştirilmesi ve ağır metallerin topraktan uzaklaştırılması içi fitoremediasyon gibi yöntemlerin kullanılması gerekmektedir. Bu çalışmada; araştırmacıların aşırı derecede ağır metallere maruz kalmış topraklardan ağır metallerin uzaklaştırılması konusunda daha fazla çalışma yaparak bu konunun yaygınlaştırılması gerekmektedir.



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DÜNYADA ve TÜRKİYE'DE ALTINOTU (*Helichrysum italicum*) TARIMI VE GELECEĞİ

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ÖZET

Dünyada 600 türü bulunan altınotu bitkisinin sadece *Helichrysum italicum* türünün alt varyetelerinin tarımı yapılmaktadır. Bu alt varyeteler arasında parfümeri ve kozmetik sektöründe en fazla kabul gören tür İtalya ve Fransa (özellikle Corsica adası) florasında bulunan subsp. *italicum* ve subsp. *microphyllum* alt türleridir. 2014 yılında kültüre alınmaya başlayan altınotu günümüzde dünyada en fazla Hırvatistan'da tarımı yapılmakta ve 3 ton civarında uçucu yağ üretildiği tahmin edilmektedir. Bosna-Hersek, Arnavutluk ve Fransa'da altınotu tarımı yapan ülkelerin başında gelmektedir. Ülkemizde altınotu tarımı ile ilgili bir veri bulunmamaktadır. Ancak Manisa, İzmir, Burdur, Ankara, Balıkesir, Çanakkale, Kütahya, Afyonkarahisar ve Isparta illerinde küçük alanlarda üretimlerin olduğu bilinmektedir. Son 10 yılda altınotu üretimi ve ekstrakt pazarında ivmeli bir artış gözlenmektedir. Ancak halen altınotu pazarında standartların belirlenmemiş olması ve özellikle bitkiden kaynaklanan uçucu yağ verimi ve bileşen farklılığı gibi olası riskler arasında bulunmaktadır. Altınotu bitkisinde birim alandan hasat edilen çiçek verimi, uçucu yağ oranı ve uçucu yağ bileşenleri farklılık göstermektedir. Yüksek polimorfizmden dolayı aynı alttürde bile farklı uçucu yağ oranı ve bileşenlerine sahip bireyler ortaya çıkmaktadır. Zira altınotute birim alan çiçek verimliliği 0.5-1.5 ton/da arasında ve uçucu yağ oranı ise %0.12-0.35 arasında değişim göstermektedir. Uçucu yağ bileşenlerinde ise α -pinene, *ar*-curcumene veya neryl acetate bileşenlerinin yüksek olduğu alt türleri bulunmaktadır. Ülkemizde altınotu üretiminde dış pazar verileri analiz edilerek uçucu yağ veya diğer ekstraktların kullanım alanları ve şekilleri ile pazar potansiyeli değerlendirilerek üretime başlanması daha uygun olacaktır. Özellikle uçucu yağ profilinin sektörün talep ettiği bir ürün dışında olması ürünlerin değerlendirilmeme olasılığını artıracaktır. Bu nedenle altınotu ve ürünlerinin sektörün talep ettiği verimlilikte ve kalitede çeşit geliştirmeye ihtiyaç bulunmaktadır.

Anahtar Kelimeler: Altınotu, *Helichrysum italicum*, Tarım, Verim, Kalite, Sorunlar ve Geleceği



IMMORTELLE (*Helichrysum italicum*) FARMING AND FUTURE IN THE WORLD AND IN TURKEY

ABSTRACT

Only sub-varieties of *Helichrysum italicum* of the immortelle plant, which has 600 species in the world, are cultivated. Among these sub-varieties, the most accepted species in the perfumery and cosmetics industry is subsp. *italicum* and subsp. *microphyllum* subspecies. Immortelle, which started to be cultivated in 2014, is mostly cultivated in Croatia in the world and it is estimated that around 3 tons of essential oil is produced. Bosnia and Herzegovina is one of the countries that cultivate immortelle in Albania and France. There is no data on immortelle cultivation in our country. However, it is known that there are small areas of production in the provinces of Manisa, İzmir, Burdur, Ankara, Balıkesir, Çanakkale, Kütahya, Afyonkarahisar and Isparta. In the last 10 years, an accelerated increase has been observed in immortelle production and extracts market. However, there are still possible risks such as the lack of standards in the immortelle market and especially the essential oil yield and component differences arising from the plant. The flower yield, essential oil content and essential oil components harvested from the unit area differ in the immortelle plant. Due to the high polymorphism, individuals with different essential oil content and components emerge even in the same subspecies. Because the unit area flower productivity in immortelle varies between 0.5-1.5 tons/da and the essential oil content varies between 0.12-0.35%. In essential oil components, there are subspecies with high α -pinene, *ar*-curcumene or neryl acetate components. In our country, it would be more appropriate to start production by analysing foreign market data and evaluating the usage areas and forms of essential oil or other extracts and the market potential. In particular, the fact that the essential oil profile is not a product demanded by the industry will increase the possibility of products not being evaluated. For this reason, there is a need to develop varieties with the productivity and quality demanded by the industry of immortelle flowers and their products

Keywords: Immortelle, *Helichrysum italicum*, Farming, Yield, Quality, Problems and Future



INTRODUCTION

The genus *Helichrysum*, which is included in the Asteraceae family, is derived from the Greek words helios (Sun) and chrysos (gold) and has 3 subsections: *Virginea*, *Helichrysum* and *Xerochlaena*. There are close to 600 species in the world, the majority of these species are found in South Africa (250 species), but they spread in Southern Europe, South-West Asia, Southern India, Sri Lanka, Australia and Mediterranean climate basins (Anderberg, 1991) (table 1). The majority of these species have aromatic properties. Although there are about 25 *Helichrysum* species with their subspecies in our country and on the European continent, these species are mostly distributed in Central and Eastern Black Sea, Eastern and Southeastern Anatolia, Central Anatolia and Mediterranean regions in our country. *H. italicum*, which is under the *Helichrysum* subsection of the *Helichrysum* genus, is the most cultivated species in the world and consists of 6 subspecies (Galbany-Casals et al., 2006): *H. italicum* subsp. *italicum* has the widest distribution area, reaching from the westernmost part of Morocco to the easternmost part of Cyprus, especially in Italy, France-Corsica and some Aegean Islands. *H. italicum* subsp. *siculum* (Jord. & Fourn.) is a species native to Sicily. *H. italicum* subsp. *microphyllum* [(Willd.) Nyman] was first (Willdenow, 1803) identified in Crete and later observed in the Balearic Islands (Majorca and Dragonera), Corsica, Sardinia and Cyprus. *H. italicum* subsp. *picardii* (Franco) is distributed in the flora of France, Italy, Portugal and Spain. *H. italicum* subsp. *pseudolitoreum* (Fiori) in Bacch Argentario, Gargano and Monut Conero flora and *H. italicum* subsp. *serotinum* (Boiss.) P. Fourn. It spreads in the Iberian Peninsula (Galbany-Casals et al., 2006).

When *Helichrysum* Geartner taxa in the Flora of Europe were examined, they were collected in 55 sections and 21 taxa under 16 species. It is recorded that they are divided into a total of 34 taxa, including members whose taxonomic status is unclear and whose distinction cannot be made clearly and which are thought to be hybrids (Öztürk, 2004). The underlined list of those found in the flora of Turkey is presented below (Table 1).



Table 1. *Helichrysum* species distributed in Europe

<u>Virginia (DC.) Fiori. section</u>	<u>Xerochlaena Section</u>
<i>H. amorginum</i> Boiss & Orph.	<i>H. foetidum</i> (L.) Cass.
<i>H. taenari</i> Rothm. (not obvious)	<i>H. bracteatum</i> (Vent.) Andrews
<i>H. sibthorpii</i> Rouy.	<i>H. petiolare</i> Hilliard & B.L. Burt (Belirgin değil)
<i>H. doerfleri</i> Rech.	
<i>H. frigidum</i> (Labill.) Willd.	
<u>Helichrysum Section</u>	
<i>H. stoechas</i> (L.) Moench <i>subsp. stoechas</i>	<i>H. ambiguum</i> (Pers.) C. Presl.
<i>H. decumbens</i> Camb. (not obvious)	<i>H. saxatile</i> Moris <i>subsp. saxatile</i>
<u><i>H. stoechas</i> (L.) Moench <i>subsp. barellieri</i> (Ten.) Nyman</u>	<i>H. litoreum</i> Guss.
<i>H. caespitosum</i> DC. (not obvious)	<u><i>H. orientale</i> (L.) Geartner</u>
<i>H. panormitanum</i> Tineo ex Guss. (not obvious)	<i>H. zivojinii</i> Černjavski
<i>H. nebrodence</i> Heldr. (not obvious)	<u><i>H. plicatum</i> DC.</u>
<i>H. pendulum</i> C. Presl. (not obvious)	<u><i>H. arenarium</i> (L.) Moench <i>subsp. arenarium</i></u>
<i>H. stramineum</i> Guss. (not obvious)	<i>H. buschii</i> Juz. (not obvious)
<i>H. fontanesii</i> Camb. (not obvious)	<i>H. rupestre</i> (Rafin) DC.
<i>H. boissieri</i> Nyman (not obvious)	
<i>H. arenarium</i> (L.) Moench <i>subsp. ponticum</i> Clapham	<u><i>H. graveolens</i> (Bieb.) Sweet</u>
<u><i>H. italicum</i> (Roth) G. Don <i>subsp. italicum</i></u>	<i>H. heldreichii</i> Boiss.
<i>H. italicum</i> (Roth) G. Don <i>subsp. microphyllum</i> Nyman	<i>H. saxatile</i> Moris <i>subsp. errerae</i> (Tineo) Nyman
<i>H. italicum</i> (Roth) G. Don <i>subsp. serotinum</i> (Boiss.)	

IMMORTELLE PLANT and ITS TECHNICAL FEATURES

There are many variations in immortelle species in the world due to their flower and leaf structures. Due to the differences in flower morphologies, 30 different morphological groups were formed (Hilliard, 1983). According to the species, the flower beds are usually hairy or woolly, the plants can be seen as short or tall, herbaceous or bush. The cultivated immortelle (*Helichrysum italicum*) plant is a perennial semi-shrub plant. It can grow to a height of seventy cm and its branched stems have small, hairy leaves and an inflorescence of several small flowers. On their branched stems, narrow pointed leaves covered with small hairs, green on the face and gray-green on the back, are alternately arranged. The lower leaves are collected in a rosette. The thicker leaf cuticle protecting the shoots to reduce transpiration and the thick hairs on the back enable this plant to adapt to dry habitat conditions, thus classifying it as a xerophytic plant group (Gulin, 2014). The flowers are golden yellow in color, and different types of plants with orange or white flowers can also be found. The flowers retain their natural color even after drying. Budding usually occurs in June and flowering continues from July to August. After fertilization, the fruit ripens quickly. Fruit achene, smooth or rough, small, elongated, almost



black. The weight of 1000 seeds is 0.027-0.031 g and there are 32.000-37,000 seeds in 1 g. The plant is relatively resistant to low temperatures and tolerates prolonged droughts (Stepanović et al., 2009).

PRODUCTION STATUS of IMMORTELLE and ITS PRODUCTS in THE WORLD and in TURKEY

In the regions where immortelle cultivation is done, the production areas are generally close to the marginal areas, and production has also started on fertile agricultural lands in recent years. Most of the areas where immortelle cultivation is carried out are sloping lands that do not hold water, and they are dry, calcareous and lime-rich soils. Usually their pH is between 5-7. Organic matter content is below 1.5 and they are low fertile soils. In general, the immortelle plant gives economic and high quality products in regions with a warm and moderately dry climate with at least 6-8 hours of daily sunshine, with a Mediterranean climate where the winters are not very harsh and the average temperatures of 20-30 °C in spring and early summer are common. However, the immortelle plant can also withstand lower temperatures.

In the world, only *Helichrysum italicum* species and its subspecies are cultivated in immortelle species. In recent years, immortelle agriculture has a tendency to increase rapidly in the world. In countries such as Bosnia and Herzegovina, Croatia, France, Spain, Portugal and Romania, intensive collection was made from natural vegetation until 2014. However, due to these collections, the species has begun to face the danger of extinction and has brought with it a ban on collection from the wild, especially in the Balkan countries (Licina and Kralj, 2016). Thereupon, cultivation studies have started and agricultural areas have started to show a great increase in the countries mentioned now. On the other hand, in the Grasse region of France, known for its lavender fields, due to the intense fungal disease called stolbur phytoplasma carried by *Hyalesthes obsoletus* in lavender fields in recent years, yellowing and drying of the plants have occurred and lavender fields have started to be removed in the region (Gaudin et al., 2011). Immortelle plantations took its place and lavender (*Lavender-Lavandula angustifolia*) agricultural areas were shifted to Balkan countries, especially Bosnia and Herzegovina, and our country. There is no official recorded data on immortelle production areas and production amounts in the world. For this reason, data related to production areas were compiled from academic researches. Sub-varieties of *H. italicum* are grown in the production of immortelle in the world. Among these sub-varieties, the most accepted species in the perfumery and cosmetics industry is subsp. *italicum* and subsp. *microphyllum* subspecies.



In France (especially in Corsica) and on the European continent, immortelle cultivation areas have started to increase rapidly in recent years. In France, where the collection from nature is controlled, approximately 35% of the production amount is collected from nature, the rest is in cultural areas. In the regions of Ardèche, Drôme, Tarn, Alpes-de-Haute-Provence, Vaucluse, immortelle is produced on a minimum of 200 hectares, mostly organic. On the other hand, it is known that in the Ajaccio region of France, about 32 tons of immortelle is distilled annually and approximately 55 kg of immortelle oil is produced. In the Balkan countries, where production is intense, immortelle is produced on an area of approximately 1,500 hectares in Bosnia-Herzegovina in Neum, Stolac, Ravno, Siroki Brijeg, Posusje, Mostar, Grude, Ljubuski, Citluk, Capljina and Tomislavgrad regions. In Albania, the production areas are estimated to reach 100 hectares in the short term and the production is around 2 tons. It is estimated that around 3 tons of essential oil is produced in Croatia, which is the world's largest producer of immortelle.

In our country, there is no clear data on immortelle production areas. However, it is known that there are small areas of production in the provinces of Manisa, İzmir, Burdur, Ankara, Balıkesir, Çanakkale, Afyonkarahisar and Isparta.

IMMORTELLE SPECIES AND THE USAGE AREAS OF THE PRODUCTS FROM PAST TO PRESENT

Immortelle has a wide range of uses in the world due to its properties in herbal medicine, aromatherapy and cosmetics. The ancient Romans and Greeks adorned statues of the gods with wreaths of Helichrysum flower heads, a practice mentioned by classical writers since the 7th century BC. On the other hand, in the production of folk clothes, which are still traditionally used in the center of Sardinia, the flower heads and mulberry leaves of *H. italicum* are used together with the yellow silks that emerge when fed to the silkworm. Theophrastus (3rd century BC) mentions the application of immortelle mixed with honey to treat burns and wounds in *Historia Plantarum*. Dioscorides (1st century AD) reported the use of a medicinal wine from *Helichrysum* in the treatment of arthritic conditions and sciatica. Similar information is mentioned in Pliny's (1st century AD) *Naturalis Historia* and in the medical literature of the Renaissance. On the other hand, Pliny stated that the immortelle flower protects clothes from moths due to its unpleasant smell. Italian Renaissance physician and botanist Castore Durante (1529-1590) also drew attention to the use of a medicinal wine infused with *H. italicum* flower heads to treat liver ailments, and also recommended decoction of the plant for colds. Overall, the most common medicinal uses of *Helichrysum* documented by ancient authors were as a



topical antiseptic, a cicatrizing (i.e., scar-forming) agent, joint health and liver protection, and for the treatment of airway infections. Theophrastus classified *Helichrysum* as a mind-altering herb, possibly due to its use in ritual fumigations. A similar use is common in South Africa, where there are about 250 *Helichrysum* species, and some species are known as psychotropic agents. In fact, it has been reported that a *Helichrysum* species in Africa is the only plant containing cannabinoids other than hemp, and cannabigerol (CBG) has been isolated in studies. According to Tyrrhenian, *Helichrysum* has a pleasant and persistent odor distinct from essential oil and is quite difficult to identify with other odors other than "the smell of *Helichrysum*". The greatest ethnopharmacological information on *H. italicum* comes from the northern Tyrrhenian region, where the use of the plant is well documented in both human and veterinary medicine for the management of respiratory and digestive problems and topical wound healing. Therefore, the herb is thought to be beneficial for inflammatory and infective airway conditions, including cough, bronchitis, laryngitis, and tracheitis. *Helichrysum italicum* is also used as a cholagogue (i.e. bile stimulant) and choloretic agent in herbal teas. *H. italicum* is also very common in culinary use. In Asia, the seedlings and sprouts of immortelle are edible, used to prepare banh khuc, a delicacy of Vietnamese cuisine. *H. italicum* is the source of one of the most expensive and sought after European honeys, miele di spiaggia (seashore honey). In the Tyrrhenian region, immortelle leaves are used to flavor local dishes and salads and give a "curry-like" flavor. The herb is also included in the mixes of Mediterranean curry (*H. italicum*, onion, rosemary, wild fennel, thyme and Nepeta) sauce. It is also used in the production of alcoholic and non-alcoholic beverages.

