ÇUKUROVA

INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS

November 03-05, 2025 / Yumurtalık, Adana, Türkiye

Cukurova University, Yumurtalik Vocational School

THE PROCEEDINGS BOOK

EDITOR

Assist. Prof. Dr. Hülya SAYĞI

ISBN: 979-8-89695-245-9

www.iksad.co.uk/tr/cukurova

Copyright © Liberty

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS

November 03-05, 2025 / Yumurtalık, Adana, Türkiye

Cukurova University, Yumurtalik Vocational School

EDITOR

Assist. Prof. Dr. Hülya SAYĞI

Issued: 10.12.2025

Liberty Publishing House

Water Street Corridor New York, NY 10038

www.libertyacademicbooks.com

+1 (314) 597-0372

ALL RIGHTS RESERVED NO PART OF THIS BOOK MAY BE REPRODUCED IN ANY FORM, BY PHOTOCOPYING OR BY ANY ELECTRONIC OR MECHANICAL MEANS, INCLUDING INFORMATION STORAGE OR RETRIEVAL SYSTEMS, WITHOUT PERMISSION IN WRITING FROM BOTH THE COPYRIGHT OWNER AND THE PUBLISHER OF THIS BOOK.

© Liberty Academic Publishers 2025

The digital PDF version of this title is available Open Access and distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 license (http://creativecommons.org/licenses/by-nc/4.0/) which permits adaptation, alteration, reproduction and distribution for noncommercial use, without further permission provided the original work is attributed. The derivative works do not need to be licensed on the same terms.

adopted by Mariam Rasulan

ISBN: 979-8-89695-245-9

CONGRESS ID

CONGRESS TITLE

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS

DATE and PLACE

November 03-05, 2025 / Yumurtalık, Adana, Türkiye

HONORARY PRESIDENT

Prof. Dr. Hamit Emrah BERİŞ/ Rector of Çukurova University

CONGRESS PRESIDENT

Assist. Prof. Dr. Hülya SAYĞI/Çukurova University

ORGANIZING COMMITTEE

Prof. Dr. Ahmet ÇELİK/Adıyaman University
Lecturer Dr. Uğur KEKEÇ/Çukurova University
Lecturer Dr. Özgür YILMAZ/Çukurova University
Lecturer Dr. Bilge BOZ/Çukurova University
Lecturer Canani YALÇIN/Çukurova University
Lecturer Ayhan SAYĞI/Çukurova University

COORDINATOR

Gönül EDEŞLER
Neslihan BALCI

NUMBER of ACCEPTED PAPERS - 38
NUMBER of REJECTED PAPERS – 10

PARTICIPANTS COUNTRY

Türkiye-13, Algeria-3, Bangladesh-3, Georgia-1, India-2, Indonesia-1, Iran-1, Israel-1, Kazakhstan-1, Morocco-7, Nigeria-2, Vietnam-3

SECRETARIAT COMMITTEE

Dr. Bıçkın Temel BAŞKAN
Dr. Surhan TABAKOĞLU
Lecturer Dr. Ali Serhat ÖZKÜTÜK

SCIENTIFIC COMMITTEE

Prof. Dr. Ebru KAFKAS / Çukurova University, Türkiye
Prof. Dr. H. Yıldız DAŞGAN / Çukurova University, Türkiye
Prof. Dr. Mehmet ÇELİK / Çukurova University, Türkiye
Prof. Dr. Mehmet Fırat Baran / Siirt University, Türkiye
Prof. Dr. Erdal Sakin / Harran University, Türkiye
Prof. Dr. Mahmut İslamoğlu / Adıyaman University, Türkiye
Prof. Dr. Vedat Beyyavaş / Harran University, Türkiye
Prof. Dr. Olufunmilola Leah Dominic / University of Ilorin, Nigeria
Assoc. Prof. Dr. Muharrem A. KAMBEROĞLU / Çukurova University, Türkiye
Assoc. Prof. Dr. Sevinç ATEŞ / Akdeniz University, Türkiye
Assoc. Prof. Dr. Burhanettin İMRAK / Çukurova University, Türkiye
Assoc. Prof. Dr. Mehmet Ali SARIDAŞ / Çukurova University, Türkiye
Assoc. Prof. Dr. Çetin Akkuş / Kastamonu University Tourism Management, Türkiye
Assoc. Prof. Dr. İsmail Ukav / Adıyaman University, Türkiye
Assoc. Prof. Dr. YASİN Demir / Bingöl University, Türkiye
Assoc. Prof. Dr. Meltem Avan / Adıyaman University, Türkiye
Assoc. Prof. Dr. Gülşen Kırpık / Adıyaman University, Türkiye
Assoc. Prof. Vüqar NƏZƏROV / Azerbaijan University of Tourism and Management, Azerbaijan
Assoc. Prof. Səkinə HACIYEVA / Azerbaijan University of Tourism and Management, Azerbaijan
Assoc. Prof. Cemal HACIYEV / Azerbaijan University of Tourism and Management, Azerbaijan
Assoc. Prof. Dr. Nodar Sulashvili / University of Georgia, Georgia
Assistant Prof. Dr. Aykut ŞİMŞEK / Kastamonu University Tourism Management Gastronomy Department, Türkiye
Assistant Prof. Dr. Fatma YENİLMEZ / Çukurova University, Türkiye
Assistant Prof. Dr. İbrahim Halil Yanardağ / Malatya Turgut Özal University, Türkiye
Assistant Prof. Dr. Emrah Ramazanoğlu / Harran University, Türkiye
Assistant Prof. Dr. Asuman Yanardağ / Malatya Turgut Özal University, Türkiye
Assistant Prof. Dr. Somayyeh Razzaghi / Erciyes University, Türkiye
Assistant Prof. Dr. Muzaffer Kırpık / Adıyaman University, Türkiye
Dr. Iram Liaqat / Government College University, India
Dr. İlkay Çelik / Adıyaman University, Türkiye
Dr. Bıçkın TEMEL, Türkiye

ÇUKUROVA

INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS

November 03-05, 2025 / Yumurtalık, Adana, Türkiye

Cukurova University, Yumurtalik Vocational School

CONGRESS PROGRAM

Zoom Meeting ID: 829 5595 6031

Zoom Passcode: 080808

https://us02web.zoom.us/j/82955956031?pwd=GsVi1QhpX92DXa3zqKwmbawCnYFOpm.1

Participant Countries (12):

Türkiye, Algeria, Bangladesh, Georgia, India, Indonesia, Iran, Israel, Kazakhstan, Morocco, Nigeria, Vietnam

Önemli, Dikkatle Okuyunuz Lütfen

- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
- Online sunum yapabilmek için https://zoom.us/join sitesi üzerinden giriş yaparak "Meeting ID or Personal Link Name" yerine ID numarasını girerek oturuma katılabilirsiniz.
- Zoom uygulaması ücretsizdir ve hesap oluşturmaya gerek yoktur.
- Zoom uygulaması kaydolmadan kullanılabilir.
- Uygulama tablet, telefon ve PC'lerde çalışıyor.
- Her oturumdaki sunucular, sunum saatinden 5 dk öncesinde oturuma bağlanmış olmaları gerekmektedir.
- Tüm kongre katılımcıları canlı bağlanarak tüm oturumları dinleyebilir.
- Moderatör – oturumdaki sunum ve bilimsel tartışma (soru-cevap) kısmından sorumludur.

Dikkat Edilmesi Gerekenler - TEKNİK BİLGİLER

- Bilgisayarınızda mikrofon olduğuna ve çalıştığına emin olun.
- Zoom'da ekran paylaşma özelliğini kullanabilmelisiniz.
- Kabul edilen bildiri sahiplerinin mail adreslerine Zoom uygulamasında oluşturduğumuz oturuma ait ID numarası gönderilecektir.
- Katılım belgeleri kongre sonunda tarafınıza pdf olarak gönderilecektir.
- Kongre programında yer ve saat değişikliği gibi talepler dikkate alınmayacaktır.

Important, Please Read Carefully

- To be able to attend a meeting online, login via https://zoom.us/join site, enter ID "Meeting ID or Personal Link Name" and solidify the session.
- The Zoom application is free and no need to create an account.
- The Zoom application can be used without registration.
- The application works on tablets, phones and PCs.
- The participant must be connected to the session 5 minutes before the presentation time.
- All congress participants can connect live and listen to all sessions.
- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

Points to Take into Consideration - TECHNICAL INFORMATION

- Make sure your computer has a microphone and is working.
- You should be able to use screen sharing feature in Zoom.
- Attendance certificates will be sent to you as pdf at the end of the congress.
- Requests such as change of place and time will not be taken into consideration in the congress program.

***

Zoom'a giriş yapmadan önce lütfen örnekteki gibi salon numaranızı, adınızı ve soyadınızı belirtiniz
Before you login to Zoom please indicate your hall number, name and surname

exp. H-1, Gamze TURAN

Opening Ceremony

03.11.2025 / 10:00 – 10:40
Cukurova University, Yumurtalik Vocational School

Assist. Prof. Dr. Hülya SAYĞI
Cukurova University, Director Yumurtalik Vocational School
PRESIDENT OF CONGRESS

Prof. Dr. Shakhlo BOTIROVA
Alfraganus University

Dr. Mustafa Latif EMEK
President of IKSAD Institute

Prof. Dr. Hamit Emrah BERİŞ
Rector of Çukurova University
HONORARY PRESIDENT OF CONGRESS

Erdinç ALTIOK
Yumurtalik District Mayor

Yakup PAPAKER
Yumurtalik District Governor

Panel Presentations

03.11.2025 / 11:00 – 12:00
Cukurova University, Yumurtalik Vocational School

Şahin BİLGİÇ
Chairman of the Board of Directors of the Commodity Exchange

Göksel TANSALAR
Chairman of the Board of Ramada Hotel

Sadık KESKIN
Keskin Tarım

Face to Face PRESENTATIONS

03.11.2025 / Hall-4

ANKARA LOCAL TIME

14 00 : 16 00

Address: Cukurova University, Yumurtalik Vocational School

HEAD OF SESSION: Hülya SAYĞI

AUTHORS	AFFILIATION	TOPIC TITLE
Bıçkın TEMEL	Cukurova University	EXAMPLE of YUMURTALIK HARVEST ROUTE WITHIN THE SCOPE of AGRICULTURAL TOURISM
Uğur KEKEÇ Burçak KAPUR	Cukurova University	ADVANCES IN SENSOR-BASED AND INTELLIGENT IRRIGATION SCHEDULING: INTEGRATING SOIL, PLANT, AND CLIMATE DATA FOR PRECISION WATER MANAGEMENT
Uğur KEKEÇ Burçak KAPUR	Cukurova University	INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE AND ADAPTATION STRATEGIES IN THE AGRICULTURAL SECTOR
Hülya SAYĞI	Cukurova University	THE EFFECT OF CLIMATE CHANGE ON THE AGRICULTURAL PLANT PATTERN PRODUCED IN THE ÇUKUROVA REGION: THE EXAMPLE OF YUMURTALIK DISTRICT

ONLINE PRESENTATIONS

03.11.2025 / Session-1, Hall-1

ANKARA LOCAL TIME | 10 00 : 12 00

ZOOM ID: 829 5595 6031 | **ZOOM PASSCODE: 080808**

HEAD OF SESSION: Bekir ATAR

AUTHORS	AFFILIATION	TOPIC TITLE
Zehra Meliha TENGİZ Osman İNAN Sedanur ŞAHİN	Yozgat Bozok University	THE HISTORY OF AGRICULTURAL CENSUSES AND RECOMMENDATIONS FOR INCREASING THEIR CONTRIBUTION TO AGRICULTURAL SUPPORT POLICIES
Zehra Meliha TENGİZ Mehmet ERKUŞ	Yozgat Bozok University Plant Protection Central Research Institute Directorate	ANALYSIS OF TURKEY'S COMPARATIVE ADVANTAGE IN OLIVE OIL FOREIGN TRADE WITH A FOCUS ON THE EUROPEAN UNION MARKET
Mesut ADA Hayat TOPÇU Salih KAFKAS	Çukurova University Tekirdağ Namık Kemal University	IDENTIFICATION OF QUANTITATIVE TRAIT LOCI (QTL) IN WALNUT: MOLECULAR APPROACHES IN BREEDING PROGRAMS
Mesut ADA Hayat TOPÇU Salih KAFKAS	Çukurova University Tekirdağ Namık Kemal University	MARKER-ASSISTED SELECTION IN WALNUT (JUGLANS REGIA L.) BREEDING: MOLECULAR MARKERS, QTL, AND GWAS APPLICATIONS
Sevinç DEMİR Emine Burcu TURGAY Merve Nur ERTAŞ ÖZ Reyhan BAHTİYARCA Sefa AYTEN	Republic of Turkey Ministry of Agriculture and Forestry	PREVALENCE OF FUNGAL PATHOGENS (ALTERNARIA BURNSII AND FUSARIUM OXYSPORUM F. SP. CUMINI) LIMITING CUMIN (CUMINUM CYMINUM L.) PRODUCTION IN THE CENTRAL ANATOLIA REGION OF TURKEY
Bekir ATAR	Isparta University of Applied Sciences	SPEED BREEDING METHOD APPLICATIONS IN WHEAT
Fatma YENİLMEZ	Cukurova University	EFFECT OF LAVENDER ESSENTIAL OIL SCENT APPLIED DURING INCUBATION ON HATCHING CHARACTERISTICS
Ayşe DOLAR Erol ATAY Murat DAL	Hatay Mustafa Kemal University Munzur University	THE IMPACT OF CLIMATE CHANGE ON HISTORIC STONE STRUCTURES: THE CASE OF THE TRAJAN AQUEDUCTS
Murat DURMUŞ Melis ÇELIK GÜNEY	Cukurova University	EFFECTS OF KID AGE, DAM AGE AND BIRTH TYPE ON TESTICULAR MEASUREMENT IN ALPINE KIDS

ONLINE PRESENTATIONS

03.11.2025 / Session-1, Hall-2

ANKARA LOCAL TIME 10 00 : 12 00

ZOOM ID: 829 5595 6031 **ZOOM PASSCODE: 080808**

HEAD OF SESSION: Bouzekraoui Hicham

AUTHORS	AFFILIATION	TOPIC TITLE
Djihane Romayssa MAHAMMED Nabila BELYAGOUBI-BEHNHAMMOU Asmaa DICH Larbi BELYAGOUBI Sarra BENAISSA Kamal BENMANSOUR Gabriele DI MARCO Alessia D'AGOSTINO Antonella CANINI Angelo GISMONDI	University of Tlemcen	PLANT EXTRACT-BASED INTEGRATED DEVELOPMENT OF BIOACTIVE AND BIO-SENSITIVE FILMS FOR ACTIVE PACKAGING APPLICATIONS AND SUSTAINABLE DESIGN
SAGHOURI EL IDRISSI Imane KETTANI Rajae KHALFI Chemsdoha FERRAHI Moha BRHADDA Najiba	University of Ibn Tofail	PLANT RESPONSES TO WATER STRESS REVEALED FROM SOIL MOISTURE DYNAMICS
Bouzekraoui Hicham Mouaddine Atika El Garnaoui Mohamed Hilali Abdessamad	University Sultan Moulay Slimane	PHYSICO-CHEMICAL AND BACTERIOLOGICAL QUALITY OF IRRIGATION WATER AND ITS IMPACT ON AGRICULTURAL SOILS, IN THE PERI-URBAN AREA OF BÉNI MELLAL (MOROCCO)
Sara Qouissah Houda ELYacoubi Aboukhalaf Abdelghani Laila Bikjdaouene Oumaima Abouyaala Asmaa ELYamani Jamila Riyahi Atmane Rochdi	Ibn Tofail University	ANTIOXYDANT ACTIVITY AND ACUTE TOXICITY OF METHANOLIC EXTRACT OF LEMON VERBENA
Fatima Mourabiti FatimaZahra Jouga Yasmina Mouzoun Abdelaziz Soukri Bouchra El Khalfi	Hassan II University of Casablanca	INTEGRATED EPIDEMIOLOGICAL AND MOLECULAR ANALYSIS OF CARBAPENEM RESISTANCE AMONG CLINICAL ISOLATES
Keddar Fayza Boualem Malika Brada Moussa	University Hassiba Benbouali UniversityAbdelhamid Ibn Badis	PHYTOCHEMICAL PROFILING AND ASSESSMENT OF THE ANTIMICROBIAL ACTIVITY OF THE PHENOLIC EXTRACT FROM THE LEAVES OF URTICA DIOICA
Chowdhury, Bappy Saha, Anik Ghosh, Srikanta Sadekeen, Nafis Acharjee, Mahima Ranjan Datta, Narayan Tarin, Omme Johora Rahman, Ahmedur Haque, Mohammad Mozibul Ahmad, Monsur	Chattogram Veterinary and Animal Sciences University	FROM PAN TO PLATE: HOW TRADITIONAL COOKING METHODS ALTER ROHU FISH LIPID PROFILES AND HEALTH BENEFITS
Salma MAKDOUF Yasmine TABOUKTIRT Karima El Bouqdaoui Abdelhakim El Makssoudi Mounia Cherki	Hassan II University of Casablanca	COMPARATIVE STUDY OF THE PHYTOCHEMICAL COMPOSITION OF FUMARIA PARVIFLORA FROM THREE REGIONS OF MOROCCO

ONLINE PRESENTATIONS

03.11.2025 / Session-1, Hall-3

ANKARA LOCAL TIME | 10 00 : 12 00

ZOOM ID: 829 5595 6031 | **ZOOM PASSCODE: 080808**

HEAD OF SESSION: Shahjahan

AUTHORS	AFFILIATION	TOPIC TITLE
Nzennwa Rosemary Chiamaka Attah, Chidera Happiness	University of Nigeria	CHALLENGES FACED BY MARKETER IN MARKETING OF NON-TIMBER FOREST PRODUCTS: EVIDENCE FROM AFRICAN OIL BEAN SEED MARKETING
Tri Thong Truong Ngoc Canh Dao	Nam Can Tho University	DEVELOPING AGRICULTURAL TOURISM IN AN BINH WARD, CAN THO CITY, VIETNAM: A STAKEHOLDER PERSPECTIVE
Tri Thong Truong Van Do Nguyen Thanh Quoc Duong	Nam Can Tho University Kien Giang College	MOTIVATIONS FOR EXPERIENCING AGRICULTURAL TOURISM IN DA LAT: A PERSPECTIVE FROM GENERATION Z TOURISTS IN THE MEKONG DELTA REGION, VIETNAM
Tilottama Mondal Shahjahan	Bangladesh Agricultural University	COMBINED EFFECTS OF SUMITHION AND MERCURY ON HEMATOLOGY AND HISTOPATHOLOGY OF NILE TILAPIA WITH IMPLICATION FOR AQUACULTURE, AGRICULTURE AND ANIMAL HEALTH
Mir Ashrafia Ananna Shahjahan	Bangladesh Agricultural University	BIOREMEDIATION OF MERCURY-INDUCED GROWTH RETARDATION IN NILE TILAPIA (Oreochromis niloticus) USING DIETARY VITAMIN E AND SELENIUM
Valery V. Belakhov	Israel Institute of Technology	THE USING OF NON-MEDICAL ANTIFUNGAL ANTIBIOTICS TO PROTECT AGRICULTURAL PLANTS FROM DISEASES CAUSED BY FUNGAL PHYTOPATHOGENS
Hassna LEKNIZI Elyachioui Mohamed Brahim BOURKHISS	Université Ibn Tofail	BIOTECHNOLOGICAL VALORISATION OF SHRIMP WASTE: PHYSICOCHEMICAL AND MICROBIAL QUALITY
BENYAHOUB Rabie CHOUANA Toufik AZIB Salim	Kasdi Merbah University	UNLOCKING THE POTENTIAL OF QUINOA: NUTRITIONAL, TECHNOLOGICAL, AND AGRONOMIC INSIGHTS FOR ALGERIA

ONLINE PRESENTATIONS

03.11.2025 / Session-1, Hall-4

ANKARA LOCAL TIME | 10 00 : 12 00

ZOOM ID: 829 5595 6031 | **ZOOM PASSCODE: 080808**

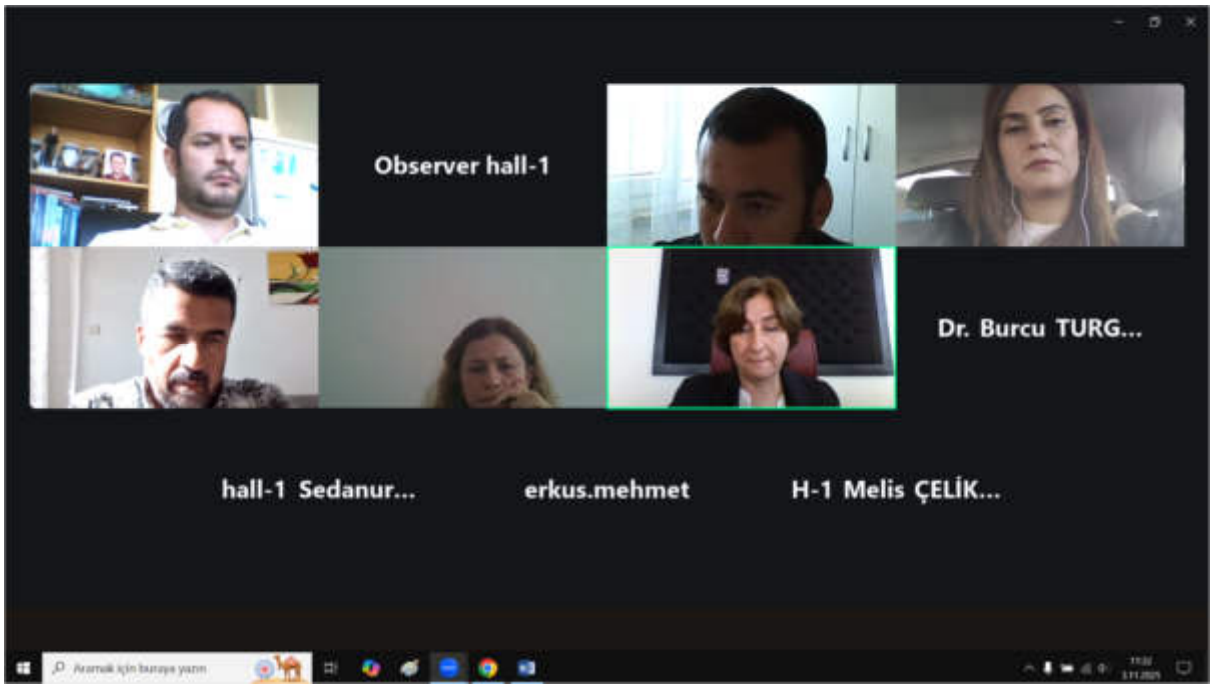
HEAD OF SESSION: Shaik Salma Asiya Begum