Since cell renewal has become almost synonymous with "anti-aging skin care" in recent years, immortelle essential oil is dermatologically applied against stretch marks, hemorrhoids, acne scars, surgical scars and wounds, and can be deeply effective even in small dilutions (Haas, 2004). It has been reported that the neryl acetate component in immortelle essential oil has very high antiradical activity and increases collagen I production by about 6 times, and has value as a cell regenerator and decongestant (Millou et al., 2010). It is used in skin care products due to its ability to stimulate the regeneration of skin cells and is called "liquid suture" (Price and Price, 2012). In addition, it has been determined that immortelle essential oil prevents the formation of blood clots and clot accumulation in the veins (Marković, 2005; Battaglia, 2003; Gattefossé, 1993). Immortelle essential oil is preferred in perfumery because it gives a spicy, herbaceous and fruity odor because it brings together many scent notes. However, such notes are difficult to use in perfumers' current compositions; You can find Immortelle in famous



perfume lines such as Cuir Beluga by Guerlain or Magie Noire by Lancôme. On the other hand, the concrete and absolutes of the immortelle flower are also used in perfumes.

CONCLUSION and SUGGESTIONS

The flower yield, essential oil ratio and essential oil components harvested from the unit area differ in the immortelle plant. Although *H. italicum* is the type that is cultivated and traded among the immortelle species in the world, individuals with different essential oil ratios and components emerge among its subspecies and even in the same subspecies due to high polymorphism. Because the flower productivity per unit area of immortelle varies between 0.5-1.5 tons/da and the essential oil rate varies between 0.12-0.35%. In essential oil components, there are subspecies with high α -pinene, ar-curcumene or neryl acetate components. Because of these differences, producers who plan to grow immortelle in our country should definitely analyze the species information, essential oil yield and quality before the seedling plantation. Finally, Isparta University of Applied Sciences Rose and Aromatic Plants Application and Research Center (GÜLAB) carries out a comprehensive research on immortelle breeding and cultivar development and develops neryl acetate, ar-curcumene and α -pinene types with high essential oil content and flower yield.

Two cultivars [Hélímily 1 (neryl acetate content approx. 30%) and Hélímily 2] registered in France were registered in immortelle farming, and the cultivar used in production was standardized. It is not yet possible to bring these varieties to our country. Because the variety registration is carried out by private companies, the production areas are the private areas of the companies and they are taken under the protection of the variety. In our country, new areas have been started to be established in immortelle production. Produced immortelle genotypes are mostly cultivated in Balkan countries and have high α -pinene and ar-curcumene content. The country that has a say in the production of this type in the world is Croatia with a production area of 1.500 ha. For this reason, in order to compete in the global market in terms of unit area efficiency and quality, it is necessary to create an environment on equal terms with this country. In our country, it would be more appropriate to start production by analyzing foreign market data and evaluating the usage areas and forms of essential oil or other extracts and the market potential. Otherwise, it may cause a market problem. In particular, the fact that the essential oil profile is not a product demanded by the industry will increase the possibility of products not being evaluated. For this reason, there is a need to develop varieties with the efficiency and quality demanded by the industry of immortelle and its products.



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HİBRİT VE STANDART ÇEREZLİK AYÇİÇEĞİ GENOTİPLERİNİN ORTA KARADENİZ GEÇİT BÖLGESİ PERFORMANSLARININ BELİRLENMESİ

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ÖZET

Araştırma, hibrit ve standart çerezlik ayçiçeği genotiplerinin Tokat-Kazova şartlarındaki performanslarının belirlenebilmesi amacıyla yapılmıştır. Çalışmada, Çiğdem 1, Ahmetbey, Metinbey, Somon Beyazı, Baklan, Karakeçili, İnegöl alası, S 300, S 400, 361 S, 361 G, 363, PST 361, ŞYT 361, AYB 361, AMZ 361 ve AMZ 363 genotipleri kullanılmıştır. Deneme tesadüf blokları deneme desenine göre üç tekerrürlü olarak 2021 yılında yürütülmüştür. Çalışmada yaprak sayısı, bitki boyu, sap çapı, tohum eni, tohum boyu, boş tane oranı, kabuk oranı, tabla çapı, tabladaki tane sayısı, bin tane ağırlığı, hektolitre ağırlığı, tane sınıfı (8 mm elek), tane verimi ve yağ oranı özellikleri incelenmiştir. İncelenen özelliklerden sap çapı hariç çeşitler arasındaki farklılık istatistik olarak önemli ($p<0.05$ ve $p<0.01$) bulunmuştur. Bitki boyu ortalaması 177.31 cm bulunmuş ve en uzun boy 191.70 cm ile Karakeçili çeşidinde tespit edilmiştir. En büyük tohum eni 11.69 mm ve en büyük tohum boyu 30.00 mm ile İnegöl alası genotipinde belirlenmiştir. Hibrit çeşitlerin tane eni ortalamaları standartlara göre daha geniş iken boyları daha kısa kalmıştır. Boş tane oranı en düşük çeşit ise S 300 olarak tespit edilmiştir. Tabla çapı 18.88-24.25 cm arasında değişmiş ve en büyük tablalar ŞYT 361 çeşidinde belirlenmiştir. Hibritlerin tabladaki tane sayıları (1136.96 adet) standartlara göre (1356.68 adet) daha düşük olmuştur. Hibritlerin bin tane ağırlıkları 189.34 g, hektolitre ağırlıkları 262.45 g, standartların bin tane ağırlığı 160.36 g ve hektolitre ağırlıkları 258.31 g olarak belirlenmiştir. Bin tane ve hektolitre ağırlıkları standartlara göre yüksek olan hibritlerin dekara verim ortalaması 542.17 kg/da olarak belirlenmiş ve standartların verim ortalamasından %8.00 daha yüksek olmuştur. Bölgede en iyi performansı 361 S çeşidi göstermiş ve 669.08 kg/da verim alınmıştır.

Anahtar kelimeler: Adaptasyon, Bin tohum ağırlığı, Tane verimi, Yağ oranı



DETERMINING THE PERFORMANCE OF SOME HYBRID AND STANDARD CONFECTIONERY SUNFLOWER GENOTYPES IN MIDDLE BLACK SEA TRANSITIONAL ZONE

ABSTRACT

The research was carried out to determine the performance of hybrid and standard confectionery sunflower genotypes under Tokat-Kazova conditions. Çiğdem 1, Ahmetbey, Metinbey, Salmon Beyazı, , Baklan, Karakeçili, İnegöl alasi, S 300, S 400, 361 S, 361 G, 363, PST 361, ŞYT 361, AYB 361, AMZ 361 and AMZ 363 genotypes were used in this study. The experiment was carried out according to the randomized blocks design with three replications in 2021. Number of leaves, plant height, stem diameter, grain width, grain length, empty grain rate, shell rate, tray diameter, number of grains per tray, thousand grain weight, hectoliter weight, grain class (8 mm sieve), grain yield and oil rate properties were examined. All of the cultivars were significantly as statistically ($p < 0.05$ and $p < 0.01$) except for the stem diameter. The average plant height was found to be 177.31 cm and the tallest was 191.70 cm in Karakeçili cultivar. The largest seed width was 11.69 mm and the largest seed length was 30.00 mm in Inegol alasi genotype. While the average grain width of hybrid cultivars was wider than the standards, their lengths remained shorter. The variety with the lowest empty grain rate was determined as S 300. The diameter of the trays varied between 18.88-24.25 cm and the largest trays were determined in ŞYT 361 cultivar. The number of grains per tray of the hybrids (1136.96 piece) were lower than the standards (1356.68 piece). The thousand-grain weight of the hybrids was determined as 189.34 g, the hectoliter weight was 262.45 g, the thousand-grain weight of the standards was 160.36 g and the hectoliter weight was 258.31 g. The average yield per decare of hybrids with a thousand grain and hectoliter weights compared to the standards was determined as 542.17 kg/da and was 8.00% higher than the average yield of the standards. The 361 S variety showed the best performance in the region and 669.08 kg/da yield was obtained.

Keywords: Adaptation, Thousand grain weight, Grain yield, Oil rate



1. GİRİŞ

Ayçiçeği bitkisi genel olarak sabit yağ kaynağı olmasının yanında çerezlik tüketim amacıyla da yetiştirilmektedir. Dünya ayçiçeği üretimi yaklaşık 28 milyon ha alanda 50 milyon tondur (Anonim, 2020). Dünyada üretilen ayçiçeğinin %2.6'sı çerezliktir (Palabıyık, 2022). Türkiye'de ayçiçeği başlıca yağ bitkisi olmasının yanında, çerezlik olarak tüketimi gün geçtikçe artmaktadır. Türkiye ayçiçeği üretimi 2.07 milyon ton civarında olup bunun %8.3'ü çerezliktir (Anonim, 2021). Türkiye dünyadaki önemli çerezlik ayçiçeği tüketici ülkeler arasında yer almaktadır (Hladni ve Miladinović, 2019). Türkiye'nin son yıllarda çerezlik ayçiçeği ithalatına ödediği döviz yaklaşık 30 milyon dolardır (Cebbar, 2019). Türkiye yağlık ayçiçeği verimi dekara 273 kg, çerezlik ayçiçeği ise 223 kg'dır (Anonim, 2021). Tokat'ta 2021 yılında yağlık ayçiçeği 208 bin dekar alanda 58 bin ton üretim yapılmıştır. Buna karşılık çerezlik ayçiçeği ise en son 2011 yılında 91 dekar alanda 18 ton üretim yapılmış ve son yıllarda istatistiki veri bulunmamaktadır (Anonim, 2021). Türkiye'nin çerezlik ayçiçeği üretiminin artırması için potansiyeli bulunan Karadeniz Bölgesinin iç kısımlarında üretimin yaygınlaştırılması gerekmektedir.

Bitkiler yetiştirildikleri lokasyonların çevre şartlarından doğrudan ya da dolaylı olarak etkilenmektedirler. Genotiplerin çevre şartlarına göre farklı tepkiler vermesi agronomik özellikler bakımından farklı performansların elde edilmesine neden olmaktadır (Tan ve ark., 2017). Türkiye'de uzun yıllardır çerezlik ayçiçeği üretiminde köy popülasyonları ve yerel çeşitler kullanılmaktadır (Polatlı ve Ünay, 2015). Son yıllarda çerezlik ayçiçeği yetiştiriciliğinde hibrit tipteki yerli ya da ithal edilen tohumluklar kullanılmaya başlamıştır (Cebbar, 2019). Özellikle Çin'den ithal edilen siyah renk kabuğa sahip, iri taneli ve yağ oranı yüksek hibrit çeşitlerin Türkiye'de yetiştiriciliği yapılmaktadır.

Türkiye'de geliştirilen veya yurtdışından ithal edilen hibrit çeşitlerin üretileceği çevrelere sağlayacağı uyum, verim ve kaliteyi doğrudan etkilemektedir. Yapılan araştırmalarda kullanılan genotiplerin çevreye gösterdikleri tepkilere göre çiçeklenme gün sayıları, olgunlaşma gün sayıları, tohum verimi, bin tane ağırlıkları, tablada tane sayıları gibi özellikler farklılıklar göstermektedir (Pekcan ve ark., 2015). Ege bölgesinde Aldemir ve ark. (2016), 13 genotip ile yaptıkları çalışmada en yüksek verimi (619 kg/da) ETAE-C-TM-10-2010 hibrit çeşit adayından aldıklarını bildirmişlerdir. İzmir-Menemen'de 3 genotip ve iki standart çeşit ile yapılan araştırmada Çiğdem 1 standart çeşidi en yüksek tohum verimine sahip olurken denemede yer alan genotiplerden Ege Güneşi 603 kg/da tane verimi ile standartla istatistiki olarak aynı grupta yer almıştır (Tan ve ark., 2017). Tokat, Orta Karadeniz Geçit Kuşağı



Tarımsal Araştırma Enstitüsü Müdürlüğünde Yazıcı, (2020) tarafından 18 popülasyon ve iki standart (Çiğdem 1 ve İnegöl alası) çeşit ile yürütülen çalışma sonucunda Kahramanmaraş, Yozgat ve Sivas bölgelerinden toplanan popülasyonların öne çıktığı belirlenmiştir. Çerezlik ayçiçeği üretiminde genetik ve çevrenin etkili olması genotiplerin performanslarını değiştirmektedir.

Bu araştırmanın amacı; son yıllarda Çin'den ithal edilen hibrit çerezlik ayçiçekleri ile Türkiye'deki hibrit ve standart çeşitlerin Tokat'taki performanslarının tespit edilmesidir. Böylece araştırmada kullanılacak genotipler arasında bölgeye en uygun genotip ya da genotiplerin belirlenmesi hedeflenmiştir.

2. MATERYAL VE YÖNTEM

2.1. Materyal

Araştırmada, Çiğdem 1, Ahmetbey, Metinbey, Somon Beyazı, , Baklan, Karakeçili, İnegöl alası, S 300, S 400, 361 S, 361 G, 363, PST 361, ŞYT 361, AYB 361, AMZ 361 ve AMZ 363 genotipleri kullanılmıştır (Çizelge 1).

Çizelge 1. Araştırmada kullanılan çerezlik ayçiçeği genotipleri

Sıra no	Genotipin ismi	Genotipin temin edildiği yer	Tohum tipi
1	Palancı 1	TTAE	Hibrit
2	Ahmetbey	TTAE	Hibrit
3	Metinbey	TTAE	Hibrit
4	Somon Beyazı	TTAE	Hibrit
5	Çiğdem 1	TTAE	Standart
6	Baklan	TOGÜ Ziraat Fakültesi	Standart
7	Karakeçili	TOGÜ Ziraat Fakültesi	Standart
8	İnegöl alası	TOGÜ Ziraat Fakültesi	Standart
9	S 300	Aybaklar Tarım	Hibrit
10	S 400	Aybaklar Tarım	Hibrit
11	361 S	Aybaklar Tarım	Hibrit
12	361 G	Aybaklar Tarım	Hibrit
13	363	Aybaklar Tarım	Hibrit
14	PST 361	Aybaklar Tarım	Hibrit
15	ŞYT 361	Aybaklar Tarım	Hibrit
16	AYB 361	Aybaklar Tarım	Hibrit
17	AMZ 361	Aybaklar Tarım	Hibrit
18	AMZ 363	Aybaklar Tarım	Hibrit



Araştırmanın yürütüldüğü arazinin beş farklı noktasından 0-30 cm derinlikte toprak örneklemeleri yapılmıştır. Alınan örneğin analizi sonucunda toprak yapısı killi-tınlı, organik maddece az, orta kireçli, hafif alkali, fosfor ve potasyum içeriği az olarak belirlenmiştir (Kaçar, 2016; Çizelge 2).

Çizelge 2. Deneme alanı toprak analiz sonuçları

pH	Kireç (%)	Tuz (Ms)	Organik Madde (%)	K ₂ O (kg/da)	P ₂ O ₅ (kg/da)	Tekstür
8,03	12,36	0,02	1,55	92	6,7	Killi-Tınlı
Hafif alkali	Orta kireçli	Tuzsuz	Az	Az	Az	

Araştırmanın yürütüldüğü lokasyonun iklim verileri incelendiğinde uzun yıllara göre çalışma yılında sıcaklıkların ortalama 0,7 °C arttığı, yağışların ortalama 5,3 mm/ay artmasına karşın nem oranlarının benzer olduğu görülmüştür (Çizelge 3).

Çizelge 3. Çalışmanın yürütüldüğü vejetasyon dönemi iklim verileri

Aylar	Ortalama Sıcaklık (°C)		Toplam Yağış (mm)		Nispi Nem (%)	
	1951-2020	2021	1951-2020	2021	1951-2020	2021
Mart	7,4	6,0	41,6	71,2	60,7	64,6
Nisan	12,4	13,7	53,4	14,2	59,2	56,6
Mayıs	16,3	18,5	59,2	54,6	61,8	53,9
Haziran	19,6	20,0	38,9	55,5	60,1	62,7
Temmuz	22,1	24,1	11,6	27,7	57,6	56,3
Ağustos	22,3	23,6	8,4	17,9	58,0	59,0
Eylül	18,8	17,8	18,0	27,1	59,6	64,1
Ortalama	17,0	17,7	33,0	38,3	59,6	59,6

Tokat Meteoroloji Müdürlüğü

2.2. Yöntem

Araştırma, TOGÜ Uygulama ve Araştırma Merkezi deneme alanlarında Tesadüf Blokları Deneme Desenine göre üç tekerrürlü olarak 2021 yılında yürütülmüştür. Ekim işlemi, 12 Nisan 2021 tarihinde çapa ile açılan sıralara el ile, ekim sıklığı 70x40 cm (Akkaya, 2006) olacak şekilde yapılmıştır. Denemelerde parseller üçer sıra olup her bir genotipe ait sıralar ara verilmeksizin birbirini takip edecek biçimde düzenlenmiştir. Parsellerde sıraların uzunluğu 6 m olup, her sıraya 30'ar adet tohum (15 ocak olacak şekilde) ekilerek çıkış sonrasında teklemeye yapılmıştır. Blokların baş ve sonlarından birer sıra kenar tesiri oluşturulmuştur. Çalışmada P ve K'un tamamı ekim ile birlikte 7 kg/da NPK (15-15-15) formunda olacak şekilde, N'un kalan 8 kg/da ise bitkiler yaklaşık 30 cm boya ve tabla oluşturmaya başladıkları zaman eşit miktarlarda



uygulanmıştır (Zubillaga ve ark., 2002). Ekim sonrası bitki gelişimleri tamamlanıncaya kadar yabancı otlarla mücadele edilmiştir. Sulama işlemi, kritik gelişme dönemlerinde topraktaki nemin durumuna göre damlama sulama yöntemi ile 4 kez yapılmıştır. Çalışmada hastalık-zararlı oluşmamış ancak kuş zararı için delikli torbalar, tozlanması tamamlanan tablolara takılarak önlem alınmıştır. Brakte yaprakların yarıya yakın kısmının sarıdan kahverengine dönüştüğü ve tablanın arka kısmında %1-10 kahverengileşme oluşmaya başladığı Ağustos 2021'de tablolar kesilerek hasat edilmiştir. Hasat sonrası tam kuruması tamamlanan tablolar harman edilmiştir. Harman sonrasında nem oranları %8'e sabitlenerek dekara tohum verimleri hesaplanmış ve her bir parselden ayrı ayrı örnekler alınarak yağ analizleri yapılmıştır. Çalışmada incelenen özellikler için Evcı ve ark. (2011), Çil ve ark. (2011), Polatlı (2013), Yılmaz ve ark. (2017) ve Tarımsal Değerleri Ölçme Denemeleri Teknik Talimatından (Anonim, 2019) yararlanılmıştır. Yağ analizi; ince olarak öğütülmüş tohum örneklerinin önce nem içerikleri belirlenmiştir. Daha sonra bu örneklerden iki paralel halinde takriben 3-5'er g örnek alınarak Soxhlet cihazında hekzanla çözümlenerek kayıplar belirlenmiştir. Bulunan yağ miktarının (nemsiz) örnek ağırlığına oranlanmasıyla yağ oranı belirlenmiş, kuru madde esasına göre düzenlenip % olarak ifade edilmiştir. Araştırma sonucunda elde edilen veriler JMP istatistik programı (Version 13.0, SAS Institute) ile varyans analizine tabi tutularak, ortalamalar arasındaki farklılıklar Tukey çoklu karşılaştırma testiyle belirlenmiştir (Kalaycı, 2005).

3. BULGULAR VE TARTIŞMA

Araştırmada genotipler 19-20 günde çıkış göstermiş, 40-47 gün arasında tabla oluşturmuş, 56-64 gün içerisinde çiçeklenmiş ve 155-160 günde olgunlaşmalarını tamamlamışlardır. Genotiplerin çıkış sürelerinde önemli farklılıklar olmamasına karşın, çiçeklenme ve olgunlaşma gün sayılarında genetik özelliklerine bağlı olarak değişiklikler belirlenmiştir (Pekcan ve ark., 2015). Çalışmada çeşitler ortalama 20.66 adet yaprak oluşturmuş, 10, 15, 16 ve 17 numaralı genotipler en fazla yaprağa sahip olmuşlardır. Bitki boyu 148.10-192.23 cm arasında değişmiş ve en kısa genotipin 3 numaralı, en uzunun ise 18 numaralı çeşit olduğu tespit edilmiştir. Sap çapları bakımından farklılıklar olmasına rağmen istatistiki olarak önemli çıkmamıştır. Tohum eni en geniş (11.69 mm) ve en uzun (30.00 mm) çeşit 8 numaralı genotip olmuştur.



Çizelge 4. Çerezlik ayçiçeği genotiplerinin yaprak sayısı, bitki boyu, sap çapı, tohum eni, tohum boyu, boş tane ve kabuk oranları

Genotipler	Yaprak sayısı (adet)*	Bitki boyu (cm)**	Sap çapı (mm) ^{öd}	Tohum eni (mm)**	Tohum boyu (mm)*	Boş tane oranı (%)**	Kabuk oranı (%)*
1	16.78 ^b	166.57 ^{de}	28.50	9.28 ^{abc}	22.57 ^b	2.58 ^{fg}	41.46 ^b
2	21.87 ^{ab}	151.89 ^{ef}	32.42	9.83 ^{abc}	24.33 ^{ab}	5.09 ^{ab}	49.79 ^a
3	19.34 ^{ab}	148.10 ^f	29.66	9.03 ^{abc}	24.50 ^{ab}	5.92 ^a	48.74 ^a
4	18.58 ^{ab}	167.77 ^{cde}	29.39	7.42 ^c	23.11 ^b	2.43 ^g	45.91 ^{ab}
5	19.75 ^{ab}	167.40 ^{de}	28.81	8.55 ^{bc}	23.15 ^b	3.57 ^{c-f}	44.28 ^{ab}
6	20.20 ^{ab}	191.03 ^a	32.12	8.52 ^{bc}	25.05 ^{ab}	3.92 ^{cd}	46.88 ^{ab}
7	18.9 ^{ab}	191.70 ^a	31.50	8.14 ^{bc}	23.38 ^b	2.81 ^{efg}	44.27 ^{ab}
8	18.93 ^{ab}	185.80 ^{ab}	30.95	11.69 ^a	30.00 ^a	3.68 ^{cde}	49.85 ^a
9	20.63 ^{ab}	169.47 ^{bcd}	31.36	10.20 ^{ab}	26.61 ^{ab}	2.20 ^g	47.27 ^{ab}
10	22.43 ^a	185.63 ^{ab}	30.68	10.69 ^{ab}	25.10 ^{ab}	2.76 ^{efg}	44.99 ^{ab}
11	21.43 ^{ab}	185.87 ^{ab}	32.83	10.52 ^{ab}	27.12 ^{ab}	2.56 ^{fg}	47.88 ^a
12	20.39 ^{ab}	175.77 ^{a-d}	29.77	9.51 ^{abc}	28.44 ^{ab}	3.82 ^{cde}	47.66 ^{ab}
13	21.63 ^{ab}	183.03 ^{a-d}	33.83	10.74 ^{ab}	25.49 ^{ab}	3.91 ^{cd}	48.02 ^a
14	21.57 ^{ab}	178.03 ^{a-d}	29.97	10.51 ^{ab}	27.64 ^{ab}	4.25 ^{bc}	48.22 ^a
15	22.93 ^a	177.47 ^{a-d}	28.44	9.99 ^{abc}	26.21 ^{ab}	3.27 ^{c-g}	49.41 ^a
16	22.87 ^a	184.83 ^{abc}	30.21	10.19 ^{ab}	25.84 ^{ab}	2.93 ^{d-g}	45.86 ^{ab}
17	22.23 ^a	188.97 ^a	32.24	9.20 ^{abc}	23.66 ^b	3.24 ^{c-g}	44.95 ^{ab}
18	21.30 ^{ab}	192.23 ^a	31.35	9.77 ^{abc}	23.82 ^b	2.25 ^g	48.81 ^a
Genel ort.	20.66	177.31	30.78	9.65	25.33	3.40	46.90
Std. ort.	19.45	183.98	30.85	9.23	25.40	3.50	46.32
Hibrit ort.	21.00	175.40	30.76	9.78	25.32	3.37	47.07
CV%	8.0	3.2	8.6	9.0	7.6	10.3	4.4

*p<0.05, **p<0.01 ve öd: önemli değil

Boş tane oranı ortalaması %3.40 olarak gerçekleşmiş ve en az boş tane oranı 9 numaralı (%2.20) çeşitten elde edilmiştir. Genotiplerin kabuk oranları %41.46-49.85 arasında değişmiş en az kabuk oranına 1 numaralı çeşit sahip olmuştur (Çizelge 4). Araştırmada kullanılan hibritler ortalama yaprak sayısı, tohum eni ve kabuk oranı bakımından standartlardan daha yüksek, bitki boyu, sap çapı, tane boyu ve boş tane oranı oranları bakımından ise daha düşük değerlere sahip olmuşlardır (Pekcan ve ark., 2015; Sayın, 2019). Çalışmada kullanılan çeşitlerin çevreye gösterdikleri tepkilere göre yukarıda bahsedilen parametrelerde farklılıklar oluşmuş ve sap çapı hariç hepsi istatistiki olarak önemli (p<0.01, p<0.05) bulunmuştur (Aldemir ve ark., 2016).



Çerezlik ayçiçeği genotiplerinde tabla çapı, tabladaki tane sayısı, bin tane ve hektolitreye ağırlıkları tane verimi üzerinde önemli etkiye sahiptir. Araştırmada, ortalama tabla çapı 21.93 cm olurken en büyük tablalara sahip çeşitler 10, 11, 14, 15, 16 ve 18 numaralıdır. Tabladaki tane sayısı 708.0 ile 1640.0 adet/tabla olarak değişmiş ve en fazla tane 6 numaralı çeşitte tespit edilmiştir.

Çizelge 5. Çerezlik ayçiçeği genotiplerinin taba çapı, tabladaki tane sayısı, bin tane ağırlığı, hektolitreye ağırlığı, 8 mm elek oranı, verim ve yağ oranları

Çeşitler	Tabla çapı (cm)**	Tabladaki tane sayısı (adet/tabla)*	Bin tane ağırlığı (g)**	Hektolitreye ağırlığı (kg/100 lt)**	8 mm elek oranı (%)**	Verim (kg/da)**	Yağ oranı (%)**
1	19.32 ^{bc}	1024.0 ^{bc}	196.09 ^{abc}	298.27 ^a	77.08 ^{bcd}	449.58 ^{efg}	28.08 ^{abc}
2	21.99 ^{ab}	1193.3 ^{ab}	156.93 ^{c-f}	250.52 ^{b-e}	76.50 ^{bcd}	451.74 ^{efg}	21.44 ^f
3	18.88 ^c	708.0 ^c	185.10 ^{a-e}	249.39 ^{b-e}	76.66 ^{bcd}	302.86 ^h	21.66 ^f
4	19.48 ^{bc}	1120.0 ^{bc}	131.87 ^f	300.84 ^a	36.18 ^f	372.45 ^{gh}	27.18 ^{a-e}
5	21.74 ^{abc}	1249.3 ^{ab}	144.93 ^{def}	300.76 ^a	62.74 ^e	447.11 ^{fg}	28.93 ^{ab}
6	22.93 ^a	1640.0 ^a	166.48 ^{b-f}	275.69 ^{a-d}	68.65 ^{cde}	545.28 ^{b-e}	24.81 ^{b-f}
7	21.28 ^{abc}	1260.0 ^{ab}	143.35 ^{ef}	246.02 ^{cde}	66.60 ^{de}	509.23 ^{c-f}	28.44 ^{ab}
8	22.37 ^{ab}	1277.3 ^{ab}	186.68 ^{a-d}	210.78 ^e	93.07 ^a	493.37 ^{def}	23.23 ^{ef}
9	21.97 ^{ab}	1142.7 ^{bc}	195.84 ^{abc}	260.01 ^{a-d}	86.32 ^{ab}	625.65 ^b	21.33 ^f
10	23.23 ^a	1177.3 ^{abc}	195.70 ^{abc}	251.93 ^{b-e}	87.27 ^{ab}	611.99 ^b	30.37 ^a
11	22.89 ^a	1242.7 ^{ab}	214.03 ^a	282.93 ^{abc}	81.21 ^{abc}	669.08 ^a	27.91 ^{a-d}
12	21.20 ^{abc}	1146.7 ^{bc}	181.26 ^{a-e}	236.00 ^{de}	75.32 ^{b-e}	466.63 ^{efg}	23.69 ^{def}
13	21.44 ^{abc}	1216.0 ^{ab}	191.03 ^{abc}	250.69 ^{b-e}	83.36 ^{ab}	587.71 ^{bcd}	21.84 ^f
14	22.92 ^a	1210.7 ^{ab}	214.22 ^a	244.04 ^{cde}	85.01 ^{ab}	589.74 ^{bcd}	25.15 ^{b-f}
15	24.25 ^a	1317.3 ^{ab}	208.03 ^{ab}	241.88 ^{cde}	85.35 ^{ab}	638.60 ^b	21.23 ^f
16	23.29 ^a	1262.7 ^{ab}	203.83 ^{ab}	237.22 ^{de}	88.80 ^{ab}	611.76 ^b	25.38 ^{b-f}
17	22.13 ^{ab}	1038.7 ^{bc}	206.43 ^{ab}	283.05 ^{abc}	93.06 ^a	608.00 ^b	25.34 ^{b-f}
18	23.42 ^a	1117.3 ^{bc}	170.43 ^{b-f}	287.55 ^{ab}	75.56 ^{b-e}	604.62 ^{bc}	23.83 ^{c-f}
Genel ort.	21.93	1185.76	182.90	261.53	77.83	537.08	24.99
Std. ort.	22.08	1356.68	160.36	258.31	72.77	498.75	26.35
Hibrit ort.	21.89	1136.96	189.34	262.45	79.12	542.17	24.60
CV%	4.6	13.1	7.5	5.1	5.7	5.9	5.7

*p<0.05, **p<0.01



Araştırmada bin tane ağırlığı 131.87-214.22 gram arasında değişim göstermiştir. Ortalama bin tane ağırlığı 182.90 g, hibritlerin ortalaması 189.34 g ve standart çeşitlerin ortalaması ise 160.36 g olarak tespit edilmiştir. Hektolitre ağırlığı genel ortalaması 261.53 g olarak tespit edilmiş, en yüksek hektolitre ağırlıkları 1, 4 ve 5 numaralı çeşitlerde olduğu görülmüştür. Çalışmada da 8 mm elek üzerinde kalan ayçiçeği oranları belirlenmiştir. Bu oran %36.18 ile %93.07 arasında değişmiştir. En yüksek orana sahip çeşitler ise 8 ve 17 numaralı çeşitler olmuştur. Standart çeşitlerin ortalaması %72.77 olurken hibritlerin ortalaması %79.19 olarak gerçekleşmiştir (Çizelge 5). Tüm bu incelenen parametreler tane verimleri üzerine doğrudan etki etmiş ve en yüksek tohum verimi 669.08 kg/da ile 11 numaralı hibrit çeşitten elde edilmiştir. Standart çeşitlerin ortalama verimleri 498.75 kg/da olurken hibritlerin ortalama verimleri 542.17 kg/da olarak belirlenmiştir (Pekcan ve ark., 2015; Hladni ve Miladinović, 2019). Çerezlik ayçiçeğinde yağ oranının düşük olması istenmektedir. Burada da en yüksek yağ oranı %30.37 olarak belirlenmiş, çeşitlerin genel ortalaması %24.99 olmuştur.

4. SONUÇ

Dünyada ve Türkiye’de yağlık ayçiçeği üretimi-tüketiminin yanı sıra çerezlik olarak da üretim-tüketimi yapılmaktadır. Türkiye yıllık çerezlik ayçiçeği üretimi ile dünyada önde gelen ülkeler arasında olmasına rağmen ihtiyacını yerli üretimden karşılayamamaktadır. Bu nedenle başta Çin’den olmak üzere çerezlik ayçiçeği ithalatı gün geçtikçe artmaktadır. Türkiye’de üretimin artırılabilmesi için yetiştiricilikte kullanılan yerel popülasyonlar yerine standart ve özellikle hibrit çeşitlerin kullanılması gerekmektedir. Bu çalışmada hibrit çeşitlerin performanslarının standartlardan daha üstün olduğu görülmüştür. Çalışma materyalinin çoğunluğunu oluşturan hibrit çeşitlerin Tokat-Kazova lokasyonundaki performansları da farklılıklar göstermiş ve en yüksek verim 361 S isimli hibrit çeşitten elde edilmiştir. Türkiye çerezlik ayçiçeği üretiminin artırılabilmesi için kısa vadede Türkiye’de var olan veya ithal edilen yeni çeşitlerin farklı lokasyonlarda çalışmaları yapılarak ekonomik olanların yetiştiricilikte yer alması, uzun vadede ise yerli hibrit çeşitlerimizin sayılarının artırılması gerekmektedir.



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FOOD SECURITY SYSTEM IN INDIA

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ABSTRACT

A food system is a composition of varieties of activities which begins from the process of planting a seedling nurturing it, preparing it manufacturing from it, finally an eatable form farm to the plate then again to the garbage can or compost pile. Food can be consider as a projectile which drives the growth of a nation. Particularly agriculture. Farming related business activities in a sustainable manner will help the individual or group of individuals and finally in turn the nation as whole. India's agriculture is directly depended on the climate of the geographical area it possess. Indian agriculture till the date depend directly or indirect on the help of monsoon. Hence the ultimate change will have a great impact on India as far as convinced there is a rise in temperature all over the world. This is reduced the rain fall and another impact of climate change is like cyclones hitting. The unexpected coast lines of India and thus causing Agricultural losses. The rising in temperature will change the perception trended and thus in turn Affect the water availability this is also out cited frequency of enhance weather conditions. But Indians case is unique one got self sufficient in its food production soon at her its independence. There are a lot of reason for it. The green revolution is the Germ that made Indian bright in the case of food production it actually tripled the Indian production of food grains soon after is implementation in 1960's it helped to reduce the food insecurity by a percentage of 50, similarly poverty too.