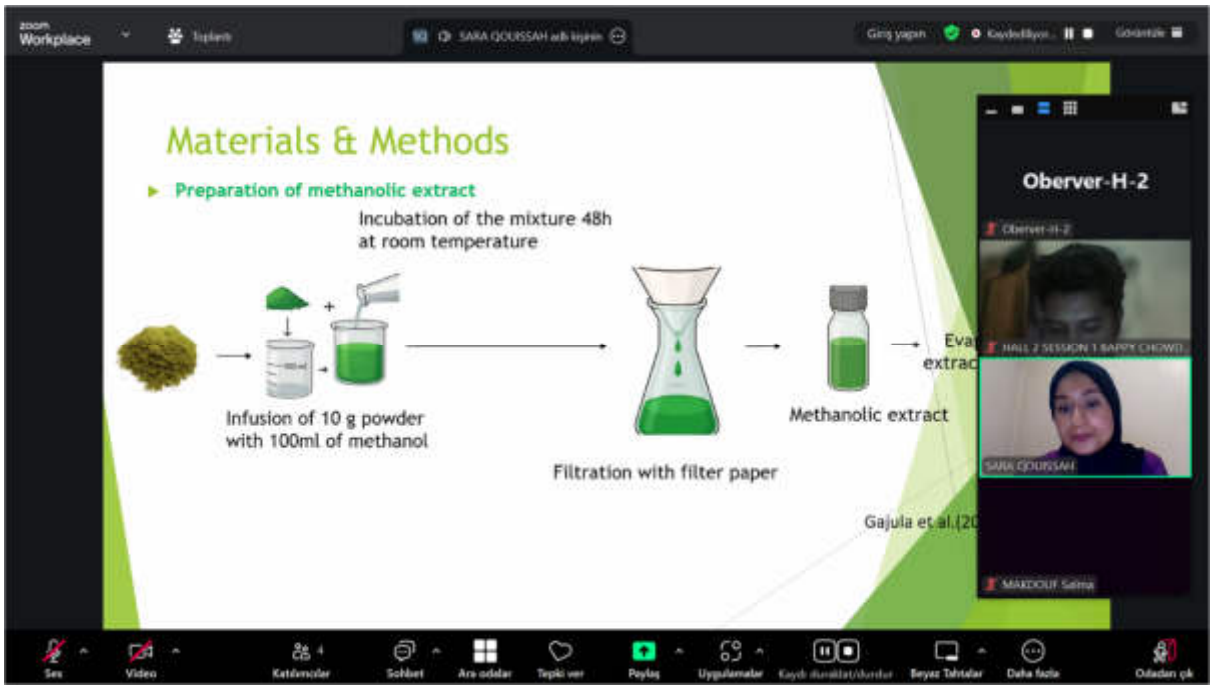
AUTHORS	AFFILIATION	TOPIC TITLE
OBINNA, AL MACHEBE, NS AMAEFULE, BC NWOGA, CC	University of Nigeria	SERUM BIOCHEMICAL RESPONSE OF RABBIT BUCKS ADMINISTERED MACA ROOT EXTRACT AND MUCUNA PRURIENS SEED EXTRACT
Shaik Salma Asiya Begum Shaik Tanveer Fathe Ahamed	Lakireddy Bali Reddy College of Engineering	A HYBRID IOT–AI FRAMEWORK FOR REAL-TIME CROP MONITORING AND PRECISION FARMING APPLICATIONS
Astha Bagjilewale	Vit Bhopal University	PREDICTIVE ANALYTICS FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY
Duong To Quoc Thai Nguyen Thanh Tuan	Dong Thap University	THE "LAND REFORM" POLICY OF THE REPUBLIC OF VIETNAM GOVERNMENT IN SOUTH VIETNAM (1955-1963)
Arie Febrianto Mulyadi Novia Trisna Rahmayanti, Sukardi	Universitas of Brawijaya	FORMULATION AND EVALUATION OF AN ANTIOXIDANT CLAY MASK CONTAINING AVOCADO LEAF (PERSEA AMERICANA MILL.) AND LEMON (CITRUS LIMON L.) EXTRACTS"
Mohamad Jafari	---	PHOSPHORUS IN SOIL, CHALLENGES AND MANAGEMENT SOLUTIONS FOR ITS CONSUMPTION
Salome Bezarashvili Lali Bakradze Ketevan Murjikneli N.Khunashvili Genadi Kverenchkhiladze	Tbilisi State Medical University	MICROPLASTIC POLLUTION: ENVIRONMENTAL CONSEQUENCES AND ECOLOGICAL DISRUPTIONS
Zubaidullayeva A.N.	Kazakh-Turkish University	EFFICIENCY OF GROWING SWEET SORGHUM (SORGHUM SACCHARATUM PERS.) IN THE TURKESTAN REGION
Anas Fellaki Mohamed Abourouh Houda ElYacoubi Asmaa ElYamani Atmane Rochdi	Ibn Tofail University	CULINARY AND MEDICINAL USES OF WILD TRUFFLES IN THE MAÂMORA FOREST, MOROCCO

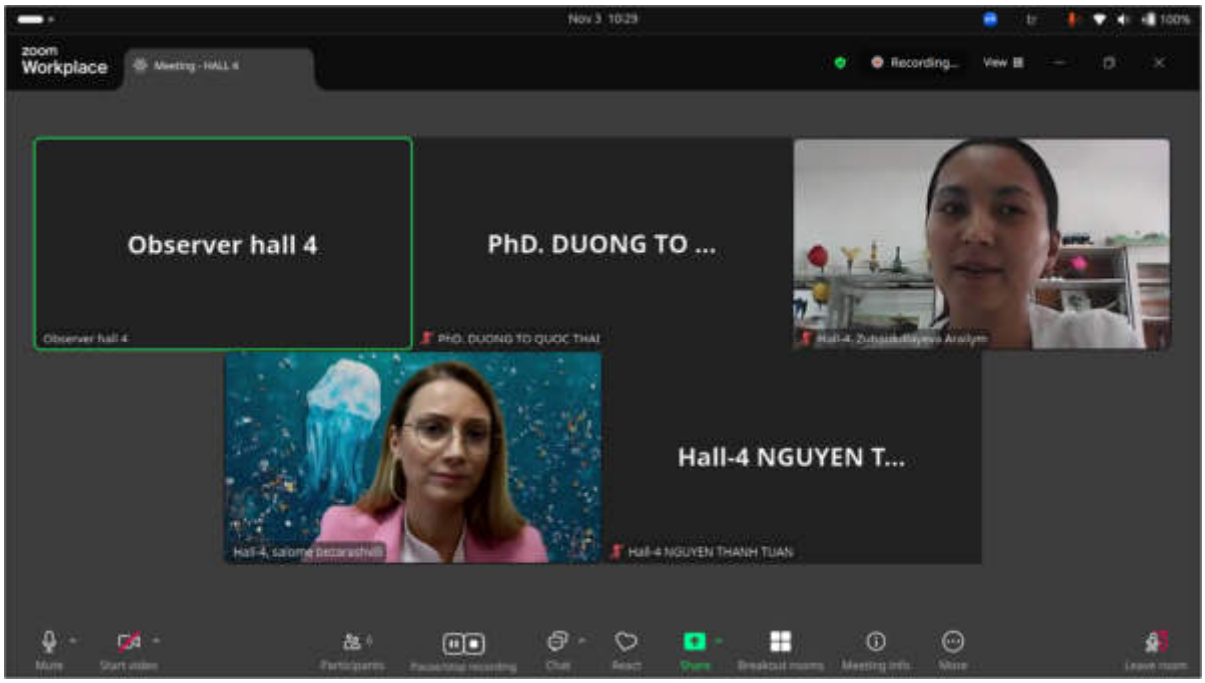
PHOTO GALLERY

ÇUKUROVA
ULUSLARARA TARIM VE TURİZM KONGRESİ

ADANA


Observer hall-1
Dr. Burcu TURG...
hall-1 Sedanur...
erkus.mehmet
H-1 Melis ÇELİK...


Materials & Methods
Preparation of methanolic extract
Incubation of the mixture 48h
at room temperature
Infusion of 10 g powder
with 100ml of methanol
Filtration with filter paper
Methanolic extract
Oberver-H-2


Observer hall 4
PhD. DUONG TO ...
Hall-4 NGUYEN T...

CONTENTS

AUTHORS	PRESENTATION TITLE	NO
Bıçkın TEMEL	EXAMPLE of YUMURTALIK HARVEST ROUTE WITHIN THE SCOPE of AGRICULTURAL TOURISM	1-2
Uğur KEKEÇ Burçak KAPUR	ADVANCES IN SENSOR-BASED AND INTELLIGENT IRRIGATION SCHEDULING: INTEGRATING SOIL, PLANT, AND CLIMATE DATA FOR PRECISION WATER MANAGEMENT	3-14
Uğur KEKEÇ Burçak KAPUR	INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE AND ADAPTATION STRATEGIES IN THE AGRICULTURAL SECTOR	15-23
Hülya SAYĞI	THE EFFECT OF CLIMATE CHANGE ON THE AGRICULTURAL PLANT PATTERN PRODUCED IN THE ÇUKUROVA REGION: THE EXAMPLE OF YUMURTALIK DISTRICT	24-31
Zehra Meliha TENGİZ Osman İNAN Sedanur ŞAHİN	THE HISTORY OF AGRICULTURAL CENSUSES AND RECOMMENDATIONS FOR INCREASING THEIR CONTRIBUTION TO AGRICULTURAL SUPPORT POLICIES	32-40
Zehra Meliha TENGİZ Mehmet ERKUŞ	ANALYSIS OF TURKEY'S COMPARATIVE ADVANTAGE IN OLIVE OIL FOREIGN TRADE WITH A FOCUS ON THE EUROPEAN UNION MARKET	41-42
Mesut ADA Hayat TOPÇU Salih KAFKAS	IDENTIFICATION OF QUANTITATIVE TRAIT LOCI (QTL) IN WALNUT: MOLECULAR APPROACHES IN BREEDING PROGRAMS	43-47
Mesut ADA Hayat TOPÇU Salih KAFKAS	MARKER-ASSISTED SELECTION IN WALNUT (JUGLANS REGIA L.) BREEDING: MOLECULAR MARKERS, QTL, AND GWAS APPLICATIONS	48-56

Sevinç DEMİR Emine Burcu TURGAY Merve Nur ERTAŞ ÖZ Reyhan BAHTİYARCA Sefa AYTEN	PREVALENCE OF FUNGAL PATHOGENS (ALTERNARIA BURNSII AND FUSARIUM OXYSPORUM F. SP. CUMINI) LIMITING CUMIN (CUMINUM CYMINUM L.) PRODUCTION IN THE CENTRAL ANATOLIA REGION OF TURKEY	57-67
Bekir ATAR	SPEED BREEDING METHOD APPLICATIONS IN WHEAT	68-69
Fatma YENİLMEZ	EFFECT OF LAVENDER ESSENTIAL OIL SCENT APPLIED DURING INCUBATION ON HATCHING CHARACTERISTICS	70-71
Ayşe DOLAR Erol ATAY Murat DAL	THE IMPACT OF CLIMATE CHANGE ON HISTORIC STONE STRUCTURES: THE CASE OF THE TRAJAN AQUEDUCTS	72-80
Murat DURMUŞ Melis ÇELIK GÜNEY	EFFECTS OF KID AGE, DAM AGE AND BIRTH TYPE ON TESTICULAR MEASUREMENT IN ALPINE KIDS	81-88
Djihane Romayssa MAHAMMED Nabila BELYAGOUBI-BEHNHAMMOU Asmaa DICH Larbi BELYAGOUBI Sarra BENAISSA Kamal BENMANSOUR Gabriele DI MARCO Alessia D'AGOSTINO Antonella CANINI Angelo GISMONDI	PLANT EXTRACT-BASED INTEGRATED DEVELOPMENT OF BIOACTIVE AND BIO-SENSITIVE FILMS FOR ACTIVE PACKAGING APPLICATIONS AND SUSTAINABLE DESIGN	89-90
SAGHOURI EL IDRISSI Imane KETTANI Rajae KHALFI Chemsdoha FERRAHI Moha BRHADDA Najiba	PLANT RESPONSES TO WATER STRESS REVEALED FROM SOIL MOISTURE DYNAMICS	91
Bouzekraoui Hicham Mouaddine Atika El Garnaoui Mohamed Hilali Abdessamad	PHYSICO-CHEMICAL AND BACTERIOLOGICAL QUALITY OF IRRIGATION WATER AND ITS IMPACT ON AGRICULTURAL SOILS, IN THE PERI-URBAN AREA OF BÉNI MELLAL (MOROCCO)	92

Sara Qouissah Houda ELYacoubi Aboukhalaf Abdelghani Laila Bikjdaouene Oumaima Abouyaala Asmaa ELYamani Jamila Riyahi Atmane Rochdi	ANTIOXYDANT ACTIVITY AND ACUTE TOXICITY OF METHANOLIC EXTRACT OF LEMON VERBENA	93-94
Fatima Mourabiti FatimaZahra Jouga Yasmina Mouzoun Abdelaziz Soukri Bouchra El Khalfi	INTEGRATED EPIDEMIOLOGICAL AND MOLECULAR ANALYSIS OF CARBAPENEM RESISTANCE AMONG CLINICAL ISOLATES	95
Keddar Fayza Boualem Malika Brada Moussa	PHYTOCHEMICAL PROFILING AND ASSESSMENT OF THE ANTIMICROBIAL ACTIVITY OF THE PHENOLIC EXTRACT FROM THE LEAVES OF URTICA DIOICA	96
Chowdhury, Bappy Saha, Anik Ghosh, Srikanta Sadekeen, Nafis Acharjee, Mahima Ranjan Datta, Narayan Tarin, Omme Johora Rahman, Ahmedur Haque, Mohammad Mozibul Ahmad, Monsur	FROM PAN TO PLATE: HOW TRADITIONAL COOKING METHODS ALTER ROHU FISH LIPID PROFILES AND HEALTH BENEFITS	97-98
Salma MAKDOUF Yasmine TABOUKTIRT Karima El Bouqdaoui Abdelhakim El Makssoudi Mounia Cherki	COMPARATIVE STUDY OF THE PHYTOCHEMICAL COMPOSITION OF FUMARIA PARVIFLORA FROM THREE REGIONS OF MOROCCO	99
Nzennwa Rosemary Chiamaka Attah, Chidera Happiness	CHALLENGES FACED BY MARKETER IN MARKETING OF NON-TIMBER FOREST PRODUCTS: EVIDENCE FROM AFRICAN OIL BEAN SEED MARKETING	100
Tri Thong Truong Ngoc Canh Dao	DEVELOPING AGRICULTURAL TOURISM IN AN BINH WARD, CAN THO CITY, VIETNAM: A STAKEHOLDER PERSPECTIVE	101-108
Tri Thong Truong Van Do Nguyen Thanh Quoc Duong	MOTIVATIONS FOR EXPERIENCING AGRICULTURAL TOURISM IN DA LAT: A PERSPECTIVE FROM GENERATION Z TOURISTS IN THE MEKONG DELTA REGION, VIETNAM	109-116

Tilottama Mondal Shahjahan	COMBINED EFFECTS OF SUMITHION AND MERCURY ON HEMATOLOGY AND HISTOPATHOLOGY OF NILE TILAPIA WITH IMPLICATION FOR AQUACULTURE, AGRICULTURE AND ANIMAL HEALTH	117
Mir Ashrafia Ananna Shahjahan	BIOREMEDIATION OF MERCURY-INDUCED GROWTH RETARDATION IN NILE TILAPIA (Oreochromis niloticus) USING DIETARY VITAMIN E AND SELENIUM	118
Valery V. Belakhov	THE USING OF NON-MEDICAL ANTIFUNGAL ANTIBIOTICS TO PROTECT AGRICULTURAL PLANTS FROM DISEASES CAUSED BY FUNGAL PHYTOPATHOGENS	119
Hassna LEKNIZI Elyachioui Mohamed Brahim BOURKHISS	BIOTECHNOLOGICAL VALORISATION OF SHRIMP WASTE: PHYSICOCHEMICAL AND MICROBIAL QUALITY	120
BENYAHOUB Rabie CHOUANA Toufik AZIB Salim	UNLOCKING THE POTENTIAL OF QUINOA: NUTRITIONAL, TECHNOLOGICAL, AND AGRONOMIC INSIGHTS FOR ALGERIA	121
OBINNA, AL MACHEBE, NS AMAEFULE, BC NWOGA, CC	SERUM BIOCHEMICAL RESPONSE OF RABBIT BUCKS ADMINISTERED MACA ROOT EXTRACT AND MUCUNA PRURIENS SEED EXTRACT	122
Shaik Salma Asiya Begum Shaik Tanveer Fathe Ahamed	A HYBRID IOT–AI FRAMEWORK FOR REAL-TIME CROP MONITORING AND PRECISION FARMING APPLICATIONS	123
Astha Bagjilewale	PREDICTIVE ANALYTICS FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY	124
Duong To Quoc Thai Nguyen Thanh Tuan	THE "LAND REFORM" POLICY OF THE REPUBLIC OF VIETNAM GOVERNMENT IN SOUTH VIETNAM (1955-1963)	125-135
Arie Febrianto Mulyadi Novia Trisna Rahmayanti, Sukardi	FORMULATION AND EVALUATION OF AN ANTIOXIDANT CLAY MASK CONTAINING AVOCADO LEAF (PERSEA AMERICANA MILL.) AND LEMON (CITRUS LIMON L.) EXTRACTS”	136

Mohamad Jafari	PHOSPHORUS IN SOIL, CHALLENGES AND MANAGEMENT SOLUTIONS FOR ITS CONSUMPTION	137
Salome Bezarashvili Lali Bakradze Ketevan Murjikneli N.Khunashvili Genadi Kverenchkhiladze	MICROPLASTIC POLLUTION: ENVIRONMENTAL CONSEQUENCES AND ECOLOGICAL DISRUPTIONS	138-141
Zubaidullayeva A.N.	EFFICIENCY OF GROWING SWEET SORGHUM (SORGHUM SACCHARATUM PERS.) IN THE TURKESTAN REGION	142-146
Anas Fellaki Mohamed Abourouh Houda ElYacoubi Asmaa ElYamani Atmane Rochdi	CULINARY AND MEDICINAL USES OF WILD TRUFFLES IN THE MAÂMORA FOREST, MOROCCO	147

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

TARIM TURİZMİ KAPSAMINDA YUMURTALIK HASAT ROTASI ÖRNEĞİ

Dr. Bıçkın TEMEL
Çukurova Üniversitesi Turizm İşletmeceiliği Bölümü
ORCID: 0000-0002-9334-9361

ÖZET

Alternatif turizm türleri, kitle turizminin çevresel ve sosyo kültürel baskılarından kaçınmak isteyen turistleri kırsal deneyimlere yönlendirmektedir. Araştırmalar, agro turizmin sürdürülebilir kırsal kalkınma için yeni gelir fırsatları sağladığını ve yerel toplulukların yaşam kalitesini artırdığını göstermektedir. Menemen ve Muğla örnekleri, yerel halkın katılımının zayıf olduğu durumlarda agro turizm projelerinin kısıtlı kaldığını, güçlü iş birliklerinin ise başarıyı artırdığını vurgular. SWOT analizleri, tarımsal çeşitlilik ve jeotermal kaynaklar gibi güçlü yönlerin yanında tesis eksikliği ve tanıtım sorunlarının geliştirilmeye muhtaç alanlar olduğunu ortaya koyar. Türkiye bağcılık bölgelerinin tarım turizmine katkısı ise bağ bozumu ve şarap tadım festivalleriyle zenginleştirilmiştir.

Yumurtalık, tarım ürünleri, antik liman kaleleri ve lagünleri ile kültür ve doğa turizmine ev sahipliği yapar. Şimşek'in "Hasat Rotaları" çalışmasına göre, hasat temelli turlar yerel ürün tanıtımını güçlendirirken kırsal marka değerini artırmaktadır. Bu doğrultuda Yumurtalık ilçesinin agro turizm potansiyelini tespit etmek ve "Yumurtalık Hasat Rotası", oluşturmada güçlü ve zayıf yönlerinin ortaya konularak hasattan sofraya bir rota oluşturulması amaçlanmıştır. Çalışmada nitel araştırmalarda sık kullanılan durum çalışması benimsenmiş olup iki temel araştırma sorusu geliştirilmiştir. Verilerin toplanmasında doküman incelemesinden faydalanalırken, analiz kısmında ise içerik analizi kullanılmıştır. "Yumurtalık Hasat Rotası" SWOT Analizi yapılarak güçlü ve zayıf yönleri, iç ve dış çevreden kaynalanan tehtit ve fırsatlar değerlendirilmiştir. Bulgulara göre agro turizm temelli hasat rotası oluşturulmasının yerel kalkınmayı desteklediği, ekonomik katkı sağladığı ve uygun yönetişim yönetimiyle sürdürülebilir biçimde uygulanabileceği sonuçlarına ulaşılmıştır. Bu rota özelinde doğa ve kültür birikimi açısından zengin bir ekosisteme sahip olması en güçlü yönünü oluştururken, tanıtım ve marka yönetiminde geri kalması ilçenin zayıf tarafını göstermektedir. Mavi bayraklı plaja sahip olmasının yanında, doğal zenginlikleri içerisinde barındırması bir fırsat olarak öne çıkarken, kalabalıklaşmaya bağlı çevre kirliliği ve tahribatı doğal yaşam için bir tehtit unsuru oluşturmaktadır. Sonuç olarak Yumurtalık Hasat Rotası, yöre açısından kırsal kalkınma ve sürdürülebilir turizm bilincisinin arttırılmasına olanak tanıyacaktır.

Anahtar Kelimeler: Agro-turizm; Kırsal kalkınma; Sürdürülebilir turizm; Yumurtalık Hasat Rotası; Yerel ürünler.

EXAMPLE of YUMURTALIK HARVEST ROUTE WITHIN THE SCOPE of AGRICULTURAL TOURISM

ABSTRACT

Alternative tourism types are directing tourists seeking to escape the environmental and sociocultural pressures of mass tourism toward rural experiences. Research shows that agrotourism provides new income opportunities for sustainable rural development and improves the quality of life of local communities. The examples of Menemen and Muğla highlight that agrotourism projects remain limited when local participation is weak, while strong collaborations increase their success.

SWOT analyses reveal that, despite strengths such as agricultural diversity and geothermal resources, a lack of facilities and promotional challenges are areas in need of development. The contribution of Turkey's viticulture regions to agrotourism is enriched by grape harvest and wine tasting festivals.

Yumurtalık, with its agricultural products, ancient harbor castles, and lagoons, hosts cultural and nature tourism. According to Şimşek's "Harvest Routes" study, harvest-based tours strengthen the promotion of local products and increase rural brand value. In this context, the aim was to identify the agrotourism potential of the Yumurtalık district and to create a "Yumurtalık Harvest Route" by identifying its strengths and weaknesses, creating a route from harvest to table. The study adopted a case study, frequently used in qualitative research, and developed two primary research questions. Document review was used for data collection, while content analysis was employed for analysis. A SWOT analysis of the Yumurtalık Harvest Route was conducted to assess its strengths and weaknesses, as well as threats and opportunities arising from the internal and external environments. The findings concluded that creating an agrotourism-based harvest route supports local development, contributes to the economy, and can be implemented sustainably with appropriate governance. While the district's strength lies in its rich ecosystem, particularly in terms of natural and cultural heritage, its lag in promotion and brand management represents its weakness. While its Blue Flag beach and natural riches are an advantage, environmental pollution and damage due to overcrowding pose a threat to wildlife. Ultimately, the Yumurtalık Harvest Route will facilitate rural development and raise awareness of sustainable tourism in the region.

Keywords: Agrotourism; Rural development; Sustainable tourism; Yumurtalık Harvest Route; Local products.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

ADVANCES IN SENSOR-BASED AND INTELLIGENT IRRIGATION SCHEDULING: INTEGRATING SOIL, PLANT, AND CLIMATE DATA FOR PRECISION WATER MANAGEMENT

Uğur KEKEÇ
University of Cukurova, Yumurtalık Vocational School, Department of Plant and Animal Production
ORCID: 0000-0003-1321-9135

Burçak KAPUR
University of Cukurova, Faculty of Agriculture, Department of Agricultural Structures and Irrigation
ORCID: 0000-0001-6131-4458

ABSTRACT
Water scarcity and the demand for higher crop productivity have accelerated the evolution of irrigation scheduling from empirical routines to intelligent, data-driven systems. This review synthesizes recent progress in sensor-based and automated irrigation scheduling across eleven key studies. Traditional evapotranspiration (ET) and water-balance models remain fundamental but are increasingly enhanced by real-time soil and plant sensing technologies. Capacitance, tensiometric, and dielectric soil-moisture sensors combined with wireless sensor networks (WSN) and Internet-of-Things (IoT) platforms enable continuous field monitoring and adaptive irrigation control. Integration of these sensors with model-based or fuzzy-logic algorithms allows closed-loop regulation that dynamically adjusts irrigation depth and timing according to crop stage and micro-climate variability. Applications in orchards, vegetable systems, and arid-region field crops demonstrate water savings of 30-50 % and yield maintenance or improvement compared with conventional scheduling. Site-specific calibration and hybrid ET sensor approaches are emphasized as critical for accuracy. Emerging trends include machine-learning-based decision support, cloud-connected mobile interfaces, and the convergence of remote sensing (NDVI, UAV imagery) with ground sensors. Collectively, these advances mark a transition toward autonomous, precise, and resource-efficient irrigation management, positioning sensor-integrated systems as essential tools for sustainable agriculture under climate-change pressures.
Keywords: Precision irrigation, Sensor-based irrigation, Soil moisture sensors, IoT and wireless networks, Water use efficiency

1. INTRODUCTION
Global agriculture faces mounting pressure to produce more food with less water under intensifying climate change and resource constraints. Irrigation, which accounts for nearly 70% of global freshwater withdrawals, remains a critical determinant of agricultural productivity and sustainability (FAO, 2001). However, traditional irrigation scheduling methods often based on fixed intervals or empirical estimations fail to address the spatiotemporal variability of soil and crop water status, resulting in water waste, nutrient leaching, and reduced water-use efficiency (Walker, 1989; Miyamoto, 1983).
Over the past two decades, irrigation science has undergone a paradigm shift from conventional evapotranspiration (ET)-based approaches to sensor-integrated, data-driven scheduling systems. These systems aim to determine both when and how much to irrigate by incorporating feedback from the soil plant atmosphere continuum (Gu et al., 2020).

The four dominant methods of irrigation scheduling include: (1) ET and water balance (ET-WB) approaches, (2) soil moisture–based control, (3) plant-based measurements, and (4) model- or algorithm-driven systems. While ET-WB models (e.g., FAO-56 Penman Monteith) provide robust theoretical foundations (Allen et al., 1998), their precision depends heavily on local calibration of crop coefficients and climatic inputs (Cahn & Johnson, 2017).

Recent developments in sensor technology, wireless sensor networks (WSN), and Internet-of-Things (IoT) platforms have revolutionized irrigation management. Studies in various agroecosystems from olives (Millán et al., 2020) and apples (Domínguez-Niño et al., 2020) to vegetables (Cahn & Johnson, 2017) demonstrate that integrating capacitance-type soil moisture sensors with automated controllers can reduce water use by 30–50% without yield penalties. Low-cost sensors such as ECH$_2$O-5TE and Watermark devices have been widely tested, though their accuracy often requires site-specific calibration (Ganjegunte et al., 2012; Datta & Taghvaeian, 2023).

Furthermore, intelligent control algorithms, including fuzzy logic and AI-based decision-support tools, have shown promise in enabling adaptive irrigation under variable field conditions (Jamroen et al., 2020; Roy et al., 2021). These systems dynamically integrate multiple data streams soil moisture, canopy temperature, NDVI, and local meteorological data to optimize irrigation timing and depth. The growing fusion of remote sensing, IoT telemetry, and cloud analytics suggests a near-future landscape of autonomous irrigation systems capable of real-time learning and self-correction (Sui, 2018; Vellidis et al., 2008).

Overall, sensor-based and intelligent irrigation scheduling offers a pathway toward climate-smart and resource-efficient agriculture, aligning technological innovation with global sustainability goals. The following sections of this review will explore the theoretical foundations, sensor technologies, intelligent frameworks, and field-level applications that underpin this transition.

2. FUNDAMENTALS OF IRRIGATION SCHEDULING

Efficient irrigation scheduling aims to determine the optimal timing and amount of water required to sustain crop growth and maximize water-use efficiency (WUE). The basic principle is to maintain soil moisture within an optimal range between field capacity and the permanent wilting point, ensuring that the crop experiences neither water stress nor excessive saturation (Allen et al., 1998). Historically, irrigation scheduling has evolved through three major approaches: climate-based (ET-WB), soil-based, and plant-based methods (Gu et al., 2020).

2.1. Evapotranspiration and Water-Balance Approach

The ET-WB method forms the cornerstone of modern irrigation science. It estimates crop evapotranspiration (ETc) as the product of the reference evapotranspiration (ETo) and a crop coefficient (Kc) derived empirically or through field calibration (Allen et al., 1998). Daily soil water deficit is then tracked using a simplified water-balance model that considers rainfall, irrigation, percolation, and runoff. This method is widely used for both research and practical irrigation scheduling across field and orchard crops (Cahn & Johnson, 2017; Domínguez-Niño et al., 2020).

However, ET-based scheduling relies heavily on accurate meteorological data and region-specific crop coefficients. Spatial variability in soil texture, topography, and canopy structure can lead to significant deviations between modeled and actual crop water use (Doorenbos & Pruitt, 1977; Gu et al., 2020).

Furthermore, in regions with heterogeneous microclimates—such as Mediterranean or semi-arid systems ETc estimates often require real-time adjustments or integration with sensor feedback (Millán et al., 2020; Roy et al., 2021).

2.2. Soil Moisture–Based Scheduling

The soil-based approach measures the actual water status of the root zone, providing direct feedback on the plant's available water supply. Common sensing technologies include tensiometers, gypsum blocks, capacitance and frequency-domain reflectometry (FDR) probes, and time-domain reflectometry (TDR) systems (Evett et al., 2012; Ganjegunte et al., 2012). These devices enable continuous monitoring of volumetric soil water content (θ) or matric potential (ψ), which can be translated into irrigation thresholds.

Despite their practicality, soil sensors exhibit measurement bias depending on soil salinity, temperature, and installation depth. Studies in pecan orchards and cotton systems have shown that uncalibrated sensors can over- or underestimate soil water by up to 20% (Sui, 2018; Ganjegunte et al., 2012). Therefore, site-specific calibration remains critical for accurate irrigation decisions. The recent generation of low-cost wireless sensors and data loggers, integrated with wireless sensor networks (WSN), has addressed some of these challenges by improving spatial resolution and real-time communication (Vellidis et al., 2008; Datta & Taghvaeian, 2023).

2.3. Plant-Based and Integrated Measurements

Plant-based methods assess crop water status directly, using physiological or biophysical indicators such as leaf water potential, stomatal conductance, stem diameter variation, or canopy temperature. Among these, the Crop Water Stress Index (CWSI) derived from thermal infrared imaging is widely applied for continuous stress detection (Idso et al., 1981). Integration of canopy temperature with environmental variables like vapor pressure deficit (VPD) enables real-time diagnosis of water stress (Jamroen et al., 2020).

Although plant-based sensing provides the most biologically relevant measure of crop water status, it is often limited by the cost and complexity of instrumentation. For this reason, recent studies have focused on hybrid systems that combine ET-WB models, soil sensors, and plant stress indicators to form closed-loop control frameworks (Domínguez-Niño et al., 2020; Roy et al., 2021). These hybrid models balance predictive capacity (from ET-WB) with empirical feedback (from sensors), offering robust solutions under field variability.

2.4. Limitations and Transition to Smart Irrigation

Traditional scheduling methods are often limited by static thresholds and lack of real-time adaptability. As illustrated in Figure 1, modern sensor-based irrigation systems integrate soil moisture, plant, and weather data through IoT-enabled platforms, allowing autonomous and optimized water management decisions. Variations in soil hydraulic properties, root distribution, and microclimate reduce the reliability of one-size-fits-all thresholds. As a result, the focus of modern irrigation research has shifted toward intelligent decision-support systems capable of adapting to dynamic field conditions. These systems use IoT connectivity, machine learning, and real-time sensor data to continuously update irrigation decisions, thus bridging the gap between theory and on-farm practice (Gu et al., 2020; Roy et al., 2021; Jamroen et al., 2020).

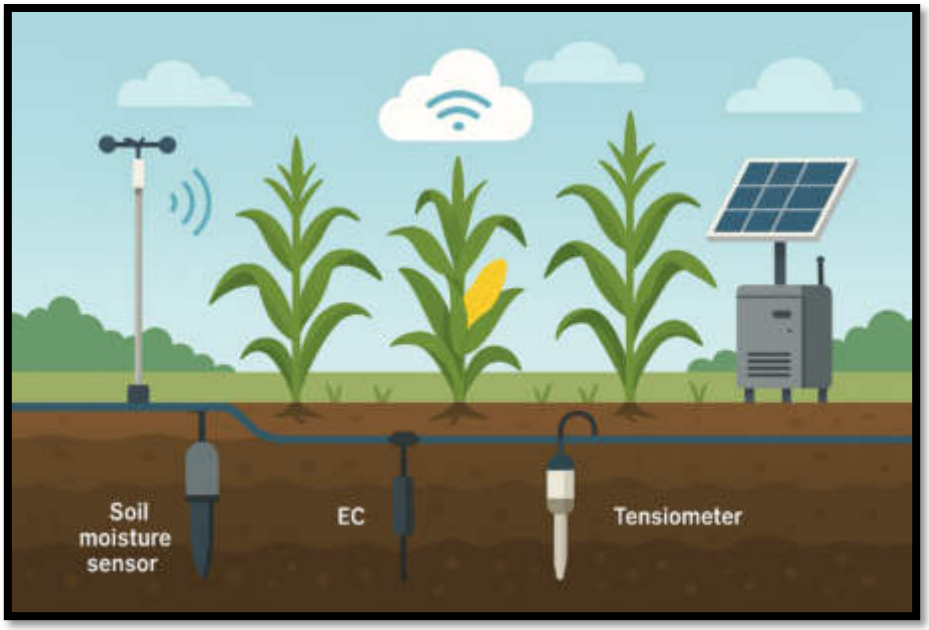


Figure 1. Smart Sensor-Based Irrigation System (Field Crops)

3. SENSOR-BASED IRRIGATION TECHNOLOGIES

3.1. Overview of Sensor-Based Systems

Sensor-based irrigation technologies represent a major step toward precision agriculture, allowing the continuous measurement of soil, plant, and atmospheric parameters that influence water availability and crop performance. These technologies provide real-time feedback to automated irrigation controllers, enabling site-specific management of water resources (Gu et al., 2020; Sui, 2018). The key advantage of sensor-based systems is their ability to close the loop between water demand estimation and field application, thus achieving high water-use efficiency (WUE) and minimizing environmental losses.

3.2. Soil Moisture Sensor Technologies

The most widely adopted sensors for irrigation scheduling are those that measure soil water content (θ) or matric potential (ψ) in the crop root zone. These include tensiometers, resistance blocks (e.g., Watermark), and electromagnetic sensors such as time-domain reflectometry (TDR), frequency-domain reflectometry (FDR), and capacitance probes (Evett et al., 2012; Ganjegunte et al., 2012; Datta & Taghvaeian, 2023).

- Tensiometers provide direct readings of soil water potential but are limited to wet soil conditions (<-80 kPa).
- Gypsum and granular matrix sensors (e.g., Watermark 200SS) are inexpensive but sensitive to temperature and salinity (Ganjegunte et al., 2012).
- Capacitance and TDR/FDR sensors estimate soil water content based on the dielectric permittivity of the soil, allowing continuous logging at multiple depths. However, these sensors often require site-specific calibration, as signal interpretation can vary with soil texture, bulk density, and salinity (Datta & Taghvaeian, 2023).

A comparative analysis by Gu et al. (2020) and Sui (2018) showed that although these sensors accurately capture temporal soil moisture dynamics, their absolute accuracy can deviate up to ±5% volumetric water content if factory calibration is used. Hence, field calibration and depth-specific placement are crucial to align sensor outputs with the effective root zone.

3.3. Plant and Canopy Sensors

Plant-based sensors provide a biological measure of water stress, complementing soil measurements. The Crop Water Stress Index (CWSI) derived from canopy temperature (Idso et al., 1981) has been implemented in several automated systems (Jamroen et al., 2020; Millán et al., 2020). Thermal infrared sensors or UAV-mounted cameras can monitor canopy temperature across large fields, while dendrometers record stem diameter fluctuations linked to plant water status.

Recent advances in fuzzy logic algorithms have enabled real-time interpretation of multiple sensor inputs (canopy temperature, humidity, solar radiation, and soil moisture). Jamroen et al. (2020) demonstrated that a fuzzy-based irrigation system reduced water use by 59% and energy consumption by 67% while improving yield by over 20%. Such systems are particularly promising for integrating physiological feedback with environmental sensing.

3.4. Wireless Sensor Networks (WSN) and IoT Integration

The introduction of wireless sensor networks (WSN) and Internet of Things (IoT) has transformed the scalability and practicality of sensor-based irrigation. Early systems like the smart sensor array designed by Vellidis et al. (2008) utilized low-power RFID communication between nodes and a central receiver to collect temperature and soil moisture data in cotton fields. Building on this foundation, modern IoT architectures such as AgriSens (Roy et al., 2021) combine distributed sensors, cloud analytics, and mobile applications, allowing farmers to monitor and control irrigation remotely in real time.

These IoT-enabled systems integrate machine learning algorithms, cloud-based dashboards, and decision-support modules to automatically adjust irrigation depth and timing according to crop growth stage, climatic variability, and soil heterogeneity. Their reliability and cost-effectiveness make them suitable for both large-scale commercial farms and smaller operations in water-scarce regions.

3.5. Calibration, Data Management, and Limitations

Despite technological progress, several challenges persist.

- Calibration and standardization: Sensor readings vary across soil types and must be recalibrated under changing salinity and temperature conditions (Evett et al., 2012; Ganjegunte et al., 2012).
- Data overload and communication reliability: Large IoT networks generate high-frequency data streams that require robust cloud infrastructures and cybersecurity (Roy et al., 2021).
- Economic feasibility: Although sensor costs are decreasing, maintenance and system integration remain barriers for smallholders.

Nonetheless, hybrid frameworks that combine ET-WB models, soil and canopy sensors, and IoT-driven automation are emerging as the most effective pathway for sustainable irrigation (Domínguez-Niño et al., 2020; Millán et al., 2020). These systems transform raw sensor data into actionable irrigation decisions, bridging the gap between research innovation and farm-level application.

4. INTELLIGENT AND IOT-DRIVEN SCHEDULING SYSTEMS

4.1. Evolution toward Smart Irrigation

The integration of information and communication technologies (ICT) with irrigation scheduling has led to a new generation of intelligent, self-regulating systems. These systems synthesize data from soil and plant sensors, meteorological stations, and remote-sensing platforms to optimize irrigation in real time (Roy et al., 2021; Jamroen et al., 2020). Unlike traditional open-loop control that depends solely on predefined thresholds or ET models, intelligent irrigation systems operate as closed-loop frameworks, automatically adjusting irrigation frequency and volume based on sensor feedback and predictive analytics.

4.2. Internet of Things (IoT) and Cloud-Based Control

The Internet of Things (IoT) enables seamless communication among distributed sensors, controllers, and cloud servers. Modern IoT-driven irrigation systems collect high-frequency data on soil moisture, canopy temperature, and environmental conditions through wireless sensor networks (WSN) and transmit these data to cloud-based decision modules (Vellidis et al., 2008; Millán et al., 2020).

A prominent example is AgriSens, developed by Roy et al. (2021), which integrates multi-node sensors with cloud analytics for dynamic irrigation scheduling. AgriSens allows both automatic and remote manual operation modes, supporting multiple crop types with variable water needs. Field trials demonstrated that the system improved crop productivity by more than 10 %, extended network lifetime 2.5 times, and maintained a 94 % communication reliability even after 500 h of operation.

Similarly, Domínguez-Niño et al. (2020) applied a web-based application (IRRIX) that autonomously scheduled irrigation in apple orchards using a water-balance algorithm refined by capacitance soil-moisture sensors. The algorithm achieved water savings of 40-46 % without compromising yield, outperforming manual scheduling.

4.3. Fuzzy Logic and Artificial Intelligence (AI) Algorithms

To handle nonlinear relationships between environmental variables and plant responses, several researchers have implemented fuzzy logic controllers and machine-learning algorithms in irrigation systems (Jamroen et al., 2020; Roy et al., 2021).

The fuzzy logic system introduced by Jamroen et al. (2020) used canopy temperature, vapor pressure deficit (VPD), solar radiation, and soil moisture as inputs to calculate a crop water stress index (CWSI). The system adaptively triggered irrigation only when plants exhibited measurable stress, resulting in 59 % water and 67 % energy savings, while increasing yield by 22 %.

AI-enhanced models, particularly those employing artificial neural networks (ANN) and random forest regression, have been explored for predicting short-term soil moisture trends and ET fluctuations (Datta & Taghvaeian, 2023). These predictive algorithms enable proactive irrigation planning rather than reactive control, significantly improving decision accuracy under variable field conditions.

4.4. Decision-Support Systems (DSS) and Data Fusion

Decision-support systems (DSS) represent a higher level of irrigation intelligence by integrating multiple data sources sensors, satellite imagery, and historical weather datasets into a unified analytical framework. For instance, the IRRIX and AgriSens platforms merge local sensor data with meteorological forecasts to refine irrigation recommendations (Roy et al., 2021; Domínguez-Niño et al., 2020).

Remote sensing tools such as NDVI (Normalized Difference Vegetation Index) and UAV imagery provide spatial information on crop vigor and canopy development, which can be correlated with ground-based moisture data (Cahn & Johnson, 2017). Combining these technologies allows for precision zone management, where irrigation is spatially differentiated based on crop stress patterns rather than uniform field averages.
Cloud computing and IoT dashboards have also improved the user accessibility of these systems, allowing farmers to visualize soil-moisture trends and irrigation performance through smartphones or web interfaces in real time (Roy et al., 2021).

4.5. Advantages and Challenges

Intelligent IoT-driven systems offer several advantages:

- High water and energy efficiency through data-driven optimization;
- Scalability and automation with minimal labor demand;
- Adaptability to diverse crops and climatic regions.

However, challenges persist. Reliable connectivity, standardization of communication protocols, cybersecurity, and data privacy are crucial concerns (Datta & Taghvaeian, 2023). Moreover, the implementation cost and technical complexity still limit adoption in smallholder farms. Future research must focus on low-cost, open-source IoT solutions and machine-learning models that require minimal calibration, ensuring equitable access to smart irrigation technologies worldwide.