Keywords: Agriculture, Food Security, Green revolution, India



Introduction

Food security is the state in which all individuals in a population have access to sufficient, safe, and nutritious food to meet their dietary needs and preferences for an active and healthy life. It involves not only the availability of food but also access to it, which can be hindered by a variety of factors such as poverty, conflict, natural disasters, and poor infrastructure (Prosekov & Ivanova, 2018). Achieving food security requires a multifaceted approach that includes increasing agricultural productivity, improving access to markets and trade, enhancing social protection programs, and promoting sustainable food systems. It also involves addressing issues of food waste and loss, promoting gender equality, and ensuring that vulnerable populations such as women, children, and the elderly have access to adequate food (Asseng et al., 2019; Wang et al., 2022).

Food security is an important issue globally, as millions of people around the world suffer from hunger and malnutrition. Addressing food insecurity is essential for promoting economic growth, reducing poverty, and ensuring social stability. Food security is a state in which all people have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Despite progress in recent years, food security remains a major global challenge, affecting millions of people worldwide (Devereux et al., 2020). There are several factors that contribute to food insecurity, including poverty, climate change, conflict, and economic instability. In many countries, the lack of infrastructure and resources, including access to clean water, transportation, and storage facilities, also contribute to food insecurity (Briones Alonso et al., 2018; El Bilali et al., 2020). According to the United Nations, an estimated 811 million people worldwide were undernourished in 2020, an increase of around 161 million people since 2019. The COVID-19 pandemic has further exacerbated the issue of food security, with disruptions to food supply chains, income losses, and job losses affecting millions of people around the world. Efforts to improve food security include initiatives to increase agricultural productivity, improve access to markets and credit, and promote sustainable farming practices. Additionally, social safety nets and programs that provide food assistance to vulnerable populations can also help address food insecurity. Addressing food security requires a multifaceted approach that addresses the underlying causes of food insecurity and provides support to those who are most vulnerable to its effects (Devereux et al., 2020; Wang et al., 2022).



Food security system in the Global level

There are several food security programs in various countries around the world, each designed to address the specific needs and challenges of their populations. The Supplemental Nutrition Assistance Program (SNAP), also known as food stamps, is the largest food assistance program in the United States (Galitskaya et al., 2022; Smith & Harrington, 2014). It provides eligible low-income individuals and families with electronic benefits that can be used to purchase food at authorized retailers. The Supplemental Nutrition Assistance Program (SNAP), also known as food stamps, is the largest food assistance program in the United States. It is a federal program that provides nutrition assistance to low-income individuals and families to help them purchase food. Here are some key features of the SNAP program. To be eligible for SNAP benefits, individuals and households must meet certain income and asset requirements. The program is designed to assist low-income families, seniors, and individuals with disabilities. SNAP benefits are provided in the form of an electronic benefit transfer (EBT) card, which can be used to purchase eligible food items at authorized retailers. The benefits provided to each household are based on income, household size, and other factors (Chilton et al., 2014). SNAP provides nutrition education and information to help participants make healthy food choices and improve their overall health. SNAP also provides employment and training services to help participants find and maintain employment and increase their income (Byker Shanks et al., 2020; Radimer & Radimer, 2002; Smith & Harrington, 2014).

The Bolsa Familia program is a conditional cash transfer program in Brazil that provides financial assistance to low-income families (De Carvalho et al., 2021; Rocha, 2009). The program requires families to ensure that their children attend school and receive basic healthcare services in exchange for cash assistance (Berchin et al., 2019; Oliveira et al., 2020; Ribeiro-Silva et al., 2020). The Oportunidades program is a conditional cash transfer program in Mexico that provides financial assistance to low-income families (Asseng et al., 2019; Ibarrola-Rivas & Galicia, 2017). The program requires families to ensure that their children attend school and receive basic healthcare services in exchange for cash assistance (Castañeda-Navarrete, 2021; Shamah-Levy et al., 2017).

The Productive Safety Net Program (PSNP) in Ethiopia is a social protection program that provides cash and food transfers to vulnerable households. The program aims to build household resilience and increase food security by improving the productivity of smallholder agriculture and promoting livelihood diversification (Kaluski et al., 2002; Kuyu & Bereka, 2020). The Hunger Safety Net Program (HSNP) in Kenya is a social protection program that



provides cash transfers to vulnerable households in northern Kenya (Jacobi et al., 2020; Tan et al., 2018). The program aims to improve food security and resilience among pastoralist communities by providing them with predictable and reliable cash transfers (Kushitor et al., 2022). The Child Support Grant (CSG) in South Africa is a social protection program that provides cash transfers to poor families with children. The program aims to reduce poverty and improve food security by providing families with a regular source of income to purchase food and other essentials (Akinola et al., 2020; Kushitor et al., 2022; Masipa, 2017).

Food security and agriculture production

Food security and agriculture production are closely linked, as agriculture is the primary source of food for most countries, including India. The food security system in India includes various programs and initiatives aimed at promoting agriculture production and ensuring that farmers have access to markets and resources to grow and sell their crops. Here are some ways India's food security system and agriculture production are interconnected. The Indian government provides subsidies and support to farmers to help them improve their agricultural production. This includes providing them with access to credit, seeds, fertilizers, and other agricultural inputs at subsidized rates. This support helps farmers improve their crop yields and income, which in turn, contributes to the country's overall food security (Patel et al., 2020).

The Indian government invests in agricultural research and development to help farmers adopt new technologies, practices, and crops that can increase their productivity and income. This research also focuses on developing crop varieties that are more resilient to climate change and other environmental stresses, which can help ensure a steady food supply even in adverse conditions. The food security system in India includes storage and distribution infrastructure such as warehouses, cold storage, and transportation networks that help to ensure that food produced by farmers reaches the market and consumers in a timely and efficient manner. This infrastructure helps reduce post-harvest losses and improve food availability in the country. The Indian government intervenes in the market to stabilize prices of agricultural commodities and protect farmers from market fluctuations. This helps to ensure that farmers receive a fair price for their produce and are motivated to continue producing food, which contributes to the overall food security of the country (Ceballos et al., 2020; Vijaya Bhaskar et al., 2017).

Agriculture is the main food source for most people in India, and the food security system in India includes several programs and policies to ensure that all citizens have access to sufficient and nutritious food. Here are some ways in which the food security system in India and



agriculture production are interconnected. The Indian government provides subsidies and support to farmers to help them improve their agricultural production. This includes providing them with access to credit, seeds, fertilizers, and other agricultural inputs at subsidized rates. This support helps farmers to improve their crop yields and income, which in turn, contributes to the overall food security of the country (Dangar et al., 2021; Garcia et al., 2020).

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The Indian government intervenes in the market to stabilize prices of agricultural commodities and protect farmers from market fluctuations. This helps ensure that farmers receive a fair price for their produce and are motivated to continue producing food, which contributes to the country's overall food security. The food security system in India and agriculture production are closely linked, as the system provides support to farmers to improve their crop yields and income and ensures that food produced by farmers reaches consumers in a timely and efficient manner, thus ensuring food security for all citizens (Chakraborty & Sarmah, 2019).

The food security system in India

Food security in India refers to the availability, accessibility, and affordability of food to all individuals in the country. The Indian government has implemented various policies and programs to ensure food security for its citizens, especially those who are poor or belong to marginalized communities (Dr. Nawaz Ahmed, 2013). The National Food Security Act (NFSA), passed in 2013, is the primary legislation that governs food security in India (Chakraborty & Sarmah, 2019). The NFSA aims to provide subsidized food grains to approximately two-thirds of India's population (or 75% in rural areas and 50% in urban areas) through the Public Distribution System (PDS). The National Food Security Act (NFSA) is a landmark legislation passed by the Parliament of India in 2013 that aims to provide food security to India's population by ensuring access to sufficient quantity and quality of food at affordable prices. The act is considered to be one of the world's largest food security programs, covering approximately two-thirds of the country's population.



Under the NFSA, the central government is responsible for procuring and storing food grains, while state governments are responsible for distributing them to eligible households through the Public Distribution System (PDS). The act also provides for creating a National Food Security Commission to oversee its implementation and address any grievances related to food security. The NFSA guarantees 5 kg of food grains per person per month at highly subsidized prices to eligible households. These include priority households, which constitute about 75% of the rural population and 50% of the urban population, and include households headed by women, destitute, and those from traditionally marginalized communities. Antyodaya Anna Yojana (AAY) households, which are the poorest of the poor, are entitled to 35 kg of food grains per month. Overall, the NFSA seeks to ensure that no person in India goes hungry and that everyone has access to nutritious food at affordable prices.

The NFSA has significantly reduced hunger and malnutrition in India, particularly among vulnerable sections of the population, such as children, women, and the elderly. The act provides subsidized food grains to households, which has improved their access to food and reduced hunger. The NFSA has increased the availability of food grains in the country, as the government has to procure and distribute food grains to eligible households. This has also helped in stabilizing food prices and reducing food inflation.

The availability of subsidized food grains has improved the population's health outcomes, particularly among children. The act provides for the distribution of fortified food grains, which has helped in reducing the incidence of micronutrient deficiencies. The NFSA has provided a boost to the rural economy, as it has increased the demand for food grains and created opportunities for farmers to sell their produce. The act has also helped in generating employment opportunities in the transportation and storage sectors. The NFSA has faced challenges in its implementation, particularly in terms of identifying eligible households and ensuring that they receive their entitlements in a timely and efficient manner. There have also been issues related to the quality and quantity of food grains distributed under the act.

The food grains procured by the government are then distributed to eligible households through a network of Fair Price Shops (FPS) operated by the state governments. The FPS are responsible for ensuring that the food grains reach the intended beneficiaries at the subsidized prices set by the government. The NFSA mandates that the food grains should be distributed to the beneficiaries transparently and accountable, using technology to plug leakages and ensure that the intended beneficiaries receive their entitlements. NFSA has significantly impacted food



security in India, particularly in reducing hunger and improving the population's health outcomes. However, there is still scope for improvement in its implementation and addressing the challenges faced in its execution (Chakraborty & Sarmah, 2019).

Under the PDS, eligible households are provided with subsidised food grains such as rice, wheat, and coarse grains. The government procures food grains from farmers at a minimum support price and distributes them to the beneficiaries through fair price shops (FPS) located across the country (George & McKay, 2019). The PDS also covers other essential commodities such as sugar, kerosene, and cooking oil. Under the Public Distribution System (PDS), eligible households in India are provided with food grains such as rice, wheat, and coarse grains at subsidized prices. The government procures food grains from farmers at a minimum support price, a price floor set by the government to protect farmers from market fluctuations and ensure that they receive a fair price for their crops (Dar et al., 2022).

The Public Distribution System (PDS) in India is a government-sponsored program aimed at providing essential food items at subsidized rates to the poor and vulnerable sections of the population. The PDS has been in existence since the 1950s and is a crucial component of the Indian government's efforts to ensure food security and reduce poverty in the country. Here are some of the impacts of the PDS on the Indian economy (Chakraborty & Sarmah, 2019; George & McKay, 2019; A. Kumar & Ayyappan, 2014). The PDS has significantly reduced poverty in India by providing subsidized food grains to millions of households across the country. The availability of affordable food grains has helped to reduce household expenditure on food, freeing up resources for other essential needs such as education and healthcare.

The PDS has helped stabilize food prices in the country by ensuring a steady supply of food grains in the market. This has helped prevent sudden spikes in food prices, which can harm the economy, particularly on vulnerable sections of the population. The PDS has provided a boost to agricultural production in the country by creating a steady demand for food grains. This has helped increase farmers' income and incentivize them to invest in their crops, which has positively impacted the country's overall agricultural productivity. The PDS has created employment opportunities in the transportation, storage, and distribution sectors. This has positively impacted the economy, particularly in rural areas where job opportunities are scarce (A. Kumar & Ayyappan, 2014).

The PDS has faced several challenges in its implementation, including issues related to the identification of eligible beneficiaries, leakages in the system, and poor quality of food grains. These challenges have negatively impacted the program's overall effectiveness and its impact



on the economy. PDS has had significantly impacted However, there is still scope for improvement in its implementation and addressing the challenges faced by the program(Dar et al., 2022; A. Pandey & Singh, 2020).

Apart from the PDS, the government also implements other programs to ensure food security in the country. These include the Mid-Day Meal Scheme for school children, the Integrated Child Development Services for children under the age of six, and the National Rural Livelihood Mission to promote sustainable livelihoods and increase access to food in rural areas. Overall, these programs aim to address the issue of food insecurity and malnutrition in India, which continues to be a significant challenge for the country(Narayanan, 2015).

Apart from the PDS, the government also implements various other schemes to improve food security. The Integrated Child Development Services (ICDS) scheme aims to provide nutritious food to children and pregnant and lactating mothers. The Mid-Day Meal scheme provides cooked meals to school children, while the National Rural Livelihood Mission (NRLM) and the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) provide employment opportunities to rural households to improve their income and access to food (S. Kumar & Rai, 2015).

The ICDS is a centrally sponsored scheme launched in 1975 to provide services to young children and their mothers. The scheme aims to address the health, nutrition, and development needs of children below the age of six, as well as pregnant and lactating mothers. The program is implemented through a network of Anganwadi Centres, which are community-based centres providing services to children and women in their respective communities(Rai et al., 2015).

Under the ICDS, the government provides children and mothers supplementary nutrition, health check-ups, immunization, and referral services. The supplementary nutrition component includes the provision of hot cooked meals, take-home rations, and micronutrient supplementation to children and pregnant and lactating mothers. The scheme also focuses on promoting early childhood care and education and providing pre-school education to children. The ICDS is considered one of the world's largest and most successful public health and nutrition programs. It has played a key role in reducing malnutrition and improving the health and development outcomes of young children and mothers in India. The Mid-Day Meal Scheme is a centrally sponsored program that provides cooked meals to school children studying in government and government-aided primary and upper primary schools. The scheme aims to improve the nutritional status of children and to encourage children to attend school regularly. The program has successfully increased school enrollment and attendance, reduced



malnutrition, and improved children's health and development outcomes (Chaturvedi et al., 2016).

On the other hand, the National Rural Livelihood Mission (NRLM) and Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) aim to provide employment opportunities to rural households to improve their income and livelihoods. The NRLM is a poverty alleviation program that promotes sustainable livelihoods and increases access to financial services and social security for rural households. It aims to organize poor rural households into Self Help Groups (SHGs) and provide them access to credit, market linkages, and skill development opportunities (Narayanan, 2015).

The MGNREGA, on the other hand, is a rural employment guarantee program that provides 100 days of wage employment to rural households in a financial year. The program aims to provide a safety net to rural households during periods of unemployment and to create productive assets that can contribute to rural development. Both the NRLM and MGNREGA have successfully provided employment opportunities and improved rural households' livelihoods. These programs have also contributed to improving food security by increasing the purchasing power of rural households and providing them with access to food and other basic necessities (Chaturvedi et al., 2016).

The Annapurna Scheme was launched in 2000 to provide free food grains to destitute senior citizens who are unable to fend for themselves. Under this scheme, eligible beneficiaries receive 10 kg of food grains per month. Antyodaya Anna Yojana (AAY) was launched in 2000 to provide highly subsidized food grains to the poorest of poor households (S. Kumar & Rai, 2015). Under this scheme, eligible households receive 35 kg of food grains per month. Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY) was launched in 2020 in response to the COVID-19 pandemic to provide additional free food grains to poor households. Under this scheme, eligible households receive 5 kg of food grains per person per month for a period of eight months (D. K. Pandey et al., 2022)

Conclusion

The food security system in India is a complex network of policies and programs that aim to ensure that every individual in the country has access to sufficient and nutritious food. However, challenges such as leakages in the PDS, inadequate storage and distribution infrastructure, and climate change are the main problem in achieving food security -. The Indian government has implemented various policies and programs to ensure food security for its citizens, particularly those who are poor or belong to marginalized communities.



The food security system in India plays a crucial role in poverty reduction by ensuring that all citizens have access to sufficient and nutritious food. The PDS is a key component of the food security system in India, which provides subsidized food grains to poor families. This helps to reduce their food expenditure and free up resources for other essential needs, such as healthcare and education. The targeted Public Distribution System (TPDS) is a more focused version of the PDS that targets the poorest of the poor households in the country. This program provides them with food grains at highly subsidized rates, thus reducing their food insecurity and vulnerability to poverty. The MDMS provides free meals to children in primary and upper primary schools. This program helps address malnutrition and hunger among children and encourages parents to send their children to school, thus improving their educational outcomes and reducing poverty in the long run.



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DEVELOPMENT OF MOCAF (MODIFIED CASSAVA FLOUR)-BASED PASTRY FOR CASSAVA FOOD DIVERSIFICATION

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Abstract

Cassava has a low glycemic index (GI) and is recommended for people with diabetes. Cassava can be used as a substitute for rice as an Indonesian staple food. Given Indonesia's high consumption of rice and wheat, diversification of cassava-based foods could reduce consumption and limit imports of the commodities. Efforts to develop various cassava-based foods are getting more attention today. Cassava strip pastry is a new pastry made with modified cassava flour (Mocaf). The development of Cassava strip pastry was expected to expand cassava food varieties. This research aims to investigate the Cassava strip pastry process, the panels' acceptance, the packaging, the brand, and the product price. In the process, a folding process is a critical step that determines the success of products. The baking process is carried out at 180°C for 20 minutes until golden brown, stored in an airtight jar, labeled, and can be sold for Rp 20.000 of price. The product must sell more than two units of airtight jars to have a profit. The preference test results for Cassava strip pastry revealed that the panelists' preference level exceeded 50 %, with a preference for color at 66.7 %, taste at 58.3 %, texture at 50 %, and aroma at 50 %. Nutritional value information has been calculated using the Nutrisurvey tool based on the raw material formulation used. Branding on products can increase product value. As a result, to enter the modern and digital market, the product must have a new brand, be well-labeled, and be registered.

Keywords: Mocaf, Cassava strip pastry, cassava-based product, brand



Introduction

Cassava (*Manihot esculenta*) is a well-known food in Indonesia. This commodity has even become a staple food in several Indonesian regions. Cassava's high nutritional content opens the possibility of using it as a raw material for food products. The rapid microbial degradation after harvest is a significant barrier to cassava utilization. Cassava roots have a shelf life of only 24-48 hours after harvest (Wenham, 1995). Preparing a dry product, such as flour, is one way to extend the shelf life of cassava. In Indonesia, three major cassava flour products are prepared for human consumption: sundried, fermented, and roasted. Cassava flour is traditionally made from washed or peeled roots that are grated, chipped, or sliced, then sun-dried on trays and milled into flour (Subagio, 2008). Beside that, several variations of cassava-based products, such as cassava chips, pastries, cassava getuk, tapioca flour, mocaf, cassava tape, boiled/fried cassava, dry combro, and others, have been made. However, these cassava-based products can only sell at certain moments and within a limited scope of the sales area due to the processed cassava products quickly decaying. This condition also makes some products need a legal permit to sell at the modern supermarket. With the potential of cassava-based food, it is necessary to support the development of cassava-processed food, which can increase the people's economy, especially for urban society. Some modification processes can diversify cassava-based products to attract consumers' attention and to increase cassava-based food's selling value.

Mocaf (Modified Cassava Flour) is cassava flour modified through microbial or enzymatic fermentation. It is commonly used as a mixture or substitute for wheat flour because its properties are similar to wheat flour, and do not smell like cassava. Another benefit of mocaf is that it has a low glycemic index, 3.23% fiber (more than flour fiber), 89.9% carbohydrates, is gluten-free, and has a protein content that is lower than cassava flour due to the fermentation process (Ridwansyah and Yusraini 2013). The fermentation stage improves the internal stability of the starch granules, reduces swelling power, and decreases the amylose release during heat treatment (Numfor *et al.* 1998).

Mocaf has started to be processed into food ingredients, but only as a mixed ingredient, not as the main basic ingredient. One of the strategies to diversify cassava-based products is to use mocaf flour as an alternative to wheat flour in the basic ingredients. Cassava strip pastry is a new pastry made of mocaf. The development of Cassava strip pastry was expected could expand cassava-based food varieties. This study aims to investigate Cassava strip pastry development as a diversified cassava-based product.



Methodology

Cassava strip pastry was prepared according to the following formula: 150 g mocaf, korsvet 125 g, water 115mL, cassava grated boiled 50 g, wheat flour 50 g, cheese 50 g, butter 25 g, salt 1 tsp. All the ingredients were mixed in a stainless-steel bowl. After mixing and having good consistency, the dough was divided into small portions, cut out, covered by cheese on top of each portion, and baked at 180 °C for 20 minutes. The Cassava strip pastry samples investigate based on sensory evaluation, label and packaging, brand, financial and market analysis.

Results and Discussion

1. Preparation of Cassava strip pastry

Cassava strip pastry production begins with the preparation of the korsvet, first in a rectangular shape with a thickness of 0.2 cm, followed by the preparation of the dough, which starts with mixing mocaf flour and fat, salt, and cold water, stirring until smooth and smooth. Then, after grinding it as wide as the korsvete formed earlier, proceed to the folding stage. The folding process is crucial to the success of the puff pastry. After folding, the dough is formed into a rectangle with a width of 0.5 cm x 5.0 cm, then shaped into a stick, brushed with egg yolk, and sprinkled with grated cheese. The Cassava strip pastry baking process is carried out at 180°C for 20 minutes until it is golden brown (Figure 1) (Kuntari *et al.* 2021). It should be noted a folding process is a critical step that determines the success of products.

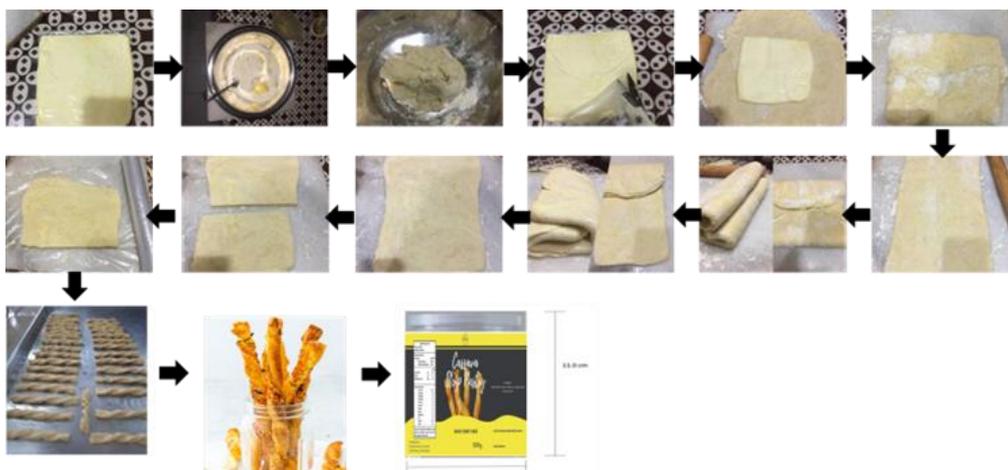


Figure 1. Step of preparation of Cassava strip pastry

2. Sensory Evaluation

The sensory analysis examines the properties of Cassava strip pastry, which include color, taste, texture, and aroma, using 36 untrained panelist senses (sight, smell, taste, touch, and hearing)



to accept or reject Cassava strip pastry samples. Figure 2 depicts the outcome of sensory evaluation based on the 'like' value—about 60% of the panelists like the color of Cassava strip pastry. Color is the first sensory that panelists can see directly. Cassava strip pastry gets its color from the ingredients, which include mofaf, wheat flour, butter, salt, korskvet, and cheese. Brown is the expected color for Cassava strip pastry.

Taste is the evaluation of a food product that determines whether or not it tastes good after consumption. The tongue is a sense that contributes to the assessment. 50% of panelists enjoy the taste of Cassava strip pastry samples, which have a savory flavor due to butter and cheese as the ingredients.

Texture is one of the factors to consider when developing a food product; a texture that is easily digested by the mouth will make the product more appealing to consumers. Food textures can be classified as smooth, hard, soft, dry, wet, or oily. The texture of Cassava strip pastry is expected to be soft on the inside and crunchy on the outside. According to sensory analysis, the texture of Cassava strip pastry samples is liked by 50% of panelists.

Aroma is the smell that food emits and can stimulate the smell in order to arouse appetite. Aroma is one factor that influences whether or not panelists accept a food product because most people smell their food before eating it. Products with an unpleasant aroma may turn off customers who want to try the product. The aroma of butter is expected in Cassava strip pastry. According to sensory analysis, the aroma of Cassava strip pastry samples is liked by 50% of panelists.

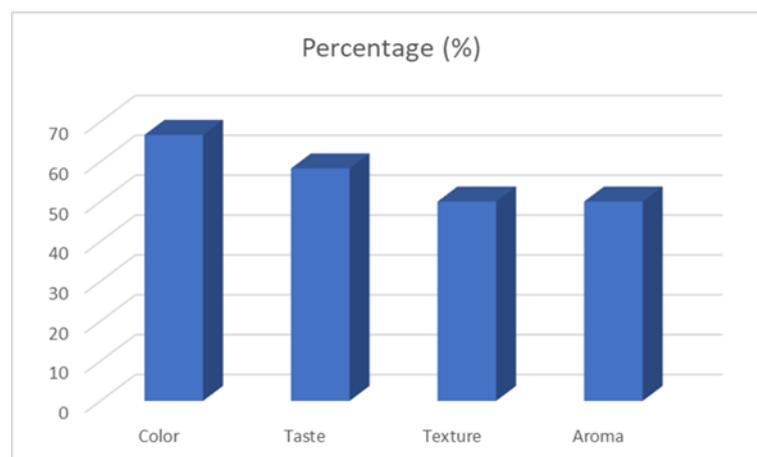


Figure 2. Percentage of sensory analysis based on “like” value



3. Label and Packaging

Cassava strip pastry should be packaged in a hermetic package. The goal is to limit the contact of products which has high fat with oxygen because it can accelerate the rancidity of the product. Thus, the packaging chosen for the Cassava strip pastry is a clear plastic jar made of Polyethylene Terephthalate (PET) with a screw-on plastic lid (Figure 2). The reason for this choice is that the characteristics of PET plastic have good water vapor and oxygen barrier properties, allowing it to withstand the entry of water vapor and gas into the packaging. This condition is suitable for packaging Cassava strip pastry products with a high enough fat content to ensure their crispiness and not go rancid quickly. As a result, the shelf life can increase. (Hastati *et al.* 2022).

Figure 2 depicts the application of food labeling for Cassava strip pastry. The length and width of the label are designed to be large enough to cover the majority of the body of the plastic jar. The goal of this condition is to reduce exposure to light, moisture, and air (oxygen) from the product's external environment. Based on the raw material formulation, nutritional value information was calculated using the Nutrisurvey tool.



Figure 3. Nutritional value information, label, and packaging of Cassava strip pastry

4. Brand of Product

A brand is an element of intellectual property rights that serves as a distinguishing feature of goods or services. Furthermore, the brand is a barometer of the product's or service's reputation. Brands embedded in goods or services will be considered by consumers when deciding whether or not to purchase the product. As previously stated, one of the issues with the application of IPR, one of which is about the brand, by SMEs is a need for more awareness of the importance



of IPR for MSME business development. This can be attributed to a lack of knowledge about intellectual property, as well as the assumption that the registration process is difficult (Ratih *et al.* 2021).

Aside from being a differentiator, the brand also serves as a promotional tool and a reputation marker for the goods or services. According to its function, the brand is one of the most important assets that can benefit businesses. Given the significance of this brand, legal protection as an object of rights, individual or legal entity, is required (Sutedi, 2009). Branding as a strategy for increasing the value of processed cassava products.

5. Financial and Market Potential

The determination of the base price is critical in order to know that the business is carried out and does not suffer losses and to know the profit that will be obtained from this business. The price per package/jar of Cassava strip pastry is Rp 20.000 with the Break Even Point (BEP) of 2 jars (Kuntari *et al.* 2021).

Before being marketed, the Cassava strip pastry requires a PIRT permit from the local City or District Health Service. This rule applies to all food producers, SMEs, and large corporations, even though not all SME food products already have PIRT permit numbers.

The Cassava strip pastry market consists of local markets, niche markets, and the potential for export market. According to the local market, market acceptance of the mocaf-based food product is low and limited by a lack of demand. The niche market of mocaf-based food products is the second market aspect. The Cassava strip pastry, as a health food commodity, has a specific market niche that is consumed by people with autism, celiac disease (a gluten-intolerant disease), or chronic ulcers in Indonesia, as well as a consumer group that leads a healthy lifestyle by consuming gluten-free foods. The Cassava strip pastry has the potential to be exported in addition to local and niche markets.

According to data, as many as 0.2 - 0.6% of Americans suffer from celiac disease, whereas in Europe, an average of 1% suffer from celiac disease (allergic to gluten), necessitating the consumption of gluten-free foods. If realized, this market potential represents a substantial market for the mocaf-based food product industry. However, in order to successfully export processed mocaf products, it must be developed in terms of industrial scale and mocaf quality in order to meet the strict European export market requirement (Triyono *et al.* 2019).

Furthermore, the advancement of information and technology opens up new channels for marketing goods and services. Marketing via digital media and the internet has advantages and disadvantages over traditional media marketing. Some of the benefits and advantages include



reaching a larger and more personal audience, which allows for more precise product marketing, lower costs, and more flexible time management. To reach marketplaces like Shopee and Tokopedia, digital marketing tools like Google My Business, Website, Whatsapp, Facebook, and Instagram can be used.

Conclusion

Cassava strip pastry has been developed as a mocaf-based food product. As a substitute for wheat flour, mocaf was used as the main ingredient in Cassava strip pastry. The Nutrisurvey tool calculated the total energy of Cassava strip pastry to be 1030 kcal based on the raw material formulation used. Its packaging can be made of polyethylene Terephthalate (PET) or glass jars. The panelists' preference level for Cassava strip pastry exceeded 50%, with a preference for color at 66.7%, taste at 58.3%, texture at 50%, and aroma at 50%, according to the preference test results. The product must have a new brand, be well-labeled, and be registered in order to enter the modern and digital market.



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BOVINE RESPIRATORY SYNCYTIAL VIRUS SEROPREVALENCE IN NON-VACCINATED DAIRY CATTLE HERDS IN KONYA PROVINCE, TÜRKİYE

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ABSTRACT

Bovine respiratory disease (BRD) complex, which causes lower respiratory tract infections in cattle, is one of the main diseases of economic losses in dairy and beef cattle breeding. It has been reported that bovine respiratory syncytial virus (BRSV) plays a predominant role in the occurrence of BRD complex. BRSV infection usually occurs in calves less than 6 months of age. However, subclinical infection is common in adult animals, and they are the main source of infection, because reinfections are common in the herds. This study was carried out to determine the prevalence of BRSV in dairy cattle in the Konya Province in Türkiye. A total of 151 cattle sera were randomly collected from dairy herds (n = 20). A commercial enzyme-linked immunosorbent assay (ELISA) kit was used to determine the presence of antibodies to BRSV in cattle sera. Antibodies to BRSV were detected in 65 cattle out of the 151 cattle (43.0%, 95% CI: 35.2 - 50.9). Results showed that animals older than 3 years old had significantly higher BRSV seropositivity than animals younger than 3 years old ($p < 0.05$). Also, BRSV seropositivity was significantly higher in female animals than in male animals ($p < 0.05$). Results of the current study revealed that BRSV circulates in dairy cattle population in the investigated herds, but results of this study are not enough to determine epidemiological status of the BRSV infection in Türkiye. Future researches are needed to determine the prevalence and associated risk factors of BRSV infection in cattle population. Vaccination can help to protect cattle from BRSV infection. Therefore, increasing farmer awareness about vaccination and biosecurity practices benefits are recommended.

Keywords: Bovine respiratory syncytial virus, Cattle, Seroprevalence, Risk factors, Türkiye



TÜRKİYE, KONYA İLİN'DE AŞILANMAMIŞ SÜT SIĞIRI SÜRÜLERİNDE BOVİNE RESPIRATORİK SİNSİTYAL VİRUSUNUN SEROPREVALANSI

ÖZET

Sığırlarda alt solunum yolu enfeksiyonlarına neden olan sığır solunum hastalık kompleksi (BRD), süt ve besi sığır yetiştiriciliğinde önemli ekonomik kayıplarına neden olan hastalıklardan birisidir. Bovine respiratorik sinsityal virusunun (BRSV), BRD kompleksinin ortaya çıkmasında predominant bir role sahip olduğu bildirilmektedir. BRSV enfeksiyonu genellikle 6 aylıktan küçük buzağılarda görülmektedir. Bununla birlikte, yetişkin hayvanlarda subklinik enfeksiyon yaygındır ve bu hayvanlar asıl enfeksiyon kaynağıdır, çünkü sürülerde re-enfeksiyon ortaya çıkabilmektedir. Bu çalışma, Türkiye'de Konya ilin 'deki süt sığırlarında BRSV prevalansını belirlemek amacıyla yapıldı. Süt sığırı sürülerinden (n = 20) rastgele örnekleme ile toplam 151 sığır serumu toplandı. Sığır serumlarında BRSV'ye karşı antikorların varlığını belirlemek için ticari bir enzime bağlı immünosorbent analiz (ELISA) kiti kullanıldı. Yüz elli bir sığırdan 65'inde BRSV antikorları tespit edildi (%43,0, %95 CI: 35,2 – 50,1). Sonuçlar, 3 yaşından büyük hayvanların, 3 yaşından küçük hayvanlara göre önemli ölçüde daha yüksek BRSV seropozitifliğine sahip olduğunu gösterdi (p < 0.05). Ayrıca, BRSV seropozitivitesi dişi hayvanlarda erkek hayvanlara göre anlamlı olarak daha yüksekti (p < 0.05). Mevcut çalışmanın sonuçları, BRSV'nin incelenen sürülerdeki süt sığırı popülasyonunda sirküle olduğunu ortaya koymuştur, ancak bu çalışmada elde edilen sonuçlar, Türkiye'deki BRSV epidemiyolojik durumunu belirlemek için yeterli değildir. Sığır popülasyonunda BRSV enfeksiyonunun prevalansını ve ilişkili risk faktörlerini belirlemek için gelecekteki araştırmalara ihtiyaç vardır. Aşılama, sığırları BRSV enfeksiyonundan korumaya yardımcı olabilir. Bu nedenle, aşılama ve biyogüvenlik uygulamalarının yararları konusunda çiftçi farkındalığının artırılması önerilmektedir.