5. APPLICATIONS AND CASE STUDIES

5.1. Orchard Crops: Automated and Deficit Irrigation

Sensor-based irrigation scheduling has achieved remarkable success in orchard systems, where water management directly affects fruit size, quality, and canopy vigor. In Mediterranean environments, Millán et al. (2020) implemented an automatic irrigation algorithm in hedgerow olive orchards using soil moisture sensors integrated into a water-balance model. The algorithm adjusted irrigation volumes daily based on capacitance probe feedback, achieving average water savings of 35-45% compared with the traditional farmer's schedule. Fruit yield and oil quality were maintained, confirming that regulated deficit irrigation (RDI) can be effectively automated when guided by real-time soil data.
Similarly, Domínguez-Niño et al. (2020) applied an automated IRRIX system in apple orchards, which scheduled irrigation dynamically using the FAO-56 water-balance approach refined by sensor feedback. Two irrigation sectors with different canopy vigor were managed separately. The system successfully matched the evapotranspiration (ET) measured by lysimeters and reduced applied water by 40-46% relative to conventional management, demonstrating the power of site-specific irrigation.
Such orchard-level experiments validate the integration of ET–WB models and capacitance sensors as a robust basis for autonomous irrigation, particularly under heterogeneous soil or canopy conditions.

5.2. Row and Field Crops: Cotton, Vegetables, and Cereals

In annual cropping systems, where temporal variability in soil moisture is high, sensor-based irrigation systems have also proved effective. Vellidis et al. (2008) developed one of the earliest wireless sensor networks (WSN) for irrigation in cotton fields in Georgia (USA). Their system, comprising multiple soil moisture and temperature nodes, transmitted data via RFID tags to a central receiver. The technology enabled precise irrigation scheduling in variable soil zones at a relatively low system cost (≈ USD 2400 for 20 nodes).

In vegetable systems, Cahn and Johnson (2017) combined remote sensing, soil moisture sensors, and evapotranspiration models to optimize irrigation timing in lettuce and processing tomato production. The results showed that sensor-based scheduling reduced water use by 30-50% while maintaining or improving yield quality parameters such as firmness and soluble solids.

Sui (2018) similarly validated soil-moisture-based irrigation scheduling in corn and soybean production, emphasizing that simple capacitance probes, when properly calibrated, can outperform fixed-schedule irrigation in both water-use efficiency and yield stability. These studies underline the versatility of sensor-based systems across crop types, from vegetables to field crops.

5.3. IoT and Intelligent Systems in Diverse Agroecosystems

Recent advances in IoT-enabled irrigation have expanded the applicability of precision irrigation beyond high-value crops. The AgriSens system developed by Roy et al. (2021) in India incorporated multiple low-cost water-level and soil sensors, controlled via a farmer-friendly mobile interface. Field experiments demonstrated a 10% yield improvement and a 2.5× longer system lifetime compared with existing wireless systems, while achieving a 94% reliability rate under variable climatic conditions.

In Thailand, Jamroen et al. (2020) designed a fuzzy-logic-driven irrigation control system using wireless sensor networks to assess soil and canopy water status. The system simultaneously considered crop water stress index (CWSI), solar radiation, and vapor pressure deficit, leading to 59.6% less water use, 67.3% lower energy consumption, and 22.6% higher crop yield than conventional irrigation. This represents one of the most comprehensive demonstrations of AI-assisted irrigation control in tropical climates.

5.4. Synthesis of Results

Across all reviewed applications, certain consistent patterns emerge. As shown in Figure 2, field implementations consistently reported water savings of 30–60%, while maintaining or improving yields across diverse crops (Vellidis et al., 2008; Domínguez-Niño et al., 2020;Jamroen et al., 2020).

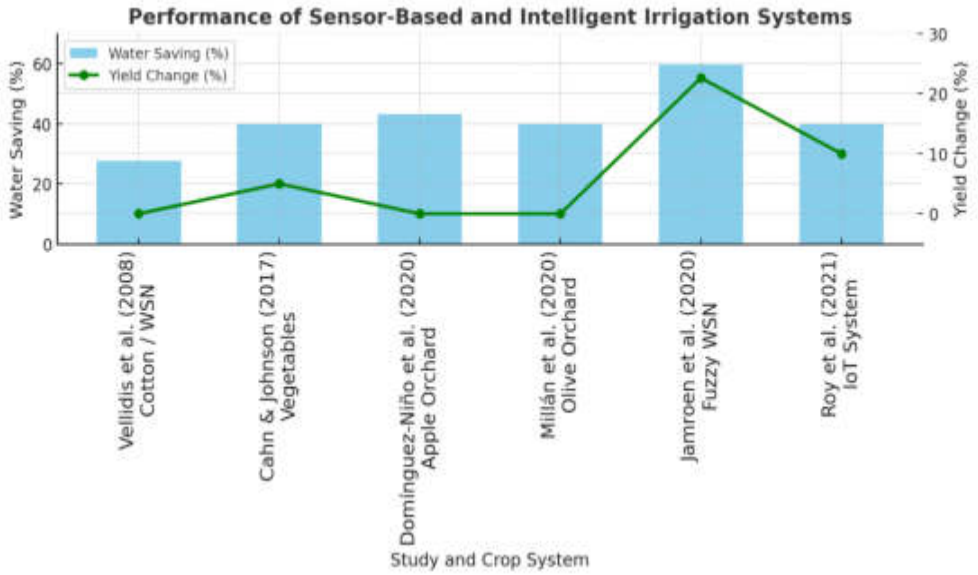


Figure 2. Performance of sensor-based and intelligent irrigation systems showing comparative water saving (%) and yield change (%) across studies.

- Water savings: Typically ranged from 30% to 60%, depending on crop type and system design (Domínguez-Niño et al., 2020; Jamroen et al., 2020; Millán et al., 2020).
- Yield effects: Most systems maintained or improved yield and fruit quality; no significant yield loss was reported under automated deficit irrigation.
- Energy efficiency: IoT and fuzzy-logic systems reduced pumping energy by up to 67% (Jamroen et al., 2020).
- Scalability and cost: Low-cost WSN and IoT frameworks (e.g., AgriSens, Vellidis et al., 2008) demonstrated economic feasibility for small and medium-scale farms.

These findings collectively indicate that sensor-based and intelligent irrigation systems are not only technologically feasible but also economically viable under real field conditions. Their adaptability to diverse crops, climates, and irrigation methods (drip, sprinkler, surface) makes them essential components of climate-resilient agriculture.

6. CHALLENGES AND FUTURE DIRECTIONS

6.1. Calibration and Data Reliability

One of the most persistent challenges in sensor-based irrigation systems is the accuracy and reliability of field measurements. Soil moisture sensors especially capacitance and frequency domain types exhibit site-specific variability due to differences in soil texture, temperature, and salinity (Datta & Taghvaeian, 2023; Evett et al., 2012). Factory calibrations rarely suffice under heterogeneous field conditions, often resulting in errors of ±5-10% in volumetric soil water content. This variability can propagate through decision algorithms, leading to either under- or over-irrigation.

To improve data reliability, multi-depth calibration procedures and sensor fusion approaches have been proposed. For instance, combining soil sensors with meteorological and canopy-based indicators (e.g., CWSI) enhances robustness under fluctuating conditions (Jamroen et al., 2020; Domínguez-Niño et al., 2020). Future systems must incorporate self-calibrating algorithms or machine-learning-based correction models capable of adapting to soil and crop dynamics automatically.

6.2. Connectivity, Energy, and Cyberinfrastructure

Wireless sensor networks (WSN) and IoT platforms depend on stable connectivity and energy-efficient communication protocols. In remote or large-scale agricultural landscapes, signal loss and power failure remain critical obstacles (Roy et al., 2021; Vellidis et al., 2008). Low-power wide-area network (LPWAN) technologies such as LoRaWAN and NB-IoT are being increasingly adopted to extend communication range while minimizing energy use. However, these systems require robust data encryption and cloud management to prevent data loss or cyber vulnerabilities in automated irrigation networks (Datta & Taghvaeian, 2023).

A growing research trend is the deployment of solar-powered sensor nodes and edge-computing frameworks, where basic data processing occurs locally at the node level, reducing transmission load and enabling near-real-time decision-making.

6.3. Economic and Operational Barriers

Although low-cost sensor options and open-source IoT platforms (e.g., Arduino, Raspberry Pi) have increased accessibility, economic and technical barriers still restrict large-scale adoption, especially among smallholder farmers. System costs, maintenance requirements, and the need for technical expertise often deter end-users (Gu et al., 2020; Ganjegunte et al., 2012).

To overcome this, extension services and public private partnerships must play a key role in capacity building and training programs that enhance user confidence in digital irrigation technologies.

Moreover, data standardization and interoperability across sensor brands and software platforms are essential to ensure scalability. Without harmonized data protocols, integration between systems (e.g., irrigation controllers, weather APIs, and farm management software) remains fragmented.

6.4. Integration with Remote Sensing and Artificial Intelligence

The convergence of remote sensing, UAV imagery, and ground-based sensors represents a transformative frontier for irrigation management. High-resolution spectral indices such as NDVI and NDWI, combined with canopy temperature and soil moisture data, allow for spatially explicit irrigation zoning (Cahn & Johnson, 2017; Millán et al., 2020).

Recent work has demonstrated that coupling ground sensors with AI-driven models for instance, neural networks, random forest regression, or fuzzy inference systems can predict soil moisture dynamics and crop water demand several days in advance (Roy et al., 2021; Jamroen et al., 2020). These predictive systems shift irrigation from reactive to anticipatory management, increasing both water-use efficiency and yield stability.

In the coming decade, digital twins of agricultural fields virtual replicas that continuously simulate and update crop soil atmosphere interactions are expected to revolutionize irrigation scheduling through real-time optimization and self-learning feedback loops.

6.5. Sustainability and Policy Implications

Sensor-based irrigation aligns directly with Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 13 (Climate Action). Yet, the transition toward widespread adoption requires supportive policy frameworks that incentivize digital transformation in agriculture. Subsidies for smart irrigation hardware, open-access cloud platforms, and regional calibration databases could accelerate adoption. Furthermore, integrating such technologies into climate-smart agriculture (CSA) initiatives will help mitigate drought impacts and enhance long-term resilience in water-scarce regions (FAO, 2001).

6.6. Outlook

The future of irrigation management lies in fully autonomous, sensor-integrated, and data-driven systems. These systems will combine soil and plant sensing, real-time weather forecasting, AI-based decision algorithms, and remote actuation to achieve near-perfect precision in water delivery. As costs decline and connectivity expands, intelligent irrigation will transition from research prototypes to mainstream agricultural practice, reshaping the sustainability landscape of global food production.

7. CONCLUSIONS

The evolution of irrigation scheduling from empirical field practices to sensor-driven and intelligent systems represents one of the most significant transformations in agricultural water management. The reviewed studies collectively demonstrate that integrating soil, plant, and climatic data into automated control frameworks substantially enhances irrigation precision and sustainability.

Across a wide range of agroecosystems orchards, vegetables, and field crops sensor-based irrigation systems consistently achieved water savings between 30% and 60%, while maintaining or improving yield and product quality (Domínguez-Niño et al., 2020; Millán et al., 2020; Cahn & Johnson, 2017). These results validate that well-calibrated soil-moisture sensors, when combined with ET–WB models and adaptive algorithms, can outperform conventional time-based irrigation strategies.

Furthermore, IoT-enabled systems such as AgriSens (Roy et al., 2021) and fuzzy logic controllers (Jamroen et al., 2020) highlight the capacity of intelligent algorithms to integrate multiple environmental inputs in real time, enabling closed-loop, site-specific irrigation. These systems not only conserve water and energy but also optimize plant health and reduce human intervention.

Nevertheless, challenges persist in sensor calibration, data reliability, and economic accessibility, particularly for smallholders in developing regions (Datta & Taghvaeian, 2023; Evett et al., 2012). Future innovation should prioritize standardization, open-source IoT architectures, and machine-learning models that adapt automatically to local conditions without extensive calibration.

Ultimately, the convergence of artificial intelligence, remote sensing, and IoT is steering irrigation toward a future of fully autonomous, self-learning water management systems. By integrating these technologies into climate-smart agriculture strategies, global agriculture can significantly enhance water productivity, mitigate drought risks, and support sustainable food security in the face of climate change (FAO, 2001; Gu et al., 2020).

REFERENCES

Allen, R. G., Pereira, L. S., Raes, D., & Smith, M. (1998). Crop evapotranspiration: Guidelines for computing crop water requirements (FAO Irrigation and Drainage Paper 56). Rome: Food and Agriculture Organization of the United Nations.

Cahn, M. D., & Johnson, L. F. (2017). New approaches to irrigation scheduling of vegetables. Horticulturae, 3(28), 1–20. https://doi.org/10.3390/horticulturae3020028

Datta, S., & Taghvaeian, S. (2023). Soil water sensors for irrigation scheduling in the United States: A systematic review of literature. Agricultural Water Management, 278, 108148. https://doi.org/10.1016/j.agwat.2023.108148

Domínguez-Niño, J. M., Oliver-Manera, J., Girona, J., & Casadesús, J. (2020). Differential irrigation scheduling by an automated algorithm of water balance tuned by capacitance-type soil moisture sensors. Agricultural Water Management, 228, 105880. https://doi.org/10.1016/j.agwat.2019.105880

Doorenbos, J., & Pruitt, W. O. (1977). Crop water requirements (FAO Irrigation and Drainage Paper 24). Rome: Food and Agriculture Organization of the United Nations.

Evett, S. R., Tolk, J. A., & Howell, T. A. (2012). Soil profile water content determination: Sensor accuracy, calibration, temperature dependence, and spatial variability. Vadose Zone Journal, 11(4), vzj2011.0177. https://doi.org/10.2136/vzj2011.0177

FAO. (2001). Water and agriculture: Sustainability issues. Food and Agriculture Organization of the United Nations, Rome.

Ganjegunte, G. K., Sheng, Z., & Clark, J. A. (2012). Evaluating the accuracy of soil water sensors for irrigation scheduling to conserve freshwater. Applied Water Science, 2, 119–125. https://doi.org/10.1007/s13201-012-0032-7

Gu, Z., Qi, Z., Burghate, R., Yuan, S., Jiao, X., & Xu, J. (2020). Irrigation scheduling approaches and applications: A review. Journal of Irrigation and Drainage Engineering, 146(6), 04020007. https://doi.org/10.1061/(ASCE)IR.1943-4774.0001465

Idso, S. B., Jackson, R. D., Pinter, P. J., Reginato, R. J., & Hatfield, J. L. (1981). Normalizing the stress-degree-day parameter for environmental variability. Agricultural Meteorology, 24, 45–55. https://doi.org/10.1016/0002-1571(81)90032-7

Jamroen, C., Komkum, P., Fongkerd, C., & Krongpha, W. (2020). An intelligent irrigation scheduling system using low-cost wireless sensor network toward sustainable and precision agriculture. IEEE Access, 8, 172756–172770. https://doi.org/10.1109/ACCESS.2020.3025590

Millán, S., Campillo, C., Casadesús, J., Pérez-Rodríguez, J. M., & Prieto, M. H. (2020). Automatic irrigation scheduling on a hedgerow olive orchard using an algorithm of water balance readjusted with soil moisture sensors. Sensors, 20(9), 2526. https://doi.org/10.3390/s20092526

Roy, S. K., Misra, S., Raghuwanshi, N. S., & Das, S. K. (2021). AgriSens: IoT-based dynamic irrigation scheduling system for water management of irrigated crops. IEEE Internet of Things Journal, 8(6), 5023–5037. https://doi.org/10.1109/JIOT.2020.3036126

Sui, R. (2018). Irrigation scheduling using soil moisture sensors. Journal of Agricultural Science, 10(1), 1–11. https://doi.org/10.5539/jas.v10n1p1

Vellidis, G., Tucker, M., Perry, C., Kvien, C., & Bednarz, C. (2008). A real-time wireless smart sensor array for scheduling irrigation. Computers and Electronics in Agriculture, 61(1), 44–50. https://doi.org/10.1016/j.compag.2007.05.009

Walker, W. R. (1989). Guidelines for designing and evaluating surface irrigation systems (FAO Irrigation and Drainage Paper 45). Rome: Food and Agriculture Organization of the United Nations.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE AND ADAPTATION STRATEGIES IN THE AGRICULTURAL SECTOR

Uğur KEKEÇ
University of Cukurova, Yumurtalık Vocational School, Department of Plant and Animal Production
ORCID: 0000-0003-1321-9135

Burçak KAPUR
University of Cukurova, Faculty of Agriculture, Department of Agricultural Structures and Irrigation
ORCID: 0000-0001-6131-4458

ABSTRACT
Climate change is one of the most important environmental problems affecting ecosystems, economic structures and social life on a global scale. The effects of climate change are increasing rapidly over the years. Due to the impact of climate change, extreme weather events such as floods, droughts and storms have become more frequent and severe since the beginning of the twenty-first century, causing more property and life losses every year in many countries. As a result of human activities increasing greenhouse gas emissions and strengthening the natural greenhouse effect, changes such as an increase in the average surface temperature of the earth, a decrease in precipitation, extremely hot days, and shifts in seasons affect all sectors, especially the agricultural sector. The effects of this change are felt especially on water resources, food security and the agricultural sector. Agreements carried out at the international level are the United Nations Framework Convention on Climate Change (UNFCCC), The Kyoto Protocol and the Paris Agreement aim to reduce greenhouse gas emissions and increase adaptation capacity. The agricultural sector has a priority position within the scope of these agreements, as it is one of the areas that both causes and is most affected by climate change. In this review, the basic principles and development process of international agreements on climate change are discussed, and then adaptation strategies to climate change in the agricultural sector are discussed. The aim is to provide policy and practice recommendations that can guide sustainable agricultural practices on a global and national scale.
Keywords: Climate change, international agreements, agricultural sector, adaptation strategies, sustainability

1. INTRODUCTION
Climate change's effects and transformative power are increasing in every field, from daily life to international politics. As a result of the greenhouse gases released into the atmosphere by human activities strengthening the natural greenhouse effect, the average surface temperature of the earth is increasing, and this has been observed especially clearly since the industrial revolution (IPCC, 2023). In order to reduce the negative effects of climate change and prevent an irreversible process for life on earth, it has become necessary to reduce greenhouse gas emissions, to transition to a low-carbon economy, and to transform all sectors, including agriculture, to become more resilient (Dellal and McCarl 2007, Dellal et al. 2011). This process affects socioeconomic systems as well as natural ecosystems, and creates significant pressures especially on the agricultural sector, which is highly dependent on climatic conditions.

Agriculture is a sector that is both exposed to the effects of climate change and is an important source of greenhouse gas emissions. Agricultural activities, especially fertilizer use, irrigation, animal husbandry and land change, cause the release of strong greenhouse gases such as methane (CH_4) and nitrogen monoxide (N_2O) into the atmosphere (FAO, 2022). On the other hand, climatic extremes such as increasing temperatures, drought, flood, frost and storm threaten the amount of agricultural production, product quality and food supply security (OECD, 2023).

Increasing population and consumption, changing consumption habits, fossil fuel consumption

Human-induced activities such as increasing greenhouse gases and decreasing forest areas lead to climate change by increasing the accumulation of greenhouse gases in the atmosphere. These activities lead to warming of the atmosphere and oceans, changes in the global water cycle, decreases in snow and glaciers, sea level rise, and changes in the frequency, severity and duration of some disasters.

When the temperature data recorded in the world since the 1800s is examined, it is seen that the hottest years were the 2000s. Temperatures have increased by approximately 1 ºC since the 1800s and it is reported that they will increase further in the next 100 years (IPCC 2023). The temperature increase in Turkey in 2023 was recorded as 1.2 oC compared to the 1991-2020 period. Temperatures higher than the average for many years in all provinces of Turkey recorded (MGM 2024)

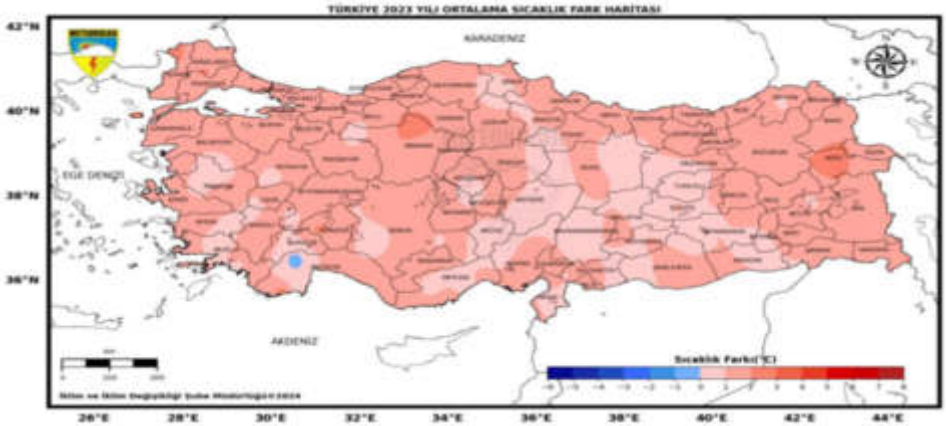


Figure 1. Turkey 2023 temperature difference map

The agricultural sector stands out from other sectors due to its dependence on natural conditions and its relevance to the impact, adaptation and combat aspects of climate change. For this reason, the international community has developed various global agreements to limit climate change and adapt to its effects. The principle of "common but differentiated responsibilities" lies at the basis of these agreements (UNFCCC, 1992).

In this paper, international agreements on climate change, the relevance of climate change to agriculture, the situation and its effects on Türkiye, and the studies on climate change adaptation and mitigation in Turkey were examined.

2. INTERNATIONAL AGREEMENTS ON CLIMATE CHANGE

The first step taken internationally towards environmental problems in the world was the United Nations "Conference on Human and Environment", held in Stockholm in 1972 with the participation of 113 countries, including Türkiye.

It was agreed that environmental problems are a global problem and threaten all humanity, and that responsibilities should be shared by all countries, and the action plan prepared to eliminate the problems was signed as a declaration and the United Nations Environmental Program (UNEP) was established.