Anahtar Kelimeler: Bovine respiratorik sinsityal virus, Sığır, Seroprevalans, Risk faktörleri, Türkiye



1. INTRODUCTION

Bovine respiratory disease complex (BRDC) causes important economic losses in cattle industry (Snowder et al., 2006). Several viral and bacterial agents are involved in BRDC. The important viral agents involved in BRDC are bovine respiratory syncytial virus (BRSV), bovine coronavirus (BCoV), bovine viral diarrhoea virus (BVDV) and bovine alphaherpesvirus 1 (BoHV-1) and bovine respirovirus 3 whereas important bacterial agents are *Mycoplasma bovis*, *Pasteurella multocida* and *Mannheimia haemolytica* (Juaréz et al., 2003; Grissett et al., 2015; Headley et al., 2018). Bovine respiratory syncytial virus (BRSV) plays a predominant role in the occurrence of BRDC (Brodersen, 2010; Timsit et al., 2016).

BRSV, renamed as Bovine orthopneumovirus, is a member of the *Orthopneumovirus* genus within the *Pneumoviridae* family, and it has non-segmented and negative-stranded RNA genome (ICTV, 2021). Genetic characterization of BRSV depends on the fusion and attachment proteins of the virus revealed that it has eight subgroups, classified as I-VIII (Bertolotti et al., 2018; Krešić et al., 2018; Leme et al., 2020).

BRSV can infect cattle, goats and sheep (Sarmiento-Silva et al., 2012). BRSV infection usually occurs in calves less than 6 months of age, but subclinical infection is common in adult animals, and they are the main source of infection, because reinfections are common in the herds (Baker et al., 1997; Hägglund et al., 2006). The clinical manifestations of BRSV infection can vary from mild to severe; fever, rhinitis, cough, increased respiratory rate, nasal discharge and decreased feed intake are mostly seen in infected animals, especially young calves (Baptista et al., 2017; Hussain et al., 2019).

BRSV is endemic in most countries. It has been reported that prevalence of BRSV infection ranged from 20% to 83% (Sarmiento-Silva et al., 2012; Sacco et al., 2014; Hussain et al., 2019). The main transmission of the BRSV are direct contact and aerosols (Urban-Chmiel et al., 2015; Hoppe et al., 2018). Morbidity could be as high as 60-80% and mortality can reach up to 20%, especially in young calves (Elvander, 1996; Valarcher and Taylor, 2007).

There is limited information available about the seroprevalence of BRSV in non-vaccinated dairy herds in Konya Province. Therefore, aim of the study was to provide information related to BRSV infection in non-vaccinated dairy herds.

2. MATERIALS AND METHODS

2.1. STUDY AREA AND SAMPLE COLLECTION

The present study was conducted between April 2021 and November 2021 in the Konya Province, an area with high livestock potential, in the Central Anatolia region of Türkiye.



Sampled cattle were from different dairy herds (n = 20). The sample size was calculated with an expected disease prevalence of 50%, confidence level of 95%, and standard error rate of 8%. A total of 151 cattle sera were randomly collected. Cattle of different ages and sex with no vaccination history against BRSV were included in the study.

The collected blood samples were centrifuged at 3000×g at 4 °C for 15 min., and obtained sera samples were stored at -20°C until analysis.

2.2. SEROLOGICAL ANALYSIS

A commercial indirect enzyme-linked immunosorbent assay (ELISA) kit (BioX Diagnostics, Belgium) was used to detect BRSV specific antibodies in sera samples. All sera were run in duplicate. The analysis was performed taking into account manufacturer's instructions. The ELISA analyses were performed using an ELISA reader (Epoch, BIO-TEK, USA), and results were evaluated taking into account manufacturer's instructions.

2.3. STATISTICAL ANALYSES

The obtained data were analysed using SPSS (version18, SPSS Inc., Chicago, USA). The association between seropositivity and sex and age were estimated by Chi-square test. A p-value of ≤ 0.05 was considered statistically significant. The BRSV seroprevalence and 95% confidence intervals were calculated by using Bayesian approach of the beta distribution.

3. RESULTS

Antibodies to BRSV were detected in 65 dairy cattle out of the 151 cattle (43.0%, 95% CI: 35.2 - 50.9). Results of the ELISA are shown in Table 1. Results showed that animals older than 3 years old had significantly higher BRSV seropositivity (50%, 95% CI: 39.7-60.3) than animals younger than 3 years old (32.8%, 95% CI: 21.0-44.6) ($p < 0.05$). Also, BRSV seropositivity was significantly higher in female animals (51%, 95% CI: 40.9-61.3) than in male animals (30.5%, 95% CI: 18.8-42.3) ($p < 0.05$).

An infected herd was defined at least one of the samples was seropositive within flock. In this study, 18 of the 20 herds (90%, 95% CI: 76.9-100.0) had at least one seropositive animals.

Table 1. Seroprevalence of BRSV in dairy cattle herds in Konya Province

Variables	Categories	No. examined	Positive, (%)	P- value
Age	< 3 years	61	20 (32.8%)	0.04
	> 3 years	90	45 (50.0%)	
Sex	Male	59	18 (30.5%)	0.02
	Female	92	47 (51.0%)	



4. DISCUSSION

BRSV, which causes pneumonia and interstitial oedema, is one of the important viral agents of economic losses in dairy and beef cattle breeding (Brodersen et al., 2010). Sampled cattle were not vaccinated against BRSV infection. Therefore, the detection of seropositive animals in this study suggests these animals were naturally infected with BRSV.

In this study, the overall prevalence of BRSV in the Konya Province was 43.0%; lower and higher prevalence rates have been reported from different regions of Turkey and other countries. Karaotcu and Yildirim (2019) reported that BRSV seropositivity was 76.4% in Denizli and Burdur Provinces in the Aegean and Mediterranean regions of Türkiye. Reported BRSV seropositivity in cattle in the Eastern and South-eastern Anatolia regions of Türkiye was 67.3% (Cabalar and Sahna, 2000) whereas in the Marmara region was 73% (Yesilbag and Gungor, 2008). Furthermore, BRSV seropositivity in cattle were 47.0% in North India (Goswami et al., 2016), 78.6% in Argentina (Ferella et al., 2018), 79.5% in Brazil (Hopp et al., 2018) and 83.1% in Iraq (Hussain et al., 2019). The variation in the BRSV seropositivity among cattle from different regions and countries may be due to the number of sampled herds and animals, age of the sampled animals, the difference in the herd management, the analysis methods and disease control programs.

In this study, age of the animals was significantly associated with BRSV seropositivity. BRSV seropositivity was significantly higher in animals older than 3 years old. Similar results were also obtained in previous studies. Goswami et al. (2016) reported that older group of animals (>4 years old) had four to six fold higher seropositivity than young animals (<1 year old). Another study which was carried out in Mexico also reported that older animals had seven fold higher odds of seropositivity to BRSV than 3- to 4-years old animals (Solís-Calderón et al., 2007). Lee et al. (2000) found that age was a significant risk factor for BRSV seropositivity, with lower prevalences in the animals <1 year old. The observed association between age and BRSV seropositivity is probably from older animals having been exposed for a longer time to the agent than the younger animals.

In the current study, an association was found between sex and BRSV seropositivity. Similarly, higher BRSV seropositivity was also reported in female animals in Colombia (Pastrana et al., 2022). However, Hussain et al. (2019) reported that there was no association between sex and BRSV seropositivity. Possible explanations for the differences in BRSV seropositivity in



different studies are the number of sampled animals, the age of the sampled animals, the sampling method, the detection method and management conditions.

In conclusion, results of this study revealed a high prevalence of the BRSV in dairy cattle in the Konya Province, suggesting that the role of BRSV in respiratory disease in the region might have been extenuated. Therefore, the implementation of disease control measures such as vaccination and improved management practices should be considered.



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ÇİFTLİK HAYVANLARININ BİLGİSAYARLA GÖRMEYE DAYALI AĞIRLIK TAHMİNİ

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ÖZET

Hayvanların ağırlıklarının ölçülmesi, beslenme, gelişim ve sağlık durumlarının izlenmesi açısından önemlidir. Bununla birlikte, geleneksel tartılarla hayvan büyümesinin gerçek zamanlı olarak izlenmesi hayvanlar için stresli, üreticiler için de maliyetli ve emek yoğun bir süreçtir. Bu çalışmada çiftlik hayvanları için bu sürecin otomatikleştirilmesinde kullanılan çeşitli bilgisayarlı görüntüleme ve makine öğrenmesi yöntemlerinin incelenmesi amaçlanmıştır. Çeşitli veri tabanları ve anahtar kelimelerle bu konuda yapılmış çalışmalar derlenmiştir. İki ve üç boyutlu görüntüleme teknikleri kullanılarak, elde edilen verilerden bilgisayarla görmeye dayalı tahmin modellerinin geliştirildiği görülmüştür. Görüntü eldesinde iki boyutlu kameralar, üç boyutlu kameralar (derinlik kamerası), kızılötesi ve ultrasonik sensörler veya bunların kombinasyonlarından oluşan sistemler kullanılabilir. Tahminleme için genellikle hayvanların üstten görünen vücut alanı, cidago yüksekliği, omuz yüksekliği, gövde uzunluğu, kalça genişliği, vücut hacmi, göğüs çevresi gibi ölçüler kullanılmaktadır. Görüntülerin işlenmesi ile elde edilen bu metrikler kullanılarak çeşitli makine öğrenmesi veya derin öğrenme algoritmaları ile hayvan vücut ağırlığı tahmin eden çalışmalar yapılmıştır. Ağırlık kestirimi modellerinde sınıflandırma için çeşitli değerlendirme ölçütleri kullanılmış ve model bazında %71 ile %99 aralığında doğruluk değerleri elde edilebildiği görülmüştür. Görüntü tabanlı ağırlık tahmini uygulamalarının başarısı, görüntü kalitesi, kamera pozisyonu, ortam aydınlatması, kamera kalibrasyonu, hayvanın vücut duruşu, görüntüleme zamanlaması, hayvanın kürk rengi ve çevreye bağlı görüntüleme hataları gibi birçok faktörden etkilenmektedir. Makine öğrenmesi perspektifinden bakıldığında, öğrenme aktarımı yaklaşımı görüntü kalitesini değiştiren faktörlerin etkisini azaltabilir. Ayrıca, daha fazla veri ve işlem gücüne ihtiyaç duysa da derin öğrenme modelleri, diğer geleneksel makine öğrenmesi yöntemlerine göre daha yüksek başarı sağlayabilirler. Sonuç olarak, bilgisayarla görmeye dayalı yöntemler görüntü eldesindeki teknik zorluklar nedeniyle henüz tam etkili ve olgunlaşmış bir çözüm sunmasa da hayvan ağırlık kestirimi konusunda gelecek vadettirmektedir.

Anahtar Kelimeler: Ağırlık tahmini Makine öğrenmesi, bilgisayarla görme, , çiftlik hayvanları



LIVESTOCK WEIGHT ESTIMATION BASED ON COMPUTER VISION

ABSTRACT

Measuring the weight of animals is essential for determining their diet, growth, and health state. Nevertheless, tracking animal growth in real time with conventional scales is stressful for the animals and expensive and labor-intensive for producers. The purpose of this research is to investigate the various computerized imaging and machine learning techniques utilized to automate this process for farm animals. Numerous databases and keywords were utilized to construct the research on this topic. It has been observed that prediction models based on computer vision have been constructed employing two- and three-dimensional image data. Image acquisition can be conducted using systems comprised of two-dimensional cameras, three-dimensional cameras (depth camera), infrared and ultrasonic sensors, or combinations thereof. For weight estimation, metrics such as body area as viewed from above, wither height, shoulder height, body length, hip width, body volume, and chest circumference are employed. Various machine learning and deep learning methods have been used to estimate the body mass of animals based on the image processing-obtained parameters. Diverse evaluative criteria were utilized for classification in weight estimation models, and it was discovered that model-based accuracy values between 71% and 99% could be reached. Numerous aspects influence the performance of image-based weight estimate applications, including picture quality, camera position, ambient illumination, camera calibration, animal body posture, imaging timing, animal fur colour, and environmental imaging errors. From the standpoint of machine learning, the learning transfer method can mitigate the influence of picture quality-altering elements. In addition, although they demand more data and computing capacity, deep learning models can achieve more success than other classic machine learning approaches. In conclusion, despite the fact that computer vision-based approaches do not yet provide a fully effective and mature solution due to technological problems in picture collecting, they are promising for estimating animal weight.

Keywords: Computer vision, livestock, machine learning, weight estimation



1. GİRİŞ

Hayvancılık ürünleri, tarımsal ürünlerden sonra ikinci sırada yer alarak insanlar için önemli bir gıda kaynağıdır. Ayrıca, özellikle gelişmekte olan ülkelerde nüfus artışı ve artan gelirler nedeniyle hayvansal proteine olan talep giderek artmaktadır (Tullo vd., 2019). Bununla birlikte yıllar geçtikçe tüm dünyada modern çiftliklerinin büyüklüğü artarken, çiftliklerin sayısı azalmaya devam etmiştir (Lowder vd., 2016). Genel olarak, çiftlik büyüklüğündeki artış, çiftçilerin hayvanlara bireysel olarak yeterince ilgi göstermesini daha zor hale getirmektedir. Bu eğilim, hassas tarım teknolojilerinin çiftçiler tarafından giderek daha fazla benimsenmesine yol açmıştır (Bikker vd., 2014). Mevcut teknolojilerin çoğu çiftlik hayvanlarının faaliyetlerinin izlenmesine odaklanmaktadır. Hayvan vücut ağırlığı da üretimde izlenmesi gereken önemli parametrelerden birisidir.

Çiftlik hayvanlarının canlı vücut ağırlığı, yem tüketimi (Putnam vd., 1964), üreme potansiyeli ve genetik seçim (Ghotbaldini vd., 2019), davranış takibi (Hong vd., 2016), çiftlik yönetimi (Halachmi vd., 2019) konuları üzende büyük öneme sahip ve yaygın olarak kullanılan bir özelliktir. Dolaylı olarak sağlık ve refah durumunun değerlendirilmesinde (Dikmen vd., 2012) ve hayvanlar için pazara çıkış süresinin belirlenmesinde (Mc Hugh vd., 2011) kullanılabilir. Vücut ağırlığındaki büyük veya ani değişiklikler bir hastalığın varlığına (Yin & König, 2018), uygunsuz barınma koşullarına (Heins vd., 2019), refah sorunlarına (Neveux vd., 2006), besleme hatalarına (Meyer vd., 1960) veya verimsiz genetik seçime (Freetly vd., 2020) işaret edebilir. Çiftlik hayvanlarında vücut ağırlığını ölçmek için tartı kullanmak en doğru olanıdır çünkü hayvanı bir tartıya yerleştirerek gerçek ağırlığı belirlenir. Ancak, geleneksel tartılarla hayvan ağırlığının takibi hayvanlar için stresli, üreticiler için de maliyetli ve emek yoğun bir süreçtir. Diğer bir yöntem ise morfolojik özellikler ve vücut ağırlığı arasındaki ampirik ilişkileri kullanarak yapılan tahmindir. (Dohmen vd., 2022).

Doğrudan tartım yöntemleri, küçük, orta veya büyük baş hayvanları taşıyabilen kısmi ağırlıklı veya tam ağırlıklı endüstriyel kantarlar gibi tartım teknolojilerine dayanır. Bu cihazlar genellikle bir çiftlikte geçiş yolları gibi belirlenmiş bir yere veya yemliklerin ve sulukların yanına yerleştirilir ve hayvanlar fiziksel olarak o yere taşınır ve tartım kantarına teker teker yerleştirilir. Bu amaçla kullanılan cihazlar çok hassas olmakla birlikte, satın alınmaları, kullanım amaçları ve operasyon boyutları, yüksek sıcaklık değişkenliği ve aşındırıcı ortamlara yerleştirilmeleri ile ilişkili tekrarlanan kalibrasyon ve bakım maliyetleri önemlidir ve küçük ve orta ölçekli çiftliklerin ve hatta ticari operatörlerin karşılanabilirlik ve sürdürülebilirlik sınırlarının ötesindedir (Dickinson vd., 2013). Hayvanları bekletme alanlarından çıkarıp tartım



istasyonlarına götürmek hem hayvanlar hem de bakıcılar için maliyetli, stresli ve potansiyel olarak zararlı bir faaliyettir ve yanlışlıkla hayvanların kilo kaybına ve hatta ölümüne dahi yol açabilir (Grandin & Shivley, 2015). Ayrıca, tartım işlemi çok zahmetli olduğundan, ölçüm sıklığı vücut ağırlığının diğer özellikler için gösterge olarak kullanılmasına izin verecek kadar yüksek değildir. Bununla birlikte, doğrudan tartım yöntemlerinin satın alınabilirliği küçük üreticiler için bir engel oluşturabileceğinden (Dickinson vd., 2013), araştırmacılar çiftlik hayvanlarında morfometrik ölçümleri ve görüntü özelliklerini vücut ağırlığı ile ilişkilendiren, regresyon modelleri ile temsil edilen dolaylı tartım yöntemleri geliştirmiştir.