The first step of international studies and agreements on climate change was the "First World Climate Conference" held by the World Meteorological Organization (WMO) in 1979.

It continued with the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988, with the joint initiative of WMO and UNEP, to evaluate the risks of climate change in human activities and to conduct further studies on climate change. The Intergovernmental Panel on Climate Change has regularly published IPCC reports every six years, prepared by many researchers working on climate change by providing scientific evaluations to politicians on the causes and effects of climate change and adaptation and mitigation measures against these effects.

UNFCCC (United Nations Framework Convention on Climate Change), adopted in Rio de Janeiro in 1992 with the participation of 172 UN countries, is the first comprehensive agreement to institutionalize international cooperation in the fight against climate change. The Convention entered into force in 1994 and called on the party countries to take joint actions to prevent greenhouse gas emissions from reaching dangerous levels.

It is envisaged that greenhouse gas emission reduction will allow ecosystems to naturally adapt to climate change, food security will not be threatened, and sustainable economic development will continue. The agreement takes into account the development priorities and special conditions of countries in greenhouse gas reduction and imposes more common responsibilities on countries with more greenhouse gas emissions. Today, 196 countries and the European Union (EU) are parties to the agreement. Turkey has been a party to the Convention since May 2024 and, like other countries party to this agreement, is obliged to adopt policies and take measures to reduce and adapt to climate change, calculate greenhouse gas emissions and report them to the UN.

Parties come together every year at the Conference of Parties (COP), which is the highest decision-making body of the UNFCCC (United Nations Framework Convention on Climate Change), and exchange ideas to determine the procedures and mechanisms to move efforts forward.

The Kyoto Protocol (1997)

The Kyoto Protocol (1997), adopted at COP3 (1997), the Conference of the Parties, is the first legally binding international agreement on reducing greenhouse gas emissions. The protocol envisaged developed countries to reduce their emissions by an average of 5% below the 1990 level (UNEP, 2018).In order for the Kyoto Protocol to enter into force, two conditions were introduced, namely that at least 55 countries that are party to the UNFCCC and the country that had at least a 55% share in the greenhouse gas emissions of 1990 must sign the protocol.

The first condition was met by opening the Protocol for signature, and the second condition could not come into force because the USA, which caused the largest greenhouse gas emissions of the period, was not a party. With the signature of Russia in 2005, the second condition was met and the Protocol could only come into force in 2005. The EU and other industrialized countries have made reduction commitments for the first obligation period (2008-2012), and 182 countries and the EU have become parties to the Protocol. Türkiye became a party to the Protocol in 2009; Since it was not a party to the UNFCCC at the time the protocol was adopted, it did not undertake any mitigation obligations.

It did not undertake any obligations between 2012-2020, which is the second obligation period of the contract. The Kyoto Protocol remained the implementation tool of the UNFCCC until 2020. There have been some problems in its implementation due to the strict structure of the Kyoto Protocol, the fact that it is only for developed countries, the changing world dynamics and the fact that there are also developing countries with high greenhouse gas emissions such as China and India.

Paris Agreement (2015)

Before the end of the second period of the Kyoto Protocol, the Paris Agreement, a new implementation tool, was adopted unanimously by 196 countries in 2015 (COP 21) to regulate the fight against climate change after 2020. and entered into force on November 4, 2016. Because it included all countries party to the UNFCCC in greenhouse gas emission reduction efforts and was more flexible than the Kyoto Protocol, the Paris Agreement was quickly adopted and became a turning point that created a new road map in the multilateral fight against climate change. With the Paris Agreement, countries are required to reach a certain peak in greenhouse gas emissions as soon as possible and accelerate the reduction and undergo a multi-dimensional economic and social transformation.

The Paris Agreement (2015) aims to keep the global temperature increase below 2°C above pre-industrial levels and, according to the IPCC report, to limit global warming to 1.5°C, with greenhouse gas emissions peaking before 2025 at the latest and reducing them by 43% by 2030 compared to 2019 and by 60% by 2035, and to reach net zero by mid-century (IPCC, 2023). This agreement provides for all countries to prepare their own national declarations of contribution (NDCs). The Koronivia Joint Agricultural Work Programme, launched at COP23 in 2017, aims to increase the potential for climate change adaptation and carbon sequestration in the agricultural sector (FAO, 2021).

3. EFFECTS OF CLIMATE CHANGE ON AGRICULTURE

Agriculture is a sector that is affected by climate change, can adapt to climate change, causes climate change by creating greenhouse gas emissions, and also acts as a sink by sequestering carbon in soil and plants. As the sector most exposed to the effects of climate change, its priority is adaptation; However, the agricultural sector is also expected to contribute to the reduction in order to achieve carbon neutral economies by mid-century.

International and national organizations, governments, state and private sector, etc. It expects various efforts from all agriculture-related parties on adaptation and mitigation in agriculture, such as policy intervention or technology development to deal with climate change threats. The European Union (EU) is leading these efforts with policy interventions and practices. Effects of climate change on agriculture; It occurs as a decrease in productivity, an increase in production costs and an increase in food safety risks (World Bank, 2022). In particular, temperature increase, precipitation regime changes and soil degradation negatively affect agricultural productivity.

Temperature Rise:

The most obvious indicator of the impact of climate change on agricultural production is manifested by increasing temperatures. High temperatures shorten the growth period of plants, cause low productivity and increase water needs. Additionally, temperature increases may halt plant growth in some regions, making agricultural production impossible.

With the changes in temperature and precipitation, it is observed that there are increases in diseases and pests (Correia et al. 2024), increases in irrigation, fertilization and weed control (Varanasi et al. 2016), changes in pollination (Crimmins et al. 2016), contractions in cultivation areas (del Pozo et al. 2019), and decreases in water resources. In studies conducted in Turkey, it is expected that climate change will reduce the productivity of crop production, grains, oil crops, industrial plants, and legumes by 5-20% in all regions and throughout the country (Dellal and Unuvar 2019; Dellal et al. 2022). Global projections reveal similar findings, and if current greenhouse gas emissions and climate change continue, it is predicted that there will be a decrease of 20-45% in corn yield, 5-50% in wheat and 20-30% in rice by 2100 (Arora 2019).

Decrease in Water Resources:
Drought caused by climate change leads to a decrease in water resources that are critical for agriculture. Restricting irrigation opportunities brings about efficiency losses in agricultural production and increases farmers' costs.

Deterioration of Soil Health:
Soil health has an important place in the relationship between climate and agriculture. Increasing temperatures and decreasing rainfall accelerate soil erosion and cause loss of organic matter. This negatively affects the fertility of the soil and makes agricultural production unsustainable in the long term.

Spread of Pests and Diseases:
Changing climatic conditions facilitate the spread of agricultural pests and plant diseases. Warmer climates, in particular, can lead to increased pest populations and the spread of plant diseases, negatively affecting the quality and quantity of agricultural products.

Decrease in Product Variety:
The interaction between climate change and agriculture also affects crop diversity. In some regions, growing certain plants may become difficult or completely impossible due to climate change. This causes a decrease in diversity in agricultural production. Losses in agricultural production affect the supply of agricultural products to the markets and cause increases in prices. Studies have determined that CO2 emissions negatively affect grain production, causing both yield and quality loss (Behera et al. 2024). Yield and quality losses have an impact on price increases, decreases in producer and consumer welfare, export losses and import increases. It is estimated that there will be changes in the production pattern by region, and the planting areas of products will expand in some regions and shrink in some regions in order to meet domestic demand. These changes in yield, production amount and cultivation areas also affect Turkey's foreign trade. According to the research results, it is estimated that exports will decrease and imports will increase (Dellal and Unuvar 2019).

4. ADAPTATION STRATEGIES IN THE AGRICULTURAL SECTOR

International and national organizations, governments, state and private sector, etc. It expects various efforts from all agriculture-related parties on adaptation and mitigation in agriculture, such as policy intervention or technology development to deal with climate change threats. The European Union (EU) is leading these efforts with policy interventions and practices. Laws, policies, strategies and actions regarding climate change in the agricultural sector in the European Union.

The EU has enacted the goal of becoming a climate neutral continent by 2050 with the Climate Law, and aims to reduce greenhouse gas emissions by at least 55% compared to 1990 levels by 2030. The EU is preparing sector-specific road maps to achieve the climate neutrality target in different areas of the economy, and one of these sectors is the agricultural sector.

The basis of the Climate Law is the European Green Deal (AYM), and the Constitutional Court will play a role in the transformation of EU agriculture as well as in the transformation of the structure of the agricultural sector of Turkey, which is a party to the Paris Agreement. After Turkey became a party to the United Nations Framework Convention on Climate Change (UNFCCC) in 2004 and especially after the first national declaration in 2006, issues related to climate change increasingly began to be included in agricultural policy documents. Another development that was very effective in this regard was the severe drought experienced in 2007 and the effects of climate change felt in the following years.

The Ministry of Agriculture and Forestry is responsible for implementing plans, programs, projects and providing the necessary support for biodiversity in agricultural ecosystems, climate change, sustainable use of natural resources, and environmentally and climate-friendly agricultural practices (TOB 2022). The Ministry carries out its work within the framework of basic laws such as the Agricultural Law, Pasture Law, Organic Agriculture Law, Soil Conservation and Land Use Law, Agricultural Reform Law on Land Arrangement in Irrigation Areas, and Agricultural Insurance Law, in line with the objectives of ensuring food safety and security, protecting natural resources, ensuring sustainability in agriculture and continuity in agricultural enterprises, securing small family businesses and protecting biological diversity.

Adaptation strategies in the agricultural sector; It includes technological, ecological, socioeconomic and managerial measures. Water management, drought-tolerant varieties, soil management, early warning systems and policy adaptation are key areas. It has been stated that priority will be given to the development of policies and legal frameworks to increase the resilience and adaptation of agriculture to the possible negative effects of climate change, and efforts will be intensified to strengthen institutional capacity, cooperation and awareness. In addition, it is stated that in order to reduce the negative effects of agricultural activities on soil, water resources and biodiversity, studies will be carried out to determine appropriate crop patterns, including crop rotation and livestock systems, which will ensure the effective use of soil and water resources and the protection of biological diversity at the provincial and/or district level, farmer guides will be prepared, the quality of agricultural lands, pastures and rural areas will be protected by more monitoring of pasture capacities and productivity, and studies will be intensified to determine and implement options that contribute to water balance and increase productivity in pastures. It is stated that studies on traditional and natural methods that are environmentally friendly and increase the capacity to adapt to climate change will continue, the number of farmers practicing organic agriculture and good agricultural practices will be increased throughout Turkey and measures will be taken to disseminate these practices in all provinces, practices such as protective and regenerative agriculture practices, rainwater harvesting, permaculture and living wind curtains will be encouraged, a national guide for nature-based solutions in agricultural activities will be developed, an ecosystem-oriented food production model will be implemented and disseminated has been expressed.

In Turkey, the 'National Climate Change Adaptation Strategy and Action Plan (2023–2030)' covers these measures (T.R. Ministry of Agriculture and Forestry, 2023). In addition, it submitted the 2053 Long Term Strategy (LTS) to the UNFCCC before COP 29 held in November 2024 (UNFCCC 2024). In Turkey's Long-Term Strategy, it is planned to improve soil and water management regarding greenhouse gas emissions reductions in the agricultural sector, disseminate climate-friendly agricultural practices, improve loss, waste and residue management in agricultural production, and disseminate training, awareness-raising and capacity building activities, taking into account gender balance. In this context; Turkey's 24 million hectares of cultivated agricultural land will be protected by 2053, non-agricultural use, fragmentation and degradation will be stopped, the consolidation of all fragmented lands will be completed by 2053, activities will be carried out for the protection, improvement, management and monitoring of pasture, meadow and grazing areas, soil health will be improved by increasing the organic matter content of the soil, the water and carbon retention capacity of the soil will be strengthened, pasture improvement will be carried out. in order to increase vegetation cover and maximize the benefits of rainfall.
It is promised that methods will be developed and rainwater harvesting techniques will be widely adopted in pastures.

5. CONCLUSION AND RECOMMENDATIONS

Climate Change has been increasing its impact on a global, regional and local scale since the early 2000s, and the expected effects are occurring earlier and more severely.
Climate change is a global problem that threatens the sustainability of agricultural production systems. The agricultural sector is the sector most affected by climate change. Since Turkey is located in a semi-arid region, it is among the countries that will be most affected by climate change. Temperature increases, changes in precipitation regimes, and more frequent and severe climate-related disasters have significant impacts on the agricultural sector. Studies show that the impact of climate change on agriculture in Turkey; It is estimated that the product yield will decrease, production will decrease, product patterns will change, prices will increase, imports will increase, exports will decrease and total welfare will decrease In order to reduce these negative effects that will arise with climate change, efforts must be increased to make the agricultural sector more resilient to climate change, as well as to reduce greenhouse gas emissions from agriculture. International agreements aim to reduce greenhouse gas emissions of countries and make agricultural systems climate resilient. For Turkey, modern irrigation systems that will increase water efficiency, development of climate-resistant varieties and strengthening farmer training should be priorities.
Turkey's climate change adaptation and mitigation action plans and the LTS submitted to the UNFCCC are the most important of these efforts. Following these documents, which are a road map towards the year 2053, will not only serve to combat climate change, but also to protect today's soil and water resources and biodiversity and transfer them to future generations, to ensure that the production structure exists in the future at least in its current state, and to enable future generations to live in a cleaner environment. In addition to these studies, carrying out publication studies to raise awareness of all sectors related to agriculture (farmers, technical personnel, decision makers, etc.) about climate change plays a key role in achieving the expectations from impact, adaptation and combat activities.

REFERENCES

Arora, N.K. 2019. Impact of climate change on agriculture production and its sustainable solutions. Environmental sustainability, 2(2), 95-96.

Behera, B. Haldar, A. Sethi, N. 2024. Agriculture, food security, and climate change in South Asia: a new perspective on sustainable development. Environment, Development and Sustainability, 26(9), 22319-22344.

Correia, C. D. Amraoui, M. Santos, J. A. 2024. Analysis of the Impacts of Climate Change on Agriculture in Angola:Systematic Literature Review. Agronomy, 14(4), 783.

Crimmins, A. Balbus, J. Gamble, J. L. Beard, C. B. Bell, J. E. Dodgen, D. Ziska, L. 2016. The impacts of climate change on human health in the United States: a scientific assessment. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.

Del Pozo, A., Brunel-Saldias, N. Engler, A. Ortega-Farias, S., Acevedo-Opazo, C. Lobos, G. A., Jara- Rojas, R. Molina-Montenegro, M.A. 2019. Climate change impacts and adaptation strategies of agriculture in Mediterranean-climate regions (MCRs). Sustainability, 11(10), 2769.

Dellal, İ. McCarl, B., 2007. İklim Değişikliği ve Tarım: Türkiye için Öngörüler, Uluslararası Küresel iklim değişikliği ve Çevresel Etkileri Konferansı, KOSKİ, Konya.

Dellal, İ. McCarl, B.A., Butt, T. 2011. The Economic Assessment of Climate Change on Turkish Agriculture, Journal of Environmental Protection and Ecology, Vol:12, No:1, 376-385.

Dellal, İ., Unuvar, F.I., Polat, K., Bolat, M., Ünal, M. 2014. İklim Değişikliği ve Kuraklığın Türkiye'de Tarımda Etkilerinin Değerlendirilmesi, TAGEM-ARGE Projesi, Ankara.

Dellal.İ., Unuvar, F.I. 2019. Effect of Climate Change on Food Supply of Turkey. Journal of Environmental Protection and Ecology 20, No 2, 692–700 (2019).

Dellal, İ. Unuvar, F.I. Topçu, P. 2022. İklim Değişikliğinin Türkiye'de Tarım Üzerine Etkisi: Tahıllar, Zeytin, Bağcılık Turkiye Klinikleri Social Pediatrics-Special Topics, 3(2), 96-102

FAO. (2021). Koronivia Joint Work on Agriculture: Progress and Future Directions. Food and Agriculture Organization of the United Nations.

FAO. (2022). The State of Food and Agriculture 2022: Climate Change and Food Systems. Rome: FAO.

IPCC. (2023). Climate Change 2023: Synthesis Report. Intergovernmental Panel on Climate Change. Synthesıs Report of the IPCC Sixth Assessment Report (AR6), https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_LongerReport.pdf.

MGM, 2024. 2023 Yılı Meteorolojik Afetler Değerlendirmesi, Araştırma Dairesi Başkanlığı Meteorolojik Afetler ŞubeMüdürlüğü, 2023, Ankara.

OECD. (2023). Climate Impacts on Agriculture and Food Systems. OECD Publishing.

T.C. Tarım ve Orman Bakanlığı. (2023). Ulusal İklim Değişikliği Uyum Stratejisi ve Eylem Planı (2023–2030). Ankara.

UNEP. (2018). Kyoto Protocol Reference Manual. United Nations Environment Programme.

UNFCCC. (1992). United Nations Framework Convention on Climate Change. United Nations.

UNFCCC 2024. https://unfccc.int/documents .

Varanasi, A. Prasad, P. V. Jugulam, M. 2016. Impact of climate change factors on weeds and herbicide efficacy. Advances in agronomy, 135, 107-146

WMO 1979. Declaration of the World Climate Conference, IOC/SAB-IV/INF3, Geneva.

World Bank (WB) COP 27 Report. 2022. Food Security and Climate Change Report. https://www.worldbank.org/en/news/feature/2022/10/17/what-you-need-to-know-about-food-security-and-climate-change.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

İKLİM DEĞİŞİKLİĞİNİN ÇUKUROVA BÖLGESİNDE ÜRETİMİ YAPILAN TARIMSAL BİTKİ DESENİ ÜZERİNE ETKİSİ: YUMURTALIK İLÇESİ ÖRNEĞİ

Dr. Öğr. Üyesi Hülya SAYĞI
Çukurova Üniversitesi, Yumurtalık Meslek Yüksekokulu
ORCID: 0000-0002-2327-566X

ÖZET
Çoğrafi iklim özellikleri tarımsal üretim üzerinde doğrudan etkilidir. Son 20-30 yıllık zaman aralığında insana bağlı faaliyetlerden kaynaklanan iklim değişimleri gözlemlenmektedir. Literatürde iklim değişikliği konusu tarımsal üretim üzerine olumlu ve olumsuz etkileri olmak üzere iki boyutta değerlendirilmektedir. Olumlu yönü daha önce yetiştirilemeyen ekonomik olarak değerli bitki çeşitlerinin yetiştirilebilmesi, olumsuz yönü olarak aşırı makine kullanımı, aşırı kimyasal kullanımı, kuraklık, tahmin edilemeyen ekim-dikim-hasat zamanları, yeni tür zararlı ve hastalıklar ve biyoçeşitliliğin azalması bu faktörlere bağlı olarak artan üretim maliyetleri sayılabilir. Bu çalışmada iklim değişikliğinin Çukurova Bölgesi özelinde Yumurtalık İlçesi'nde üretimi yapılan tarımsal bitki deseni üzerine etkisi araştırılmıştır. Araştırma materyali Yumurtalık İlçesi Ziraat Odası'na kayıtlı üreticiler, araştırma yöntemi olarak anket veri toplama tekniği kullanılmıştır. Araştırma bulgularına göre Yumurtalık İlçesinde uzun yıllar üretimi yapılan tarımsal bitki deseni turunçgiller, zeytin, karpuz, mısır, pamuk, buğday ve ayçiçeğinden oluşuyorken son yıllarda bu listeye muz, avokado ve mangodan oluşan tropikal bitkiler eklenmiştir. Çalışmada iklim değişikliğinin Yumurtalık İlçesi'nde tarımsal üretimi yapılan bitki deseni üzerinde etkili olduğu sonucuna ulaşılmıştır.
Anahtar Kelimeler: Tarım, iklim değişikliği, bitki deseni, tropikal bitkiler.

THE IMPACT OF CLIMATE CHANGE ON AGRICULTURAL CROP PATTERNS PRODUCED IN THE ÇUKUROVA REGION: THE EXAMPLE OF YUMURTALIK DISTRICT

ABSTRACT
Geographic climate characteristics directly impact agricultural production. Climate change resulting from human activities has been observed over the last 20-30 years. In the literature, climate change is evaluated in two dimensions: positive and negative impacts on agricultural production. The positive aspect includes the ability to grow economically valuable plant varieties that were previously unavailable, while the negative aspects include excessive machinery use, excessive chemical use, drought, unpredictable planting and harvesting times, new pests and diseases, reduced biodiversity, and increased production costs due to these factors. This study investigates the impact of climate change on agricultural crop production in the Yumurtalık District, specifically in the Çukurova Region. The research material was collected from producers registered with the Yumurtalık District Directorate of Agriculture and Forestry, and survey data collection was used as the research method. According to the research findings, the agricultural crop production in the Yumurtalık District for many years consisted of citrus fruits, olives, watermelon, corn, cotton, wheat, and sunflower. In recent years, tropical plants such as bananas, avocados, and mangoes have been added to this list. The study concluded that climate change has an impact on the crop pattern of agricultural production in Yumurtalık District.
Keywords: Agriculture, climate change, crop pattern, tropical plants.

INTRODUCTION

Agriculture, one of the first economic activities, is indispensable for the protection and development of human existence and the maintenance of human life, as it meets human needs in physical dimensions (food, drink, shelter) and social dimensions (providing intermediate input for the production of products that constitute human civilization) (Sayğı, 2024a). On the other hand, agriculture is an economic activity that involves humans and has both positive and negative impacts on natüre (Sayğı, 2024a). Its positive effects include meeting physical and social human needs, while its negative effects include the disruption of the natural balance caused by factors such as climate change and the pollution of water, air, and soil resources (EPA, 2025).