Ağırlık tahmini için kullanılacak morfometrik özellikler doğrudan insan eli ile ölçülebilir ya da iki boyutlu (2D) kameralar, üç boyutlu (3D) kameralar, ultrasonik ve kızılötesi sensörler gibi elektro-optik cihazlarla elde edilen görüntülerden çıkarım yapılabilir. Bu çıkarımlar manuel, yarı otomatik veya otomatik ölçümlere kadar çeşitli karmaşıklık derecelerine sahip teknolojilerin yardımıyla gerçekleştirilebilir (Fernandes, Dórea, vd., 2020). Vücut ağırlığı tahmini için beş farklı düşük seviyeli dolaylı tartım tekniğinin (Rondo bandı, Weigh bandı, Weighbridge denklemi, Schaeffer formülü ve Agarwal formülü) bir incelemesi ve karşılaştırması verilmiştir (Wangchuk vd., 2018). Bununla birlikte, bu düşük seviyeli teknolojiler hayvan ırkından, besleme yönteminden, hayvanın tokluk seviyesinden ve ölçüm bantlarının veya tüplerinin esnekliğinden etkilenmektedir. Morfometrik ölçümlerle birlikte bunlarla doğrudan bağlantılı olmayan vücut alanı, doku desenleri gibi özelliklerin de kullanıldığı bilgisayarla görme (BG), makine öğrenimi (MÖ) ve derin öğrenme (DÖ) tekniklerinin ağırlık tahmininde başarıyla uygulandığı çalışmalar son yıllarda artmaktadır (Gjergji vd., 2020).

2. BİLGİSAYARLA GÖRÜ

Bilgisayarlı Görü; şekiller, dokular, yoğunluklar ve mesafeler gibi özellikleri yorumlayarak, yeniden yapılandırarak ve görüntülerden çıkararak dünyayı görüntüler aracılığıyla tanımlamayı amaçlayan bir alan olarak tanımlanabilir (Szeliski, 2011). Bilgisayarla görü ayrıca makine görüş sistemleri, görsel görüntü sistemleri veya sadece görüntü sistemleri olarak da bilinir. Bilgisayarla görme, esasen ilgilenilen görsel sorunları ele almak için yapay sistemlerin geliştirilmesidir ve bunun için görüntü işleme ve analiz tekniklerini kullanır. Görüntü analizi ve işlemenin yanı sıra, makine öğrenimi ve örüntü tanıma gibi diğer alanlar da bilgisayarla görme ile oldukça bağlantılıdır.

Örüntü Tanıma, sadece görüntüleri değil, ses ve metin gibi diğer sinyalleri de inceleyen bir alandır. Adından da anlaşılacağı üzere, herhangi bir sinyalde ortaya çıkabilecek örüntülerin



incelenmesine adanmış bir alandır. Görüntüleme bağlamında örüntü tanıma, genellikle görüntü analizinde çizgi ve daire gibi basit geometrik yapıların veya daha karmaşık nesnelere veya örüntüleri tanımlamak için birlikte kullanılabilen kritik özelliklerinin tanımlanması için matematiksel yöntemlerin geliştirilmesi olarak incelenir. Makine öğrenimi aynı zamanda çok çeşitli veri setlerinden bilgi çıkarmak için algoritmaların geliştirilmesi ve uygulanmasıyla ilgilenen daha geniş bir alandır ve bilgisayarla görme problemlerini çözmek için özel olarak birkaç makine öğrenimi algoritması geliştirilmiş veya uyarlanmıştır.

Hayvan ağırlığı tahmini için bilgisayarla görme sisteminin ilk aşaması görüntü elde edilmesidir. Görüntü yakalama için çeşitli kamera ve sensör yapıları kullanılabilir. İkinci aşamada elde edilen görüntüler görüntü eşikleme ve ikili hale getirme gibi yaygın görüntü işleme teknikleri kullanılarak işlenir. Üçüncü aşamada ise işlenen görüntülerden, istenmeyen arka plan görüntüleri ve ağırlık tahmininde işlevsiz olan hayvan uzuv ya da parçaları segmentasyon yapıları çıkarılır. Ağırlık tahmininde kullanılacak özneteliklerin çıkarımı yapılır. Son aşamada ise çıkarılan veriler analiz edilerek (normalizasyon, model uydurma, doğrulama, ayarlama) modelleme algoritmaları ile tahminleme yapılır (Fernandes, Dórea, vd., 2020).

ÇİFTLİK HAYVANLARINI GÖRÜNTÜLEMEDE KULLANILAN TEKNİKLER

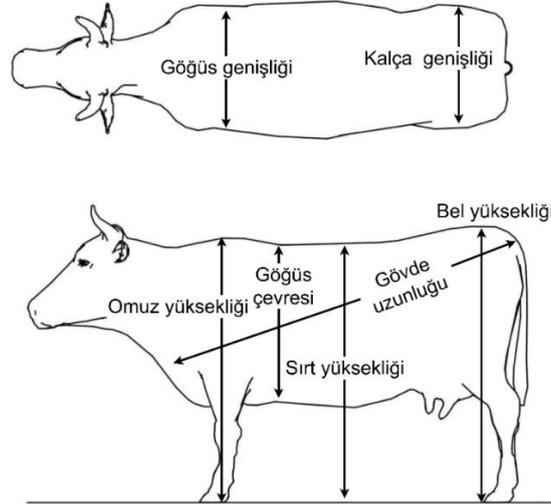
Bilgisayarlı görme kullanarak hayvanların ağırlığını tahmin etmek için görüntülerin toplanması ve işlenmesi gerekir. Ağırlık tahmin modelleri için girdi verisi olarak ihtiyaç duyulan görüntü verilerini toplamak için çeşitli teknikler mevcuttur. Görüntü toplamaya yönelik bu teknikler, 2D ve 3D görüş tabanlı teknikler olmak üzere iki ana kategoriye ayrılabilir. Sığırlar için en çok 3D derinlik kameraları tercih edilmiştir. 3D derinlik kameraları, ToF (time of flight) ya da uçuş süresi kameraları olarak da anılırlar ve yolladıkları kızılötesi ışığın kamera sensörüne gidiş-dönüş süresini hesap ederek kamera ile nesnelere arasındaki mesafeyi ölçerler. Sığırlar için en az kullanılan teknikler ise 3D stereo görüntüleme ve termal 2D görüntülemedir. Domuzların araştırılması için, 2D kamera görüntüleme en çok kullanılan tekniktir ve bunu 3D derinlik kamerası takip etmektedir. Genel olarak 3D görüntü tekniklerini kullanan çalışma sayısının 2D görüntü kullanan çalışmalardan daha fazla olduğu görülmektedir (Dohmen vd., 2022). Bunlarla birlikte 3D stereo görüntüleme gibi örnekler görülmektedir. Stereo görüntülemede iki adet 2D kamera ile nesnelere derinlik bilgisini elde etmek için iki farklı açıdan görüntü yakalanır ve bu görüntüler bir araya getirilerek 3 boyutlu bir model oluşturur. Bu kamera, insan gözünün stereoskopik algılama yeteneğini taklit ederek, nesnelere konumunu ve derinliğini tahmin etmek için kullanılır (Menesatti vd., 2014). Hayvan ağırlık tahmini için görüntü elde etmede LIDAR (Light Detection and Ranging - Işık Tespiti ve Uzaklık Tayini) sensörünü



kullanan çalışmalar da mevcuttur. LIDAR sensörleri mesafe ölçümü ve üç boyutlu harita oluşturmak için çevreyi lazer ışınları tarar ve dönen ışığı toplarlar (Huang vd., 2018; Sousa vd., 2018).

GÖRÜNTÜ TABANLI AĞIRLIK TAHMİN MODELLERİNDE KULLANILAN VÜCUT ÖZELLİKLERİ

Çalışmalarda yaygın olarak tercih edilen üç özellik, vücut uzunluğu, omuz yüksekliği ve kalça yüksekliğidir. Bunlarla birlikte, göğüs çevresi, bel çevresi ve genişliği, kalça genişliği, sırt yüksekliği, vücut üst görünüm alan ölçüsü, vücut yan görünüm alan ölçüsü, vücut hacmi, sırt üst görünüm dış bükey alanı ve çevresel uzunluğu gibi özellikler yaygın olarak kullanılmaktadır (Dohmen vd., 2022). Sığırlarda ağırlık tahmini için yaygın kullanılan ölçüler Şekil 1’de gösterilmektedir.



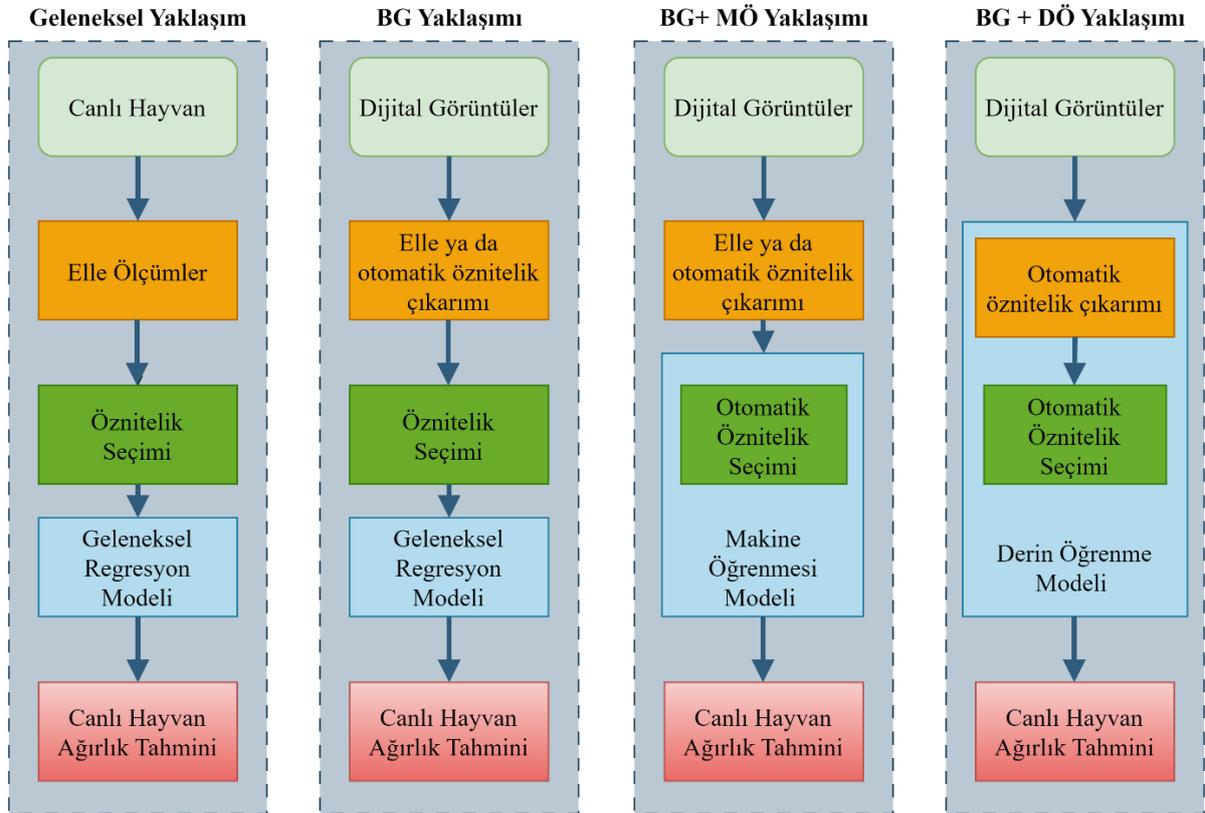
Şekil 1. Sığırlarda ağırlık tahmini için yaygın kullanılan ölçüler

AĞIRLIK TAHMİNİ İÇİN BİLGİSAYARLA GÖRÜ MODELLERİ

Modelleme açısından bakıldığında, hayvan vücut ağırlığı tahmini için farklı karmaşıklık seviyelerine sahip dört modelleme yaklaşımı ayırt edebilir (Şekil 2). Tüm modeller için özellik-öznitelik çıkarma ya da elde etme, öznitelik seçimi (modelleme için) ve otomatikleştirilebilecek regresyon ya da öğrenme modeli gibi üç ana bileşen tanımlanabilir. Bunlardan ilki olan geleneksel yaklaşımda, ölçümler manuel olarak toplanır, ilgilenen ölçüler manuel olarak seçilir ve bunlar bir veya daha fazla değişkenli tahmin denklemleri içeren geleneksel regresyon modelleri oluşturulmasında özellik olarak kullanılır. Bilgisayarla görü yaklaşımında ise, morfometrik ölçümler için 2D ve 3D sensörler kullanılır. Elde edilen görüntüler manuel ya da otomatik olarak ön işlemden geçirilir, ardından ağırlık tahmini için istatistik modellerde



kullanılacak özellikler manuel olarak seçilir. Bilgisayarla görü ve makine öğrenimini birleştiren üçüncü yaklaşım ise otomatik öznelik seçimi için makine öğrenimi yöntemlerini kullanan sistemler içerir. Burada görüntü ve özellik seçimi, görüntü segmentasyonu, morfometrik ölçüm çıkarımı gibi manuel bazı işlemler gereklidir. Bilgisayarla görü ve derin öğrenmeye dayalı dördüncü yaklaşım ise ağırlık tahmin sürecinde tam otomasyonu sağlama potansiyeline sahiptir. Derin öğrenme yaklaşımı görüntü seçimi, morfometrik öznelik çıkarımı ve öznelik seçimi gibi işlemlerin otomatik yapıldığı adımları içerir. Dolayısıyla özellik ya da özneliklerin manuel ölçümü veya çıkarımı gerekmez (Wang vd., 2021).



Şekil 2. Gelenekselden karmaşığa dört vücut ağırlığı tahmin yaklaşımının şematik gösterimi (Wang vd., 2021)

Sığır, domuz, koyun ve keçilerde farklı büyüme dönemlerinde gözlemlenen biyometrik ve morfometrik ölçümlerden çiftlik hayvanlarının vücut ağırlığını tahmin etmek için doğrusal ve çoklu regresyon gibi geleneksel istatistiksel teknikleri uygulayan birçok geçmiş araştırma olmakla beraber, başarıları sınırlıdır. Literatürde 2D ve 3D dijital görüntülerden çıkarılan özellikleri kullanarak hayvan vücut ağırlığını tahmin etmek için çeşitli makine öğrenmesi ve derin öğrenme yöntemlerinin başarılı bir şekilde uygulandığını çalışmalar mevcuttur (Tablo 1). Bilgisayarla görü ve makine öğrenimi yaklaşımları, ağırlık tahmini yanı sıra hayvan vücut



kondisyonu tahmini ve davranış takibi gibi uygulamalar için de kullanılabilir (Qiao vd., 2021).

Tablo 1 Dört çiftlik hayvanı türünde ağırlık tahmini için literatürde kullanılan MÖ yöntemleri (Wang vd., 2021)

Referans	Makine öğrenmesi yöntemi	2D/3D Görüntüler	Hayvan sayısı	Cins	R	R ²	RMSE	MAE
Taşdemir ve diğerleri, 2019	ANN/MLP	2D	115	Sığır (Holstein)	0,9916	-	-	-
Taşdemir ve diğerleri, 2011a,b	Bulanık kural tabanlı model	2D	115	Sığır (Holstein)	0,9922	-	-	-
Miller ve diğerleri, 2019	ANN	3D	1484	Sığır (Aberdeen Angus, Limousin, Simmental, Charolais)	-	0,7000	42,0000	-
de Moraes Weber ve diğerleri, 2020	LR, SVM, Random Forest (RF)	2D	34	Sığır (Girolando)	0,7100	-	46,6900	38,4600
Gjergji ve diğerleri, 2020	CNN RNN/CNN RAM CNN ile RAM	2D	20	Sığır (Nellore, Angus)	-	-	-	23,1900
Cominotte ve diğerleri, 2020	MLR LASSO PLS ANN	3D	48	Besi Sığırı	-	[0,79 - 0,92]	[7,78 - 18,14]	-
Fernandes ve diğerleri, 2020b	MLR PLS ENR MLP DL Görüntü Kodlayıcı Modeli	3D	557	Domuz	-	[0,03 - 0,87]	[1,05 - 6,44]	[0,81 - 5,21]
Megel ve diğerleri, 2020	Mask RCNN MLP	3D	500	Sığır (Ayreshire, Holstein, Jersey, Red Steppe)	[0,84 - 0,92]	-	-	[0,9 - 2,5]

Tablo 1’de verilen örnek çalışmalara bakıldığında hayvan vücut ağırlığı tahmini için çeşitli makine öğrenimi ve derin öğrenme yöntemleri ile birlikte, model başarımlarında farklı çeşitli metrikler kullanıldığı görülmektedir. Çalışmaların genelinde az sayıda hayvan ve görüntü ile çalışma yapılabildiği görülmektedir. Çalışmalardaki hayvan cins veya türlerinin farklı olması, kullanılan farklı metrikler ve ölçüler (RMSE, MAE, r, R, R², korelasyon katsayısı vb.),



deneysel sistem farklılıkları, farklı 2D ve 3D sensörlerin kullanımı model başarımlarını karşılaştırması yapmayı zorlaştırmaktadır. Kimi çalışmalarda başarımlar oransal ya da yüzdesel olarak verilirken kimilerinde mutlak kilogram olarak verilebilmektedir. Oysaki, üzerinde çalışılan hayvanların cinsi, türü, yaş grubu vb. birçok etmenden ötürü çalışma grubunun ortalama kilogram değerleri çok farklı olabilir (Los vd., 2023).

3. SONUÇ VE DEĞERLENDİRME

2D ve 3D sensör tabanlı yaklaşımlar ağırlığı tahmin etmek için invazif olmayan bir sistem oluştursa da, canlı hayvanların temassız testi hala zorlu ortam ve zayıf ışık durumu gibi birçok faktörle sınırlıdır. Çiftlik ortamında kullanılacak gerçekçi bir ağırlık tahmin sisteminin, faydalı özellikleri güvenilir bir şekilde çıkarabilmesi için değişken aydınlatma koşulları ve hayvan hareketleri gibi zorluklara uyum sağlaması gereklidir.

Çiftlik hayvanlarının vücut ağırlığı tahmininde temel bazı zorluklar bulunmaktadır. Hayvan görüntüsünün kamera bakış açısına göre eksik olması önemli bir kusurdur. Kullanılacak modellerin doğru bir tahminleme yapabilmesi için elde edilen hayvan görüntüsünün model parametrelerini eksiksiz karşılaması gereklidir. Bu nedenle kamera ve sensörlerin uygun pozisyonlanması önemlidir. Hayvanın vücut duruşu da tam görüntü eldesinde aksamalara neden olabilir. Zorlu çiftlik ortamı şartlarında ışık değişimleri, gölgeler, arka plan gürültüleri, sensörlerin toz, kir ve güneş ışığından etkilenmesi gibi görüntü kalitesini etkileyen etkenler bulunmaktadır. Temiz olmayan arka plan, hayvanlar üzerindeki kirler, deri veya kürk renginin arka plan rengine çok yakın olması gibi durumlarda görüntüdeki hayvanın tespiti ve segmentasyon aşamalarında sorunlar yaşanabilir. Görüntüsü alınan hayvanın kimlik tanınmasının hızlı ve doğru yapılması da önem arz etmektedir. Hayvan kimliği ve alınan görüntülerin doğru eşleştirilmesi her hayvanın ayrı ayrı takibi için önemlidir. Hem görüntülerin tam elde edilmesi hem de hayvan kimlik tespitinin doğru yapılması açısından iyi bir görüntüleme otomasyonunun geliştirilmesi önemlidir.

2D kameralardan çıkarılan özellikler kamera bakış açılarından veya hayvanın duruşundaki değişikliklerden etkilenmeye eğilimlidir. 2D sensörlerin aksine, 3D sensörler vücut yüzeyinde derinlik bilgisi verebilir ve bu da ağırlık tahmin doğruluğunu önemli ölçüde artırabilir. Ancak 3D sensörler 2D sensörlere göre daha pahalıdır. Ayrıca 3D veri işleme ile ilgili algoritmalar daha karmaşıktır ve işlem yükü yüksektir.

Makine veya derin öğrenme tabanlı yaklaşımlarda, büyük ölçekli veriler kullanılarak modellerin eğitilmesi büyük önem taşımaktadır. Ancak, yüksek kaliteli kamuya açık veri ve tek



tip veri standartlarının olmaması bu çalışmaları zorlaştırmaktadır. Bu nedenle, hayvan ırklarının 2D ve 3D görüntülerini ve bunlara karşılık gelen biyometrik - morfometrik (ve diğer tamamlayıcı) ölçümleri depolayan, araştırmacılara açık havuzların ve veri tabanlarının oluşturulması, temassız vücut ağırlığı tahminlerini iyileştirme potansiyeline sahip mevcut bilgisayarla görü, makine öğrenimi ve derin öğrenme yaklaşımlarının geliştirilmesi ve iyileştirilmesi için çok önemlidir.

Görüntü tabanlı ağırlık tahmin modelleri önceden ayarlanmış kameralara dayanmaktadır. Ancak model eğitiminden sonra kamera açıları ya da kalibrasyonunda bir değişiklik olursa modellerin doğruluğu da olumsuz etkilenecektir. Bu nedenle herhangi bir hayvanın görüntüsü ile eğitilebilen ve transfer öğrenimi yaklaşımını kullanan yeni modellerin geliştirilmesi başarımı artırabilir.

Ağırlık tahmini için farklı teknikler çalışılmış olmasına rağmen, mevcut tüm model ve teknikleri karşılaştıracak bir kıyaslama çerçevesi yoktur. Değerlendirme yaklaşımları ve doğrulama parametreleri çalışmalar arasında çok farklılık göstermektedir. Bu nedenle bir kıyaslama çerçevesinin oluşturulmasına ihtiyaç vardır.

4. TEŞEKKÜR

Bu çalışma Burdur Mehmet Akif Ersoy Üniversitesi Bilimsel Araştırma Projeleri Komisyonunca desteklenmiştir. Proje No: 2017K12-41003-33

5. KISALTMALAR

LR: Linear Regression: Doğrusal Regresyon,

MLR: Multiple Linear Regression: Çoklu Doğrusal Regresyon

ANN: Artificial Neural Network - Yapay Sinir Ağı

MLP: Multi Layer Perception: Çok Katmanlı Algılayıcı

SVM: Support Vector Machine - Destek Vektör Makinesi

RF: Random Forest -Rastgele Ormanlar

CNN: Convolutional Neural Networks - Evrişimli Sinir Ağları

RCNNs: Recurrent Convolutional Neural Networks - Tekrarlı Evrişimsel Sinir Ağları

RAMs: Recurrent Attention Models - Tekrarlayan Dikkat Modelleri

LASSO: Least Absolute Shrinkage and Selection Operator - En Küçük Mutlak Küçülme ve Seçim Operatörü

PLS: Partial Least Squares - Kısmi En Küçük Kareler



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**SYNTHESIS OF NEW PIPERAZINE DERIVATIVE AS POTENTIAL
ANTIMICROBIAL AGENTS**

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ABSTRACT

A new piperazine derivative: 2,2'-(piperazine-1,4-diyl)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide) was synthesized. The characterization of 2,2'-(piperazine-1,4-diyl)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide) was characterized by ¹H-NMR, ¹³C-NMR, FT-IR, Mass spectral data and elemental analysis.



INTRODUCTION

Hydrazide-hydrazone derivatives are significant nitrogenous compounds that exhibit herbicidal [1], anticancer [2], antimalarial [3], anti-inflammatory [4], antiviral [5], antibacterial [6,7], antifungal [8], anticoagulant [9], and insecticidal bioactivities [5].

In this paper, The 2,2'-(piperazine-1,4-diyl)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide) was synthesized and characterized by using elemental analyses, FT-IR, LC-MS, spectrometric methods.

Experimental

Materials

Piperazine, hydrazine hydrate, ethyl chloroacetate, potassium carbonate, 4-Diethyl amino benzaldehyde (all from Sigma-Aldrich) and solvents (all from Merck) were used without further purification. All chemicals and solvents used in synthesis were of analytical grade.

Physical Measurements

The elemental analyses (C, H, N and S) were performed on a LECO CHNS 9320 type elemental analyzer. ¹H -NMR and ¹³C -NMR spectra were recorded on a Bruker- spectropin Avance DPX-400 Ultra-Shield. TMS was used as internal standard and deuteriated DMSO as solvent. The IR spectra (4000-400 cm⁻¹) were recorded on a Mattson 1000 FT-IR spectrophotometer with samples prepared as KBr pellets. LC/MS-APCI was recorded on an Waters 2695 Alliance Micromass ZQ Spectrometer. The melting points were measured using an Opti Melt apparatus. TLC was conducted on 0.25 mm silica gel plates (60F254, Merck). The molar magnetic susceptibilities were measured on powdered samples using Gouy method.

Synthesis of 2,2'-(piperazine-1,4-diyl)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide)

The solution of 1,4-piperazinediacetic acid, 1,4-dihydrazide (2.2 g, 9.1 mmol) in 20 mL of ethanol/water (5:1) was mixed with hot solution (50 °C) of 4-Diethyl amino benzaldehyde (3.7 g, 19 mmol) in 30 mL of ethanol and stirred for 24 h at room temperature. The precipitated product was crystallized from the ethanol/water (4:1) mixture. The white crystalline solid was dried in vacuum and stored in ethanol vapor. The reaction equation was given below: LC-MS (Figure 1 (100 eV, APCI): 549,4 (M-C₂H₅, 100%), Elemental analysis for C₃₂H₅₂N₈O₂ (MW:580,82 g/mol) (Calc.%) C: 66.17; H: 9.02; N: 19.29; O: 5.51. (Found %) C, 66.87; H, 8.58; N, 20.15; O, 5.74.

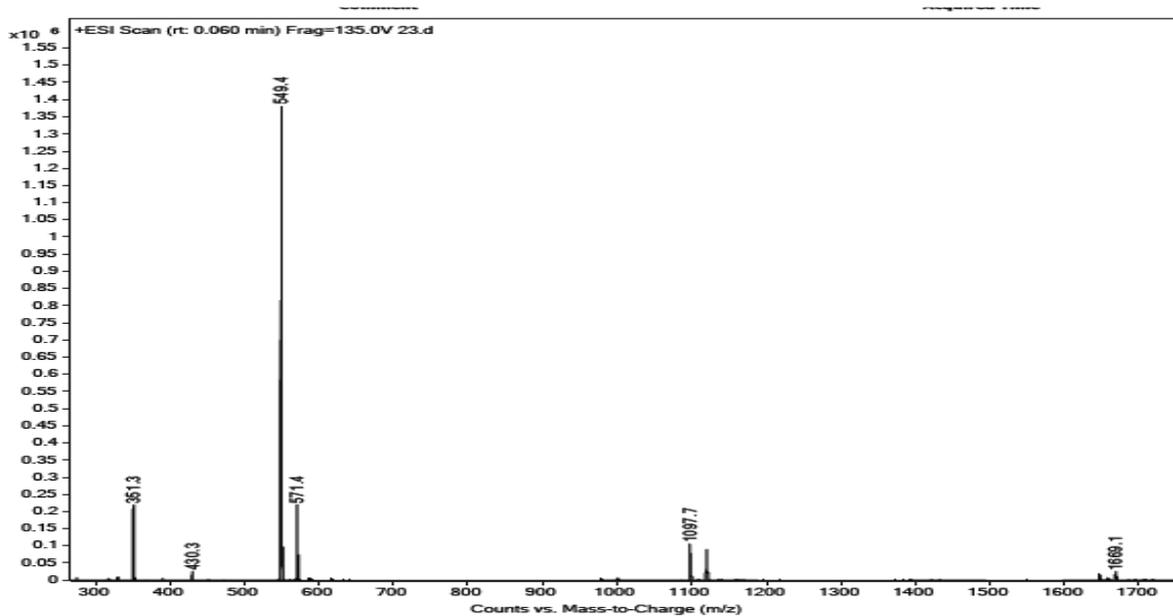
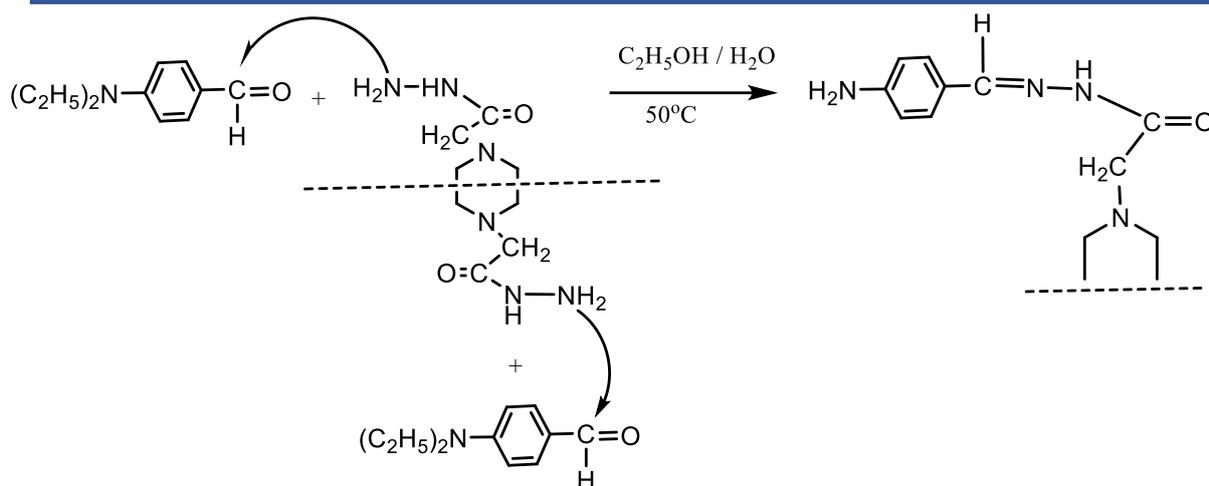


Figure 1 . LC-MS spectrum of the compound

FR spectrum of 2,2'-(piperazine-1,4-diyldi)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide) is shown in Figure 2. As seen in Figure 2, stretching bands are observed at 3187 cm^{-1} (N-H), 3066 cm^{-1} (CH: aromatic), 1688 cm^{-1} (C=O; amide), 1512 cm^{-1} (C=C: aromatic), 1294 cm^{-1} (C-N).

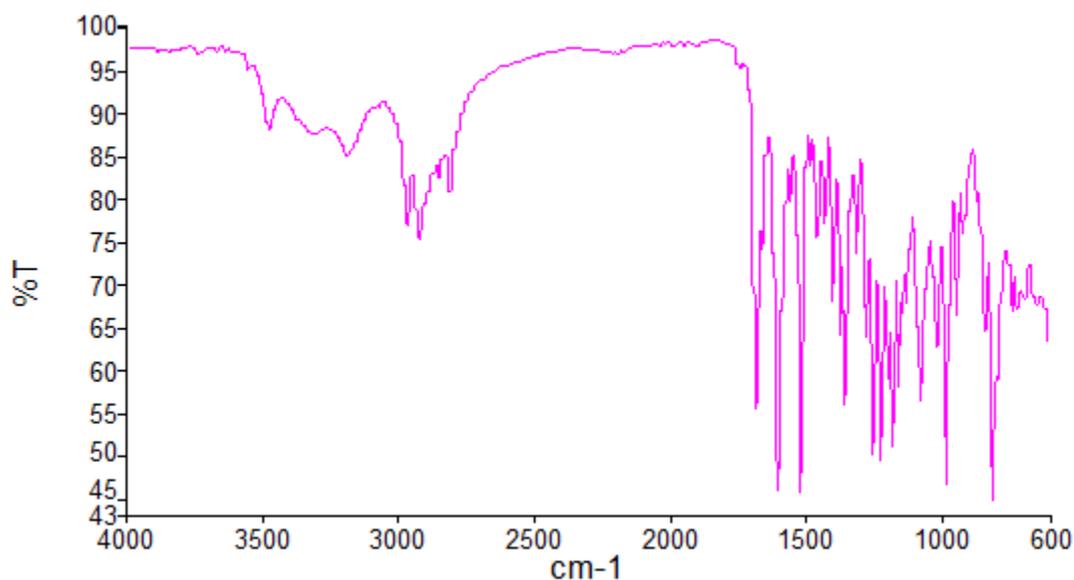


Figure 1 . FT spectrum of the compound

The NMR spectrum (^1H , ^{13}C) of 2,2'-(piperazine-1,4-diyl)bis(N'-((Z)-4-Diethylamino-benzylidene)acetohydrazide) was obtained and interpreted in d_6 -DMSO. The protons of piperazine appeared at 2.38 (m, 4H) and 2.62 (m, 4H) ppm respectively. The protons belonging to N=CH (8.2 ppm), and C-NH (11.4 ppm) were detected as singlet. Signals in the range of δ 6.94-7.60 ppm region belong to aromatic Ar-H protons.

In ^{13}C NMR spectra of the compound, Piperazine ring peak and Azomethine CH=N carbon peak were observed at 55.60 ppm and 164.5 ppm, respectively.. Signals in the δ 109.7-155.5 ppm region belong to aromatic Ar-C-atom.



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