Climate change is the changes in the prevailing air characteristics of humidity, wind, precipitation, and temperature in a region over long periods of time (Sayğı, 2021b). These characteristics influence and shape life on a given landscape. Scientific studies have demonstrated that climate change stems from activities carried out in nature to meet human needs in agriculture and other economic sectors, affecting the entire world over the years. Most of these studies concern the negative aspects of climate change. These efforts, of course, aim to protect and stimulate nature, the world, the universe, and therefore human existence. On the other hand, studies have also been conducted on the significant positive aspects of favorable climate conditions and production diversity, resulting in high-value-added production; global warming extending the growing and harvest seasons and creating a CO2 fertilization effect, increasing agricultural production; and opening up unsuitable lands to agriculture.

In the Çukurova Region, where the impact of climate change is most acute, the prevailing Mediterranean climate (mild and rainy winters, hot and dry summers) has shifted, resulting in a climate characterized by drier winters, hotter summers, and higher evaporation, altering the traditional planting and harvesting times for regional agriculture. For example, planting activities previously carried out in April have now begun in March. Furthermore, for many varieties of orange, mandarin, and lemon, which are intensively cultivated in the region, significant fruit drop due to high temperatures is causing quality and yield losses (Tablacı, 2021). While climate change has negative impacts in this region, its positive impact is that it has altered the cropping patterns used in agricultural production, allowing for the cultivation of previously uncultivated plant species such as bananas, avocados, mangoes, and dragon fruit. Bananas, in particular, an import-substituting crop, are being cultivated at significant scale.

In this study, the effects of climate change on the plant patterns used in agricultural production for many years in Adana Province and specifically in Yumurtalık District, located in the region called Çukuroava, were investigated.

MATERYAL METOT

In Yumurtalık District, where agriculture is a significant source of income, a total of 1,523 farmers are registered with the Yumurtalık District Directorate of Agriculture and Forestry. The research sample consists of farmers registered with the Yumurtalık District Directorate of Agriculture and Forestry who cultivate plants such as avocado, banana, dragon fruit, and passionflower in addition to traditional plant patterns. Accordingly, a total of 172 farmers are registered with the Yumurtalık District Chamber of Agriculture who cultivate new plant species in agricultural production. Among these farmers, 92 farmers produce avocado, 67 farmers produce banana, 6 farmers produce mango, 5 farmers produce dragon fruit, and 2 farmers produce passionflower.

Face-to-face interviews (surveys) were used as the research method. In the survey data collection method used in the research, the factors that are effective in deciding to produce a new type of plant were determined by selecting from among the most frequently mentioned factors in the literature review on the subject (Abacı and Demiryürek, 2019; Deniz and Hiç, 2022; Özekan and Akan, 2023). A stratified sample selection method was used to determine the research sample: 10 avocado growers, 7 banana growers, 1 dragon fruit growers, 1 mango growers, and 1 passionflower growers. The research data were analyzed in Microsoft Excel.

RESULTS AND DISCUSSION

Agriculture and the Effects of Climate Change on Agriculture in the Çukurova Region

Located in the eastern Mediterranean, the Çukurova Region, home to the provinces of Adana, Hatay, and İçel, covers approximately 3.9 million hectares of land formed by alluvial deposits carried by the Seyhan, Ceyhan, and Berdan Rivers (Yurdakul and Emeksiz, 1993). Thanks to favorable climate conditions, a wide variety of crops can be grown in the Çukurova Region, and yields generally exceed the average agricultural production in Türkiye. Adana Province, within the Çukurova Region, holds a significant place in horticulture, cultivating field crops such as wheat, corn, cotton, and sunflower, as well as citrus fruits such as tangerines, oranges, lemons, and grapefruits (Alemdar, Seçer, Demirdöğen, Öztornacı, Aykanat, 2014).

According to climate change projections, the Mediterranean Basin is one of the regions expected to be most affected by the positive and negative consequences of climate change (Deniz and Hiç, 2022). It is anticipated that much of Türkiye, located in this region, will experience drought, and the number of days with above-average temperatures will increase (Tarım Orman Bakanlığı. 2021). Located in the Mediterranean region, Çukurova is a plain characterized by a Mediterranean climate, characterized by hot, dry summers and mild, rainy winters. In areas with a Mediterranean climate, average annual rainfall is between 600 and 700 mm, severe summer droughts and high temperatures, often exceeding 40°C, prevail (Uçak, Ertek, Güllü and Aykanat, 2010).

One of the negative effects of climate change in the Adan Province of the Çukurova Region mentioned above is the change in the pattern of agricultural production (Table 1).

Table 1. Distribution of agricultural areas and production quantity in Adana Provınce

Type of cultivation	2020 Area (ha)	Quantity (t)	2021 Area (ha)	Quantityr (t)	2022 Area (ha)	Quantity (t)	2023 Area (ha)	Quantity (t)
Fruit	844.349	1.491.354	900.310	1.866.842	1.038.031	2.043.216	1.073.414	3.438.818
Vegetable	329.783	1.669.822	313.213	1.578.519	258.222	1.382.028	264.946	1.403.569
Field Crops	3.556.299	2.236.352	3.578.131	2.342.297	3.686.297	2.243.519	3.638.520	2.227.265

Source: Tarım Orman Bakanlığı, 2021.

According to Table 1, when vegetable and field crop production are evaluated together, there has been a decrease in both production area (approximately 18%) and production volumes (approximately 16%), while an increase in fruit production area (approximately 27%) and production volumes (approximately 131%) is observed. A detailed analysis of the increase in fruit production according to Table 1 indicates that climate change has diversified the plant patterns used in agricultural production and has positively impacted the cultivation of tropical climate-requiring plant species such as bananas, avocados, mangoes, dragon fruit, and passiflora, which were not previously cultivated in the region.

According to the data of Adana Directorate of Agriculture and Forestry, avocado fruit, which has a high income in terms of unit sales price, was first produced in Adana in 2017 on 11 decares in Kozan District and 56 decares in Yüreğir District. It is estimated that the cultivation area will be 528 decares in 2020 and 1000 decares for 2021 (AA, 2021). Tropical plant cultivation in Adana began with bananas. With the first mango production in 2020 (on 59 decares), the first pitaya production in 2017 (on 5 decares, 50 decares in 2021), and the first kiwifruit production in 2020 (on 60 decares in 2020, 100 decares in 2021), the crops have been incorporated into the Çukurova agricultural landscape (AA, 2021). Among these cultivated fruits, bananas are a typical example of plant pattern changes used in agricultural production (Table 2).

Table 2. Production, import and export values of banana production in Türkiye

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Production (t)	210.178	206.501	207.727	215.472	251.994	270.500	305.926	369.009	498.888	550.000
Imports (t)	200.695	234.632	225.099	235.188	207.170	218.548	209.392	207.850	155.427	122.116
Import value ($)	95.349.000	110.436.000	110.390.000	115.317.000	102.537.000	108.334.000	103.120.000	101.975.000	67.030.925	48.746.312

Source: Çokal, 2020.

According to 2010 data, Turkey met a large portion (approximately 50%) of its banana needs by importing (Table 2). Türkiye, an importer in the global banana trade, has seen its banana consumption increase year-over-year, reaching 6.9 kg per capita and 613,000 tons in total, according to 2018 data (TEPGE. 2020). As can be seen in Table 2, import substitution policies were followed in banana production and banana production was encouraged by the state and the amount of banana production increased from year to year. While banana production in the world has increased by 10% in the last 10 years, banana production in Turkey has increased by 4 times and banana production areas have increased by 3 times (Çelen, 2022). According to TEPGE banana production data, banana production in 2021 was 883,000 tons and banana production in Türkiye increased by approximately 139 percent compared to the 2017-2021 data According to the banana production data of the Ministry of Agriculture and Forestry, banana production in 2021 was 883,000 tons and compared to the data from 2017-2021, banana production in Türkiye increased by approximately 139 percent (Tarım Orman Bakanlığı, 2022). While the majority of banana production takes place in the provinces of Mersin (51,5%) and Antalya (42,5%), factors such as climate change, import-substitution agricultural policies, high demand, and the high economic value of the product have led to rapid development of banana production areas in Adana (4,4%), Hatay (0,9%), Muğla (0,6%) and Manisa (0,1%) (TUİK, 2022) . The reason why banana imports have not decreased despite the increase in production areas and production amounts is that the imported bananas are re-exported (according to 2021 data, the amount of bananas re-exported was 373.3 tons, 60 percent) (Çelen, 2022, Tarım Orman Bakanlığı, 2022). As of 2023, a total of 930,240 tons of bananas were produced in Turkey, with Adana Province accounting for 5% of this production, with 48,014 tons. Consequently, it is observed that the crop patterns used in agricultural production in Adana Province, in the Çukurova Region, are changing due to the positive impact of climate change.

The Impact of Climate Change on Agricultural Crop Patterns Produced in the Çukurova Region: The Example of Yumurtalık District

The factors determined within the scope of the research that are effective in the change of plant pattern in agricultural production in Yumurtalık District and the data obtained from farmers about these factors through the survey method are presented in Table 3.

Table 3. Survey results on factors affecting the change in plant pattern used in agricultural production in Yumurtalık District

Number of factor	Factors for transition to new types of plant production	Number of bservations	No	Neutral	Yes	No (%)	Neutral (%)	Yes (%)
1	Favorable climatic conditions	20	6	3	11	0,30	0,15	0,55
2	Low investment costs	20	10	8	2	0,50	0,40	0,10
3	High economic added value	20	**3**	1	16	0,15	0,05	0,80
4	Availability of government incentives	20	4	3	13	0,20	0,15	0,65
5	Provides protection from competition	20	5	8	7	0,25	0,40	0,35
6	Protection of product value	20	10	3	7	0,50	0,15	0,35
7	Willingness to try a different field	20	12	3	5	0,60	0,15	0,25
8	Experience of production in the field of expertise	20	14	0	6	0,70	0,00	0,30
9	Effortless production process	20	15	3	2	0,75	0,15	0,10
10	Low costs of production inputs	20	16	1	3	0,80	0,05	0,15
11	Easy product marketing	20	6	3	11	0,30	0,15	0,55
12	Short collection period for product prices	20	10	2	8	0,50	0,10	0,40

Table 3 shows that the most important motivation factor for surveyed farmers (Factor 3, 80%) in cultivating a new plant species is the economic added value, or the amount of income generated. This is a natural conclusion reached in observations made across all economic activities (Kagan, 2025). In this context, according to 2022 data, the average income per acre in citrus production was calculated as 25,000 ₺ (Currency of Türk Lirası), while that in banana production was 75,000 ₺. This suggests that banana production is more profitable than citrus, but the cultivation area must have suitable climatic conditions, such as a low risk of frost, and adequate water resources (TE Bilisim, 2022). Burhan, Engindeniz, Güler. (2022) examined the factors affecting the decisions of farmers to grow potatoes in Ödemiş district of İzmir province and reported that the most important factors for farmers in agricultural production are market conditions and price changes and the most important criterion for farmers to decide to grow potatoes is price. Assoutoa, Denis Acclassato Houensoub, Semedo, (2020) conducted a case study on price risk and farmers' decisions in Benin, reporting that price fluctuations are crucial in farmers' decision-making. Champika (2016), in his study on the analysis of farmers' decision-making process in the vegetable sector in Sri Lanka and ıts effects on price volatility, reported that price expectations based on price formations in previous seasons are the primary factor in farmers' selection of agricultural products to grow in the following season. According to Table 3, it was observed that government incentives and supports (Factor 4, 65%) were effective on farmers' decision to choose a new type of plant cultivation. The state is an actor that has a significant impact on economic activities, such as the enactment and implementation of laws regulating economic relations, being a large buyer/seller economic unit, and agricultural policies to be implemented. The first government incentive and support is the provision of appropriate investment capital. This includes loans of up to ₺25,000,000, with interest rates ranging from 50% to 100%, for the construction of a new, modern greenhouse of at least 20 decares for the cultivation of tropical and subtropical fruits (bananas, dates, figs, avocados, mangoes, etc.).

Government-backed greenhouse insurance covers greenhouse production against risks such as hail, earthquake, vehicle collision, storms, tornadoes, fire, landslides, floods, and snow and hail damage. Support provided during the facility's operation phase includes production loans, energy usage support, and support for employers' social security expenses, all of which reduce the financial burden on producers. Additionally, high import tax rates (The customs duty rate applied per ton is 830 Euros) are aimed at both protecting domestic production and generating high revenues.

According to Table 3, it was observed that suitable climatic conditions (Factor 1, 55%) were effective on the decision of farmers to choose a new type of plant cultivation. Climate conditions are a determining factor in agricultural production. Agricultural production activities, whether carried out in open fields or under cover, are strictly dependent on climatic conditions (Akalın, 2015). In this sense, the most important factor affecting the investment decisions of farmers is the risk of adverse climatic conditions that will prevent the return of the investment. Once a land of cotton and wheat, farmers in Adana Province who earned their living through cotton and wheat production, are now, thanks to climate change and evolving agricultural systems, making money from tropical plants like bananas, avocados, dragon fruit, and kiwifruit (Küçük Saat. 2022). As a result of changes in agriculture over the last 10-15 years due to climate change, the inclusion of tropical plants in agricultural production patterns has significantly contributed to both product diversity and the economy (Küçük Saat. 2022).

According to Table 3, it was observed that ease of product marketing (Factor 11, 55%) was effective on farmers' decision to choose a new type of plant cultivation. One of the most important problems faced by producers in agricultural production is the marketing process of the products produced (Karadaş and Bulut, 2022). In this process, the preparation of the products for the marketing process, their preservation, delivery to the market without delay, and the creation of a suitable demand and price are effective in the selection of the plant species to be produced. (Emeksiz, Albayrak, Güneş, Özçelik, Özer, and Taşdan, 2005; Gedik, 2023).

Other factors listed in Table 3 were observed to be effective in farmers' decision to choose a new type of plant cultivation as supporting elements. The field research aimed to determine the positive effect of climate change on the plant pattern used in agricultural production in Yumurtalık District and the driving factors that caused this change.

CONCLUSION

Scientific studies support the notion that climate change has both positive and negative impacts on agricultural production. Whether agriculture is carried out in open, greenhouse, or fully equipped greenhouses, climate directly impacts the technological investment costs and heating costs required to ensure suitable climatic conditions. Therefore, ensuring suitable climatic conditions is a prerequisite for agricultural production. Accordingly, while climate change has negatively impacted agricultural production in Adana Province and Yumurtalık District, such as drought, yield losses, and changes in planting and harvesting times, it has also had positive effects, such as enabling the production of new, high-value-added plant species such as bananas and avocados, which were previously uncommercial. Research results indicate that the selection of plant species used in new agricultural production was influenced by 80% economic value, 65% government incentives and support, and 55% favorable climatic conditions and marketing opportunities. The research findings indicate that climate change has an impact on the crop patterns used in agricultural production in Yumurtalık District.

REFERENCES

AA. (2021). Çukurova çiftçisinin tropikal meyve üretimine ilgisi artıyor. Anadolu Ajansı (AA), by Fansa, B. Ö. Available on: https://www.aa.com.tr/tr/ekonomi/cukurova-ciftcisinin-tropikal-meyve-uretimine-ilgisi-artiyor/2161504

Abacı, N. İ., & Demiryürek K. (2019). Çiftçilerin Ürün Desenlerine Karar Vermelerini Etkileyen Faktörler: Samsun İli Bafra İlçesi Sebze Yetiştiricileri Örneği. Turkish Journal of Agriculture: Food Science and Technology, 7(3), 426 – 434. https://doi.org/10.24925/turjaf.v7i3.426-434.2359

Akalın, M. (2015). İklim değişikliğinin tarım üzerindeki etkileri: bu etkileri gidermeye yönelik uyum ve azaltım stratejileri. Hitit Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 7(2), 351-378. https://doi.org/10.17218/husbed.87012

Alemdar, T., Seçer, A., Demirdöğen, A., Öztornacı, B., & Aykanat, S. (2014). Çukurova Bölgesinde Başlıca Tarla Ürünlerinin Üretim Maliyetleri ve Pazarlama Yapıları. TEPGE, 1-134. Available on: https://arastirma.tarimorman.gov.tr/tepge/Belgeler/Yay%C4%B1n%20Ar%C5%9Fivi/2012-2016%20Yay%C4%B1n%20Ar%C5%9Fivi/Yay%C4%B1nNo230.pdf

Assoutoa, A. B., Houensoub, D. A., & Semedo, G. (2020). Price risk and farmers' decisions: A case study from Benin. Scientific African, 8, e00311. https://doi.org/10.1016/j.sciaf.2020.e00311

Burhan, M., Engindeniz, S., & Güler, D. (2022). Analysis of Factors Affecting Potato Growing Decisions of Farmers: The Case of Ödemiş District of İzmir Province. Selcuk Journal of Agriculture and Food Sciences, 36(2), 127-132. Available on: https://dergipark.org.tr/en/pub/selcukjafsci/issue/76598/1275198

Çelen, H. (2022). Muz sektörü nereye koşuyor? Journal of Tarlasera, Available on: https://www.tarlasera.com/haber-12273-muz-sektoru-nereye-kosuyor?

Çokal, İ. (2020). Muz Üretimi İçin Muz Serası Kurma Maliyeti. Türkiye'de Muz Yetiştiriciliği, Available on: https://www.isfikirleri-girisimcilik.com/muz-uretimi-icin-muz-serasi-kurma-maliyeti#google_vignette

Deniz, M., & Hiç, Ö. (2022). İklim Değişikliği ve Tarımın Değişen Yüzü: Artan Riskler, Tarımdaki Daralmalar ve Orman Yangınları Sonrası Politika Önerileri. Biga İktisadi ve İdari Bilimler Fakültesi Dergisi, 3(1), 12-22. Available on: https://dergipark.org.tr/tr/pub/biibfd/issue/70116/1124238

Emeksiz, F., Albayrak, M., Güneş, E., Özçelik, A., Özer, O.O., & Taşdan, K. (2005). "Türkiye'de Tarımsal Ürünlerin Pazarlama Kanalları ve Araçlarının Değerlendirilmesi", VI. Türkiye Ziraat Mühendisleri Odası Teknik Kongresi, 3-7 Ocak 2005-Ankara, Bildiriler (II) :1155-1172. Available on: https://api2.zmo.org.tr/uploads/portal/resimler/ekler/7968ad196a5085f_ek.pdf

EPA. (2025). Climate Change Impacts on Agriculture and Food Supply. U.S. Environmental Protection Agency (EPA). Available on: https://www.epa.gov/climateimpacts/climate-change-impacts-agriculture-and-food-supply

Gedik, Y. (2023). Tarımsal pazarlama: Faydaları, zorlukları ve stratejileri üzerine kavramsal bir çerçeve. Turizm Ekonomi ve İşletme Araştırmaları Dergisi, 5(1), 134-147. Available on: https://dergipark.org.tr/tr/pub/turek/issue/78710/1267297

Kagan, j. (2025). Understanding Profit Motive: Definition, Theory, and Economic Impact. Available on: https://www.investopedia.com/terms/p/profit-motive.asp#:~:text=Profit%20motive%20serves%20as%20a,risk%2Dtaking%2C%20and%20competition.

Karadaş, K., & Bulut, O. D. (2022). Bitkisel Ürünlerin Pazarlama Kanalları ve Yeni Bir Pazarlama Modeli Önerisi; Iğdır İli Örneği. Adnan Menderes Üniversitesi Ziraat Fakültesi Dergisi, 19(1), 145-153. https://doi.org/10.25308/aduziraat.1074576

Küçük Saat. (2022). Çukurova tropikleşiyor, ürün çeşitliliği değişiyor. Haberler Gündem. Available on: https://www.kucuksaat.com/cukurova-tropiklesiyor-urun-cesitliligi-degisiyor-24242h.htm

Özekan, D., & Mumcu Akan, D. (2023). Türkiye'nin Tarımsal Ürün Deseninin Batı ve Orta Anadolu Özelinde Analizi. Uluslararası Ekonomi ve Yenilik Dergisi, 9(2), 251-272. https://doi.org/10.20979/ueyd.1314143

Sayğı, H. (2024a). Sürdürülebilir tarım sürecinde teknolojinin rolü. In Sürdürülebilir Tarım ve Çevre için Teknolojik Değişim. Ed. Baran, M. F. and Çelik, A. 135-153 https://dx.doi.org/10.5281/zenodo.14505421

Sayğı, H. (2024b). Protecting, improving and developing soil health and quality. In Soil Health and Last Agricultural Developments. Ed. Baran, M. F. and Çelik, A. 31-48. https://dx.doi.org/10.5281/zenodo.13770008

Tablacı, N. (2021). İklim değişikliği Çukurova'daki tarımı değiştiriyor. Termiksiz Gelecek. Available on 10.11.2025 https://www.termiksizgelecek.org/cukurovaiklim/#:~:text=TRT%20Haber'in%20haberine%20g%C3%B6re,Bu%20durum%20tar%C4%B1ma%20da%20yans%C4%B1yor.

Tarım Orman Bakanlığı. (2021). İklim Değişikliği ve Tarım Değerlendirme Raporu. Tarım ve Orman Bakanlığı Tarım Reformu Genel Müdürlüğü, 1-114. Available on: https://www.tarimorman.gov.tr/TRGM/Belgeler/IKLIM%20DEGISIKLIGI%20VE%20TARIM%20DEGERLENDIRME%20RAPORU.pdf

Tarım Orman Bakanlığı. (2022). Türkiye'nin muz üretimi son 5 yılda yüzde 139,4 arttı. Available on: https://www.tarimorman.gov.tr/Haber/5452/Turkiyenin-Muz-Uretimi-Son-5-Yilda-Yuzde-1394-Artti#:~:text=%C3%9Clkede%202017'de%20369%20bin,y%C3%BCzde%20139%2C4%20art%C4%B1%C5%9F%20g%C3%B6sterdi.

TE Bilisim. (2022). Yerli muz üreticileri yıllık talebin 10'da birini karşılayabiliyor. Available on: https://www.northcyprusuk.com/yerli-muz-ureticileri-yillik-talebin-10da-birini-karsilayabiliyor.

TEPGE. (2020). Tarım Ürünleri Piyasaları, Muz. Tarımsal Ekonomi ve Politika Geliştirme Enstitüsü (TEPGE), 1-4. Available on: https://arastirma.tarimorman.gov.tr/tepge/Belgeler/PDF%20Tar%C4%B1m%20%C3%9Cr%C3%BCnleri%20Piyasalar%C4%B1/2020-Temmuz%20Tar%C4%B1m%20%C3%9Cr%C3%BCnleri%20Raporu/muz-temmuz%202020.pdf

TUİK, (2022). Türkiye İstatistik Kurumu Tarımsal Veriler. Erişim Tarihi: 26.07.2022. http://rapory.tuik.gov.tr/html

Uçak, A. B., Ertek, A., Güllü, M., & Aykanat, S. (2010). Bazı İklim Parametrelerinin Çukurova'da Yetistirilen Mısır Bitkisi Verim ve Kalitesine Etkileri. Journal of Agricultural Faculty of Gaziosmanpaşa University, 2010(1), 9-19.

Yurdakul, O., & Emeksiz, F. (1993). Çukurova'da Tarımsal Üretim Yapısındaki Gelişmeler ve Gap Alanı İçin Öngörüler. Tarım Ekonomisi Dergisi, 02(1-2), 32-45. Available on: https://dergipark.org.tr/tr/pub/tarekoder/issue/25827/272326

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

TARIM SAYIMLARININ GEÇMİŞİ, METODOLOJİLERİ VE TARIMSAL DESTEKLEME POLİTİKALARINA KATKISININ ARTIRILMASI İÇİN ÖNERİLER

Arş. Gör. Dr. Zehra Meliha TENGİZ
Yozgat Bozok Üniversitesi, Ziraat Fakültesi, Tarım Ekonomisi Bölümü
ORCID: 0000-0002-0831-7091

Dr. Osman İNAN
ORCID: 0000-0001-7306-5516

Sedanur ŞAHİN
Yozgat Bozok Üniversitesi, Ziraat Fakültesi, Tarım Ekonomisi Bölümü
ORCID: 0009-0009-6263-9743

ÖZET
Tarım sayımı, tarımsal üretimin temelde yapısal görünümünü yerleşim yeri ölçeğinde ortaya koyan, en kapsamlı veri kaynağı olarak kabul edilmektedir. Tarımsal destekleme politikalarına kaynak olacak yapısal veriler (arazi, hayvan, alet ve makine varlığı, sulama, işgücü vb.), tarım sayımından sağlanmaktadır. Elde edilen veriler tarımsal destekleme konularında karar vericilere, politika yapıcılara ve diğer tarım sektörü paydaşlarına (üreticiler, üretim kararı verme aşamasındakiler, araştırmacılar, profesyoneller) yol gösterici niteliktedir. Bu çalışmada, genel tarım sayımlarının tarihsel evrimi, metodolojik dönüşümü ve güncel uygulama incelenmiştir. Türkiye'de cumhuriyetin kuruluşundan beri 1927, 1950, 1963, 1970, 1980, 1991 ve 2001 yılında olmak üzere toplamda 7 kez "Genel Tarım Sayımı" gerçekleştirilmiştir. 2001 yılından günümüze kadarki 24 yıllık süreçte tarım sayımı yapılmamıştır. Tarım ve Orman Bakanlığı, bunu dikkate alarak 2025 yılı Temmuz ayında yeni bir tarım sayımı için çalışmalar başlatmıştır. Tarım sayımları tarım politikalarının planlanmasında ve izlenmesinde kritik rol oynamaktadır. Birleşmiş Milletler Gıda ve Tarım Organizasyonu (FAO) 'nun 10 yıllık önerisi ve Amerika Birleşik Devletleri (USA) 'nin 5 yıllık uygulaması göz önüne alındığında, tarım sayımlarının daha sık aralıklarla ve ara dönem güncellemeleriyle desteklenerek yapılması gerekmektedir. Ayrıca, tam sayımın mümkün olduğunca tercih edilmesi, teknolojik altyapının güçlendirilmesi ve Türkiye İstatistik Kurumu (TÜİK) 'nun veri toplama süreçlerinde desteklenmesi, tarımsal destekleme politikalarının istenen kesinlik ve etkinliğe ulaşmasına katkı sağlayacaktır.
Anahtar kelimeler: Tarım sayımı, tarım envanteri, tarımsal istatistik, tarımsal destekleme, tarım politikası.

THE HISTORY OF AGRICULTURAL CENSUSES AND RECOMMENDATIONS FOR INCREASING THEIR CONTRIBUTION TO AGRICULTURAL SUPPORT POLICIES

ABSTRACT
The agricultural census is considered the most comprehensive data source that reveals the fundamental structural characteristics of agricultural production at the settlement level. Structural data (land, livestock, equipment and machinery, irrigation, labor force, etc.) that serve as a basis for agricultural support policies are obtained from the agricultural census.

The obtained data provides guidance for decision-makers and policymakers in matters of agricultural subsidies, as well as for other stakeholders in the agricultural sector (producers, those in the process of making production decisions, researchers, professionals). This study examines the historical evolution, methodological transformation, and current practice of general agricultural censuses. Since the foundation of the Republic, a total of seven "General Agricultural Censuses" have been conducted in Turkey in the years 1927, 1950, 1963, 1970, 1980, 1991, and 2001. No agricultural census has been carried out in the 24-year period from 2001 to the present. Taking this into account, the Ministry of Agriculture and Forestry has initiated work for a new agricultural census in July 2025. Agricultural censuses play a critical role in the planning and monitoring of agricultural policies. Considering the United Nations Food and Agriculture Organization's (FAO) decennial recommendation and the United States of America (USA) quinquennial practice, it is imperative that agricultural censuses be conducted more frequently and supported by interim updates. Furthermore, prioritizing complete enumeration wherever feasible, strengthening the technological infrastructure, and supporting the Turkish Statistical Institute (TÜİK) in its data collection processes will contribute significantly to achieving the desired precision and effectiveness in agricultural support policies.
Keywords: Agricultural census, agricultural ınventory, agricultural statistics, agricultural support, agricultural policy.

GİRİŞ

Tarım sayımı, tarımsal üretimin temel yapısal görünümünü yerleşim yeri bazında ortaya koyan, en kapsamlı veri kaynağıdır. Tarım sayımlarından elde edilen arazi, hayvan, alet ve makine varlığı, sulama, işgücü vb. yapısal veriler tarımsal destekleme ve izlenecek politikaların belirlenmesinde önemlidir. Bu veriler sadece politika yapıcılar için değil; üreticiler, üretim kararı verme eğiliminde olanlar, araştırmacılar ve tarım sektöründe yer alan tüm paydaşlar için yol gösterici niteliğe sahiptir (Tarım ve Orman Bakanlığı, 2025). Tarım sayımı verileri, çiftçilere ve kırsal topluluklara hizmet eden herkes (merkezi ve yerel yönetimler, tarım işletmeleri, ticaret birlikleri ve diğer kurum ve kişiler) tarafından kullanılmaktadır (USDA, 2025);

• Çiftçiler ve çiftlik sahipleri, tarım sayımı verilerini kullanarak kendi işletmelerinin geleceği hakkında bilinçli kararlar alabilirler.
• Şirketler ve kooperatifler, tarım üreticilerine hizmet verecek tesislerin yerini belirlemek için bu verileri kullanır.
• Toplum planlamacıları, kırsal bölge sakinlerine gerekli hizmetleri sunmak için bu bilgileri kullanır.
• Politika yapıcı ve karar vericiler, tarım politikaları ve programları oluştururken nüfus sayımı verilerini kullanır.

Amerika Birleşik Devletleri (ABD)'nde 1840 yılından günümüze her 5 yılda bir, Avrupa Birliği (AB)'nde 10 yılda bir ve 3-4 yılda bir güncellenerek, dünya genelinde ise 1930 yılından beri Birleşmiş Milletler Gıda ve Tarım Organizasyonu (FAO)'nun tavsiyesiyle 10 yılda bir tarım sayımı yapılmaktadır. Türkiye'de, bugüne kadar 1927, 1950, 1963, 1970, 1980, 1991 ve 2001 yılında olmak üzere toplam 7 kez ''Genel Tarım Sayımı" yapılmıştır. Tarım sayımının 10 yılda bir gerçekleştirilmesi önerilirken, 2001'den bu yana tarım sayımı yapılmamıştır. Bu durum dikkate alınarak Tarım ve Orman Bakanlığı Tarım Reformu Genel Müdürlüğü (TRGM) ile Türkiye İstatistik Kurumu (TÜİK) arasında "Genel Tarım Sayımı" yapılmasına ilişkin protokol imzalanmış ve 24 yıl sonra yeni bir tarım sayımı için çalışmalar başlamıştır.

Tarım sayımlarının tarımsal desteklemelere ve tarım politikalarına katkısının artırılması için güncel çalışmalar yapılmasına ihtiyaç duyulmaktadır. Bu çalışmada literatür ve en son tarım sayımı ile ilgili olarak güncel çalışmalar incelenmiştir. Öncelikle, tarım sayımının önemi açıklanmış; ABD, AB, dünya genelinde geçmişte ve güncel durumda yapılan çalışmalar hakkında kısa bilgiler verilmiştir. Sonrasında Türkiye'de cumhuriyetten günümüze gerçekleştirilmiş tarım sayımları hakkında bilgiler sunulmuştur. Son olarak, 2025 Temmuz ayında başlanan tarım sayımı ve tarım sayımının tarımsal destekleme politikalarına katkısının artırılması için önerilere yer verilmiştir.

DÜNYA TARIM SAYIMI PROGRAMI (WCA)

Dünya genelinde tarım sayımını teşvik etme girişimi Uluslararası Tarım Enstitüsü (IIA), 1924 Genel Kurulu'nda kabul edilen karara uygun olarak, 1929-1930 yıllarında Dünya Tarım Sayımı Programı (WCA) 'nın geliştirilmesidir. Bu programda, birçok ülkenin hükümetleri, dünya çapında tarım sayımlarının koordineli bir şekilde uygulanmasını teşvik etmek konusunda anlaşmıştır. WCA 1929–1930, ilk dünya tarım sayımıdır ve yaklaşık 60 ülkede uygulanmıştır. İlk tarım sayımı sonrası, farklı yıllarda yayınlanan beş ciltlik eser, tarım istatistiklerinin iyileştirilmesi için büyük önem taşıyan bu girişimin ilk sonuçlarını özet halinde bir araya getirmektedir (IIA, 1939). 10 yıl aralıklı olarak tarım sayımlarının yapılması öngörülmüş, II. Dünya Savaşı'nın başlaması nedeniyle 1940'da, sayım tamamlanamamıştır.

II. Dünya Savaşı sonrası artan gıda talebi ve toprak verimliliğinin bozulması gibi sorunları ele almak için FAO, 1950 yılında WCA'yı koordine etmiştir. Bu program, 81 ülkeye ait istatistiksel bilgileri derleyen ilk FAO programıdır. Bununla, tarımsal üretim ve yapısı hakkında daha önce hiç elde edilemeyen kapsamlı ve güncel bir genel bakış sağlanması planlanmıştır. 1950 WCA'da, her hükümetin tarımı hakkında kapsamlı, doğru ve karşılaştırılabilir bilgiler elde etmek amaçlanmıştır. Bu bilgiler; tarım işletmelerinin sayısı ve temel özellikleri, tarımdan geçimini sağlayanların sayısı ve özellikleri ile tüm önemli ürünlerin üretim hacmi vb. içermektedir. Sayım öncesi programı açıklayan 1 adet ve sonrasında arazi kullanımı, sonuçlar ve sayım metodolojisini açıklayan 3 adet rapor yayımlanmıştır.

WCA 1960, sayım yöntemlerinde büyük bir atılım gerçekleştirmiş ve sayımlarda örnekleme yöntemlerinin kullanılmasını, sayım sonrası anketleri de dahil olmak üzere, başlatmıştır. Örnekleme yöntemlerinin kullanılması, tarım sayımına katılan ülke sayısını artırmıştır. Sayımda, her hükümetin tarımın yapısı hakkında mümkün olduğunca doğru ve karşılaştırılabilir bilgiler elde edilmesi öngörülmüştür. WCA 1970, örneklem anketleri için çerçeve, mevcut tarım istatistikleri için referans noktası ve sonraki tarım anketlerini organize etmek için kapasite geliştirme açısından, tarım istatistiklerinin genel sisteminde tarım sayımının rolünü tartışmıştır. 89 ülkeden elde edilen verilerde ayrıca, tarım işletmelerinin diğer endüstrilerle ilişkisini ele alan yeni bir bölüm eklenmiştir. Sayım, tarımsal işletmelerin sayısı ve alanı, toprak mülkiyeti, tarım işletmecileri ve arazi kullanımı gibi tarımsal yapıların temel özelliklerini tanımlayan verilerin uluslararası karşılaştırılabilir bir biçimde özetini sunmaktadır (FAO, 2025).

WCA 1980, on yıl içinde (1976–1985) yapılan ve referans yılı olan 1980'i merkez alan ulusal sayımlara atıfta bulunduğunu açıkça belirten ilk belgedir. Tarım sayımlarının yapılmasına ilişkin ek kılavuzlar, tarım sayımının fiilen gerçekleştirilmesinde atılması gereken adımlara ilişkin pratik bilgiler sağlamak amacıyla daha sonra yayınlandı. WCA 1990 ise, ülkeleri ulusal ekonomik ve istatistiksel kapasiteleri ve gereksinimlerine göre tarım sayımını geliştirmeye ve uygulamaya teşvik etti. Program; kavramları, tanımları ve sınıflandırmaları diğer veri kaynaklarında kullanılanlarla uyumlaştırmaya özen göstermiştir.

WCA 2000, yaklaşık 122 ülkede on yıl boyunca (1996–2005) gerçekleştirilen nüfus sayımlarını kapsamaktadır. Ayrıca, 114 ülke nüfus sayımı raporlarını FAO'ya sunmuştur. Bu raporlar, yayında bildirilen tarım nüfus sayımlarına ilişkin uluslararası karşılaştırılabilir veri ve meta verilerin hazırlanmasında temel oluşturmuştur. WCA 2010 ise, on yıl boyunca (2006–2015) gerçekleştirilen sayımları kapsamıştır. Bu turda, entegre tarım sayımları ve anketleri sistemi çerçevesinde ve ulusal istatistik sisteminin daha geniş bağlamında tarım sayımlarının gerçekleştirilmesine vurgu yapan yeni bir yaklaşım kullanılmıştır.
Son olarak gerçekleştirilen WCA 2020, 2016-2025 yılları arasında ülkelerin tarım sayımlarını standart metodolojilerle yapılmasını öngören Dünya Tarım Sayımı Programını kapsamaktadır. WCA 2020, toplanan verilerin uluslararası düzeyde karşılaştırılabilir olmasını sağlarken, 21. yüzyılın ortaya çıkan bilgi ihtiyaçlarını da karşılamak amacını taşımaktadır (FAO, 2025). Bu program kapsamında Türkiye 2025 yılında genel tarım sayımını gerçekleştirmektedir.

ABD TARIM SAYIMI UYGULAMASI

ABD'de, ilk tarım sayımı, altıncı on yıllık nüfus sayımının bir parçası olarak 1840 yılında yapılmıştır. 156 yıl boyunca (1840-1996) ABD Ticaret Bakanlığı Nüfus Sayımı Bürosu, tarım sayımı verilerini toplamaktan sorumlu tutulmuş, 1997 yılında tarım sayımını yürütme sorumluluğu ABD Tarım Bakanlığı (USDA) Ulusal Tarım İstatistikleri Servisi'ne (NASS) devredilmiştir. ABD'de, beş yılda bir yapılan tarım sayımları ile, arazi kullanımı ve mülkiyeti, işletmeci özellikleri, üretim uygulamaları, gelir ve giderler ve daha birçok alanı incelenmektedir. Tarım sayımı, ABD'deki çiftlik ve çiftliklerin ve bunları işleten insanların tam bir sayımıdır. İster kırsal ister kentsel olsun, küçük arazi parçaları bile, sayım yılı boyunca 1.000 dolar veya daha fazla değerinde tarım ürünü üretilip satılmışsa veya normalde satılacaksa sayılmaktadırlar. NASS, kapsam dışı kalma (ilk etapta ulaşılamayan çiftlikler), yanıt vermeme (nüfus sayımı anketlerini geri göndermeyen kişiler) ve yanlış sınıflandırma (bir işletmenin doğru şekilde çiftlik olarak sınıflandırılıp sınıflandırılmadığı) durumlarını hesaba katmak için kabul görmüş bir istatistiksel metodoloji olan yakalama-tekrar yakalama metodolojisini kullanmaktadır (NASS, 2025). ABD'de 13 Şubat 2024 tarihinde en son yapılan 2022 yılı tarım sayımı verileri yayınlanmış ve detaylı bilgileri NASS ve FFPA tarafından yönetilen kapsamlı bir web sitesinde sunulmaktadır (AFT, 2025).

AB TARIM SAYIMI UYGULAMASI

AB'de tarım sayımları 1960'lı yıllarda ortak tarım politikasının (CAP) oluşturulmasıyla birlikte tarımsal yapının izlenmesi ve üye ülkeler arasında veri sağlamak amacıyla başlatılmıştır. İlk uyumlaştırılmış sayım 1966-67 yıllarında gerçekleştirilmiştir. Ardından 1970'den itibaren üye ülkelerde beşer yıllık tarımsal yapı sayımları yürütülmüştür. Bu sayımlar AB'nin tarım politikalarının şekillenmesinde önemli rol oynamaktadır. 2000'li yıllardan itibaren coğrafi bilgi sistemleri, uydu verileri ve elektronik anketler kullanılmaya başlanmıştır.
AB'nde 2020'de gerçekleştirilen son tarım sayımında çiftlikler, tarım arazileri, çiftlik yöneticileri ve çiftlik işçiliği hakkında değerli bilgiler sunulmaktadır. AB tarım sayımı, 27 AB ülkesinin tamamında ve bazı EFTA (Avrupa Serbest Ticaret Birliği) ülkelerinde (Norveç, İsviçre, İzlanda ve Liechtenstein) her 10 yılda bir gerçekleştirilmektedir. Sayımla, Avrupa tarım sektörü hakkında coğrafi düzeyde ayrıntılı istatistiksel bilgiler sağlanmaktadır. Tarım sayımı, her 3-4 yılda bir düzenlenen ek veri toplama faaliyetleriyle desteklenmektedir.

Veriler şu konularda geniş kapsamlı olarak toplanmaktadır: çiftliğin ve çiftçinin genel özellikleri, çiftliklerin büyüklüğü, çiftliklerde çalışan kişi sayısı, yaşları ve cinsiyetleri, çiftlik yöneticilerinin aldıkları eğitim seviyesi, hayvan barınaklarındaki mevcut yerler ve gübre yönetimi hakkında bilgiler ile diğer kırsal kalkınma sorularıdır. Son tarım sayımında, hazır bir formla temel veri toplama işlemlerinde hızlandırıcı ve kolaylaştırıcı yönde iyileştirmelere gidilmiş ve AB'deki 9 milyondan fazla çiftliğin verilerinin toplanması hedeflenmiştir. AB ülkelerinde, tarım sayımını yürütmek üzere denetçi ve sayım görevlilerinden oluşan ekipler kurulmuştur. Bu ekipler, genellikle ulusal istatistik ofisleri ve tarım bakanlığından memurlar tarafından denetlenmiştir. Tarım sayımını tamamlamak için çiftlik kayıtları, idari kaynaklar ve anketler gibi her türlü toplama yöntemini kullanılmıştır. Anketler için sayım görevlileri çiftçilerle internet üzerinden, telefonla, mektupla veya yüz yüze görüşmeler yoluyla iletişime geçmiştir. Böylece, idari kaynakların daha kapsamlı kullanımına olanak sağlanarak, sayımların genel maliyeti düşürülmüş, aynı zamanda, çiftçilere kısmen önceden doldurulmuş anketler ulaştırıldığı için çiftçilerin yükü de hafifletilmiştir (EU, 2025).

TÜRKİYE TARIM SAYIMI UYGULAMASI

Türkiye'de Tarım İstatistiklerinin Temelleri ve İlk Sayım (1927)

Türkiye'de cumhuriyetin ilk yıllarında, günümüzdeki TÜİK'in ilk hali olan İstatistik Umum Müdürlüğü'nün kurulması ile birlikte Tarım İstatistikleri Şubesi faaliyete geçmiş, böylece tarım istatistikleri derlenmeye başlanmıştır (Acar & Arslaner, 2006). İlk tarım sayımı 1927 yılında yapılmıştır. Bu sayım, yöntemi bakımından 1970'li yıllarda BM tarafından yapılan tavsiyelere yakın olarak değerlendirilmektedir. Tam sayım esasına dayanan 1927 Tarım sayımı Ekim ayında; çiftçi aileleri, ekili alanlar, üretim miktar ve değeri ile hayvanlar, tarım alet ve makinelerini kapsamıştır. Derlenen veriler, çiftçi ailesine ilişkin bilgiler, aile mülkiyetinde bulunan veya aile tarafından işlenen tapulu/tapusuz arazi miktarı, işletme işlerinde kullanılan çeki ve koşum hayvanlarının türü ve sayısı, tarım aletleri, ekilen ürünler, ekim alanları ve birime verimler ile hayvan sayılarından oluşmaktadır (Yurtoğlu, 2018).

Tarım Sayımlarının Gelişimi (1950-2001)

Türkiye'de ikinci tarım sayımı 1950'de tam sayım yöntemi ile gerçekleştirilmiştir. Öncesinde 1945'te köy sayımları yapılmış, köy sayımları 1948 ve 1949 yıllarında yinelenmiş ve köy muhtarlarından tarımsal veriler toplanmıştır. Sayım 1950 yılı Kasım ayında Muhtarlık ve Aile Anketleri olmak üzere iki bölümde uygulanmıştır. Sayıma 34 bin 702 köy ve 3 bin 406 şehir muhtarlığı tabi tutulmuştur. Tarım Bakanlığı ile Milli Eğitim Bakanlığı personeli görevlendirilmiş, ziraat ve veteriner fakültelerinden destek alınmıştır. İşletme yapıları ve cari tarım istatistiklerine ilişkin verilerin toplanmasının yanında, işletme türlerine (yalnız toprak mahsulü yetiştirenler, yalnızca hayvan yetiştirenler vb.) göre bir sınıflandırma yapılmıştır. Sayıma göre çiftçi aile yapıları, arazi parçalılığı ve bazı yeni tanımlamalar yapılmıştır. Yine, köyde yaşayan aileler 'çiftçi' ve 'çiftçi olmayanlar" aileler olarak ayrılmıştır (Yılmaz, 2012).
1963 yılı tarım sayımı, BM tarafından öngörülen 10 yıllık sayım programları çerçevesinde uygulanmıştır. Sayım çalışmaları 1958 yılında başlatılmış, 1959, 1960 ve 1962'de deneme uygulamaları yapılmıştır. Sayımda, önceki sayımlarda kullanılan tam sayım yöntemi değiştirilerek, kamu tarımsal işletmelerinde tam sayım, diğerlerinde ise örnekleme yöntemi kullanılmıştır. Tarımsal işletmelerin sayısı, arazilerin kullanılma şekli, ekilen araziler, ürün bilgileri, sulanan araziler, gübrelenen araziler, büyük ve küçükbaş hayvan sayıları, hayvansal üretim bilgileri, tarımda yer alan insan, makine ve hayvan gücü bilgileri, üreticilerin eğitim, meslek, ekonomik faaliyet alanı ve diğer özellikleri ile göç durumu ve göç sebepleri gibi bilgilerden oluşturulmuştur.

1970 yılı tarım sayımında da küçük tarımsal işletmelerde örnekleme, büyük işletmelerde tam sayım ve alan örneklemesi yöntemi uygulanmış, alan örneklemesi için topoğrafik haritalar kullanılmıştır. Sayımda birbirinden bağımsız olarak iki yöntem uygulanmıştır. İlki "Alan Örneklemesi" yöntemidir. Bu yöntem Türkiye'de tarım sayımlarında ilk defa kullanılan yöntem niteliğinde olup, daha önceki sayımların beyan esasına dayanması ve bu çalışmalarda derlenen veriler ile gerçek veriler arasında önemli farklılıkların ortaya çıkması nedeniyle tercih edilmiştir. İkinci yöntem ise 'Hane Halkı Mülakat Anketi'dir. Söz konusu anket çalışması nüfusu 5 binden az olan yerler ve nüfusu 5 binden fazla olan yerler olarak iki aşamada yapılmıştır. Sayımda, genel tarımsal yapıya ilişkin bilgiler ile çiftçilerin demografik yapısı ile ilgili bilgilerin yanı sıra, milli gelir hesaplarında kullanılan tarımsal üretim serilerinin oluşturulmasına yönelik de çalışmalar yapılmıştır. Bulgular, 1972 yılında "1970 Cari İstatistikler ve Tarım Sayımı Sonuçları" yayınında paylaşılmıştır (Şaçlı, 2009).

1980 tarım sayımı ise daha katılımcı bir anlayış, kamu kurum ve kuruluşları ile üniversitelerin katılımları yapılmış, öncesinde 20.06.1978 tarih ve 10 sayılı Başbakanlık Genelgesi ile "Tarım Sayımı Komitesi" oluşturulmuştur. Komite, düzenli olarak toplanarak zaman çizelgesini de içeren "1980 Genel Tarım Sayımı Programı" hazırlanmıştır. Sayım, arazi genişliğine bakılmaksızın bitkisel ürün yetiştiren tüm işletmeler ile en az 2 büyükbaş ve 5 küçükbaş hayvanı olan tüm tarımsal işletmelerini kapsamıştır. Veriler, 1963 ve 1970 sayımları ile benzer yöntemler kullanılarak derlenmiştir (Şaçlı, 2009).

1991 sayımında FAO ve AB'nin istatistik kriterleri dikkate alınmıştır. Çalışmalar, TÜİK tarafından oluşturulan "1991 Genel Tarım Sayım Komitesi" ile başlamıştır. Komite, ilgili kurum ve kuruluşların katılımı ile 22.06.1990 tarihinde geniş katılımlı bir toplantı yaparak, sayımda izlenecek yol, derlenecek bilgiler ve konuya ilişkin diğer talepleri toplamıştır. Söz konusu toplantı sonuçları ve FAO'nun değerlendirmeleri de dikkate alınarak çalışmalar sürdürülmüş ve deneme anketleri uygulanmıştır. Önceki üç sayımdan farklı olarak, muhtarlar yerinde ziyaret yerine, il ve ilçe merkezlerine çağrılarak anketleri burada gerçekleştirilmiş (ikinci aşamada köy ziyaretleri yapılarak belirlenen sekiz işletmede anket uygulanmıştır), diğer sayımlarda da il düzeyinde toplanan verilerin bu kez il düzeyinde yayınlanması ve ilk sonuçların aynı yıl içerisinde yayınlanmıştır (Saçlı, 2009).

Türkiye'de son tarım sayımı 2001 yılında yapılmıştır. Bu genel tarım sayımı ile tarımsal işletme listesi ile tüm tarımsal işletmelere ilişkin ayrıntılı bilgilerin toplanarak Çiftçi Kayıt Sistemi (ÇKS) elde edilmesi ve ara yıllarda tarımsal işletmeler ile ilgili araştırmalara alt yapı oluşturulması hedeflenmiştir. Cari tarım istatistikleri ile derlenemeyen tarımsal işletmelerin büyüklükleri, tipleri, arazi tasarruf şekli, arazi parça sayısı, kimyasal gübre ve zirai mücadele ilacı kullanımı, hane halkı kompozisyonu gibi bilgilerin derlenmesi amaçlanmıştır. Ancak sayımın amaçlarından birisi olan ÇKS, daha sonra Tarım ve Köy İşleri Bakanlığı bünyesinde oluşturulmuştur (Yıldırım, 2025).

2025 Genel Tarım Sayımı

Türkiye'de son olarak 2025 yılında Genel Tarım Sayımı yapılmaktadır. Sayımın ilk aşamasında, sayımın kapsayacağı kitlenin tespitine yönelik altlık çalışmaları tamamlanarak; mevcut idari kayıtlarda yer almayan tarım arazilerinin ve bu arazilerde tarımsal faaliyette bulunan işletmelerin tespiti gerçekleştirilecektir. Bu aşamada ön tarama faaliyetleri, soru formları ve veri giriş programlarının hazırlanması, bilgilendirme, eğitim ve tanıtım çalışmaları yapılacaktır. İkinci aşamada ise, ilk aşamada elde edilen bilgiler esas alınarak, uluslararası gereklilikler ve ulusal ihtiyaçlar doğrultusunda belirlenen değişkenlere ilişkin veriler sahadan derlenecek ve elde edilen veriler kamuoyu ile paylaşılacaktır (Tarım ve Orman Bakanlığı, 2025).

Tarımsal işletmelere ilişkin arazi ve hayvan varlığı gibi temel konularda tam sayım, işgücü, sulama, tarımsal alet ve makine gibi diğer konularda ise örnekleme yoluyla veri derlenmesi planlanmıştır. Tarım Sayımı ile alt idari birim düzeyinde detaylı veri toplanması, cari tarım istatistikleriyle karşılaştırma imkanı sunulması ve ara yıllarda yapılacak tarımsal araştırmalar için çerçeve oluşturulması hedeflenmektedir (Yıldırım, 2025). Sayım kapsamında, üreticilerin faaliyetlerinin doğru, eksiksiz ve güncel verilerle kayıt altına alınması ve arazi büyüklüğünden ürün çeşitliliğine, hayvancılıktan makine parkına kadar 300 farklı değişkene ait verilerin toplanması amaçlanmıştır.

Tarımsal faaliyet gerçekleştiren tüm tarımsal işletmeler (hanehalkı, hanehalkı ortaklığı, şirket, kooperatif vs.) sayım kapsamındadır. İşletmeci, arazi, hayvan, alet ve makine varlığı gibi temel konularda tam sayım, işgücü, hayvan barınakları ve gübre yönetimi, toprak yönetim uygulamaları gibi konularda örnekleme yoluyla veri derlenecektir.

Sayıma katılım zorunlu tutulmuş ve eksik veya hatalı bilgi veren tarımsal işletmelere para cezası uygulanacaktır. Sayımda tüzel kişi (kooperatifler vb.) statüsündeki tarımsal işletmelerin anketi doğrudan internet üzerinden doldurması zorunlu yuyulurken, gerçek kişi statüsündeki tarımsal işletmeler ise internet üzerinden kendileri, tarım il/ilçe bünyesindeki sayım bürolarından yüz yüze doldurabilmektedir.

Sayım öncesinde bitkisel üretim için tasarruf şekline bakılmaksızın (sahip olunan, ortakçılık, yarıcılık ya da kiralama şeklinde) kullanılan tüm parsellere ilişkin bilgiler (ada ve parsel numaraları bazında), fiilen bitkisel üretim yapılmayan; ahır, samanlık gibi işletme binaları ile kavaklık, koruluk, taşlık vb. ile kaplı diğer parseller, varsa traktör ve biçerdöverler için plaka bilgileri ile sahip olunan/ kullanılan diğer tarımsal alet ve makinelerin listesi bilgilerinin soru formuna cevap vermeden önce hazırlanması istenmektedir (TÜİK, 2025).

Sayımda beyan edilen bilgilerin, ÇKS gibi sektöre ilişkin idari kayıtlar, nüfus kayıtları, kadastro bilgileri, traktör/biçerdöver tescil kayıtları gibi verilerle anlık olarak karşılaştırılmasını sağlayacak bir veri ve yazılım altyapısı kullanılmaktadır. Saha çalışmasında; yenilikçi, bilgisayar destekli, alternatif veri toplama yöntemlerinin kullanılması öngörülmüştür (TÜİK, 2025).

Çalışmanın referans dönemi, 1 Ekim 2024 - 30 Eylül 2025 tarihleri arası dönemi kapsayan 2025 üretim yılıdır. Bitkisel üretim ile tarımsal alet ve makine kullanımı için 1 Ekim 2024-30 Eylül 2025 referans dönemi; hayvancılık, tarımsal alet ve makine varlığı için 1 Temmuz 2025 referans günü esas alınacaktır.

Saha çalışmaları, tam sayım kapsamında derlenecek veriler ile örnekleme yoluyla derlenecek işgücü verileri için Temmuz 2025'te başlanmış ve 2025 yılı sonuna kadar devam etmesi planlanmıştır. Örnekleme yoluyla derlenecek diğer verilere ilişkin çalışmalar, 2026 yılında gerçekleştirilecektir. 2025 Genel Tarım Sayımına ilişkin ilk sonuçların 2026 yılı ikinci yarısında kamuoyuyla paylaşılması planlanmaktadır.

SONUÇ VE ÖNERİLER

Tarım sayımı, bir ülkede tarımsal üretimin başlıca ürünlerinin ve temelde yapısının yerleşim yeri bazında ortaya koyulmasında en kapsamlı veri kaynağıdır. Bununla, gıda ve tarım politikalarının doğru bir şekilde planlanabilmesi ve etkinliğinin izlenebilmesi için ihtiyaç duyulan çok önemli veriler elde edilmeye çalışılmaktadır.

Türkiye'de 2001'den bugüne 24 yıl sonra ilk kez tarım sayımı yapılmaktadır. Tarım sayımının ABD'de 5 yılda bir yapıldığı ve FAO'nun 10 yılda bir tarım sayımı yapılmasını tavsiye ettiği göz önüne alındığında bu süre oldukça fazla ve daha sık tarım sayımı yapılmalıdır. Ayrıca bu tavsiyenin yanında 3-4 yılda bir veya farklı sıklıklarda güncellenmesi de önemlidir.

AB'de EUROSTAT çalışmaları incelendiğinde üye devletlerin tarım sayımının güncellenmesini ciddiye aldıkları ve düzenli bir şekilde gözden geçirdikleri görülmektedir.
WCA 1950'den WCA 2020'ye kadar, FAO kuruluşundan bu yana sekiz on yıllık nüfus sayımı turu düzenlemiştir. Bu süre zarfında, turlara katılan ülke sayısı giderek artmıştır. WCA 1950'de 80 olan ülke sayısı, mevcut WCA 2020'de yaklaşık 130'a ulaşmıştır. FAO, bu ülkelerin çoğuna teknik destek sağlamıştır.
Türkiye'de tarım sayımlarının dünya standartlarında yapılması ve diğer ülkelerle ve bölgesel olarak karşılaştırmalar yapılabilmesi, benzer ülkelerden verilerin görülerek tarımsal destekleme politikaları için çıkarımlar yapılabilmesi önemlidir.
Tarım sayımında, tam sayımın yapılması bir diğer önemli konudur. Tam sayım yönteminde, işletmelerin eksiksiz olarak kaydı ve izlenmesi ile tarımsal destekleme politikalarında istenilen kesinliğe yaklaşılabilmektedir.
Tarım sayımının, yerleşmeler üzerinden yapılması, tam yapılması ve tam sayım süresine bağlı kalınmadan güncellenmesinin tarımsal destekleme politikalarının faydalarının daha kısa zamanda alınması ve etkilerinin daha kısa zamanda görülmesine katkısı vardır.
2022 yılında FAO, dünyanın en büyük tarım veritabanı olan FAOSTAT'a, ülkelerin tarım yapılarının zaman içindeki eğilimlerini çok daha kolay bir şekilde karşılaştırma ve değerlendirme imkanı sağlayan yeni bir alan adı vermiştir. Küresel bir kamu hizmeti olarak hizmet veren açık erişim portalı FAOSTAT, istihdam ve geçim kaynakları açısından dünyanın en büyük ekonomik sektörü olan tarım sektöründeki üretim, ticaret ve tüketimle ilgili zengin verileri toplamakta ve uyumlaştırmaktadır.
Türkiye'de TÜİK'e tarım sayımında verilerin toplanmasında yeterli kolaylık gösterilmelidir. Bunun yanında, sahadan elde edilen verilerin paylaşılması ve güncellenmesinde de kurum desteklenmelidir. Sahaya çıkan personelin deneyimi, ÇKS'nin kurulu olması ve teknolojik ilerlemeler dikkate alındığında en son sayımın daha hızlı ve kolayca yapılacağı tahmin edilmektedir. Burada önemli olan ise, verilerin doğru ve net olarak ortaya konulması ile tarımsal destekleme politikalarının en iyi şekilde belirlenmesi ve uygulanmasına katkı sağlamak olmalıdır.

KAYNAKLAR

Acar, M. & Arslaner, F. (2006): *Avrupa Birliği'ne Uyum Sürecinde Türk Tarım İstatistikleri: Sorunlar, Öneriler.* Published in: Proceedings of 15th Statistical Research Symposium, Vol. 15, No. ISSN 1306-6951 (May 2006): pp. 48-69. https://mpra.ub.uni-muenchen.de/56317/

AFT (2025). The Farmland Information Center. American Farmland Trust (AFT). Erişim adresi: https://farmlandinfo.org/ Erişim tarihi: 13.09.2025.

EU (2025). Census of agriculture. European Union (EU). Erişim adresi: https://ec.europa.eu/eurostat/web/agriculture/information-data/agricultural-census#:~:text=An%20agricultural%20census%20is%20an,the%20United%20Nations%20(FAO). Erişim tarihi: 08.09.2025.

FAO (2025). World census of agriculture. Food and Agricultural Organization (FAO). Erişim adresi: https://www.fao.org/world-census-agriculture/en/ Erişim tarihi: 08.09.2025.

IIA (1939). The First World Agricultural Census (1930). Internatıonal Institute of Agriculture (IIA). Volume 1-V. Rome.

NASS (2025). Tarım Sayımı. United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS). Erişim adresi: https://www.nass.usda.gov/AgCensus/FAQ/2022/index.php Erişim tarihi: 08.09.2025.

Saçlı, Y. (2009). Türkiye'de tarım istatistikleri (gelişimi, sorunlar ve çözüm önerileri). T.C. Başbakanlık Devlet Planlama Teşkilatı (DPT). İktisadi Sektörler ve Koordinasyon Genel Müdürlüğü. Yayın No: DPT: 2792. Ankara.

Tarım ve Orman Bakanlığı (2025). Genel tarım sayımı. Tarım Reformu Genel Müdürlüğü (TRGM). Erişim adresi: https://www.tarimorman.gov.tr/TRGM/Haber/886/2025-Genel-Tarim-Sayimi Erişim adresi: 08.09.2025.

TÜİK (2025). 2025 Genel Tarım Sayımı (GTS). Türkiye İstatistik Kurumu (TÜİK). Erişim adresi: https://www.tuik.gov.tr/Kurumsal/Genel_Tarim_Sayimi Erişim tarihi: 18.09.2025.

USDA (2025). Who uses Census of Agriculture data? Census of Agriculture. United States Department of Agriculture (USDA) National Agricultural Statistics Service. Erişim adresi: https://www.nass.usda.gov/AgCensus/ Erişim tarihi: 08.09.2025.

Yıldırım, A. E. (2025). Cumhuriyetten günümüze 7 tarım sayımı (27 Eylül 2023 Çarşamba). Erişim adresi: https://www.ekonomim.com/kose-yazisi/cumhuriyetten-gunumuze-7-tarim-sayimi/709484 Erişim tarihi: 07.07.2025.

Yılmaz, D. (2012). *Demokrat Parti'nin tarım politikasının Aydın ölçeğinde değerlendirilmesi (1950-1955)* (Yüksek Lisans Tezi). Adnan Menderes Üniversitesi, Sosyal Bilimler Enstitüsü, Tarih Anabilim Dalı. Aydın, Türkiye.

Yurtoğlu, Ü. (2018). *1923-1960 yılları arası hükümet ve siyasal parti programlarında tarım* (Yüksek Lisans Tezi). Yozgat Bozok Üniversitesi Sosyal Bilimler Enstitüsü Tarih Ana Bilim Dalı. Yozgat, Türkiye.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

TÜRKİYE'NİN ZEYTİNYAĞI DIŞ TİCARETİNDE KARŞILAŞTIRMALI ÜSTÜNLÜĞÜNÜN AVRUPA BİRLİĞİ PAZARI ODAKLI ANALİZİ

Dr. Zehra Meliha TENGİZ
Yozgat Bozok Üniversitesi, Ziraat Fakültesi, Tarım Ekonomisi Bölümü
ORCID: 0000-0002-0831-7091

Mehmet ERKUŞ
Zirai Mücadele Merkez Araştırma Enstitüsü Müdürlüğü
ORCID: 0009-0006-3013-6509

ÖZET
Uluslararası tarımsal ticaret, ülkelerin ekonomileri için büyük önem taşımaktadır. Özellikle zeytinyağı gibi geleneksel tarım ürünleri küresel pazarda stratejik bir yer tutar ve ekonomik potansiyel sunmaktadır. Zeytinyağı, Akdeniz havzası başta olmak üzere birçok ülke için hem geleneksel bir tarım ürünü hem de stratejik bir gıda maddesidir. Küresel zeytinyağı piyasası, büyük üreticiler (İspanya, İtalya, Yunanistan, Türkiye gibi) arasında yoğun bir rekabete sahne olmaktadır. Bu rekabetin dinamiklerini, ülkelerin karşılaştırmalı üstünlüklerini ve pazar paylarını incelemek, sektörün geleceği açısından kritik bilgiler sunmaktadır. Türkiye, dünya zeytinyağı üretiminde ve ihracatında önemli bir yere sahiptir. Bu durum, Türkiye'nin sektördeki mevcut konumunu, potansiyelini ve rekabet gücünü analiz etmeyi değerli kılmaktadır. Bu çalışmanın amacı Türkiye'nin zeytinyağı ihracatında Avrupa Birliğine karşı karşılaştırmalı üstünlüğünü incelemek ve rekabet gücümüzü artırmak için öneriler sunmaktır. Bu kapsamda, Türkiye'nin zeytinyağı dış ticaretindeki rekabet gücü Balassa'nın açıklanmış Karşılaştırmalı Üstünlük (RCA) indeksi kullanılarak analiz edilmiştir. Özellikle son yıllarda Türkiye'nin RCA değerlerinde artış yaşanması, ülkenin zeytinyağı ihracatındaki rekabet gücünün ve uluslararası uzmanlaşmasının kayda değer ölçüde arttığını göstermektedir. Türkiye'nin zeytinyağı sektöründeki rekabet gücünü artırması için markalı, ambalajlı ve yüksek katma değerli ürünlere yönelmesi gerekmektedir. Sektörde Ar-Ge ve inovasyona yapılacak yatırımlarla verimlilik ve kalite artırılmalıdır. Üretici, ihracatçı ve kooperatifler arasındaki işbirliği güçlendirilerek daha organize bir yapı oluşturulmalıdır. Ayrıca, geleneksel pazarların yanı sıra Kuzey Amerika ve Uzak Doğu gibi yeni pazarlara yönelik tanıtım faaliyetlerinin yoğunlaştırılması önerilmektedir.
Anahtar Kelimeler: Rekabet gücü, zeytinyağı, Balassa indeksi.

ANALYSIS OF TURKEY'S COMPARATIVE ADVANTAGE IN OLIVE OIL FOREIGN TRADE WITH A FOCUS ON THE EUROPEAN UNION MARKET

ABSTRACT
International agricultural trade is of great importance for countries' economies. Traditional agricultural products, especially olive oil, hold a strategic position in the global market and offer economic potential. Olive oil is both a traditional agricultural product and a strategic food item for many countries, particularly in the Mediterranean basin. The global olive oil market is witnessing intense competition among major producers (such as Spain, Italy, Greece, and Turkey). Examining the dynamics of this competition, countries' comparative advantages, and market shares provides critical information for the future of the sector. Turkey holds a significant position in world olive oil production and exports. This makes it valuable to analyze Turkey's current position, potential, and competitiveness in the sector.

The aim of this study is to examine Turkey's comparative advantage in olive oil exports against the European Union and to offer suggestions to increase our competitiveness. In this context, Turkey's competitiveness in olive oil foreign trade has been analyzed using Balassa's Revealed Comparative Advantage (RCA) index. The increase in Turkey's RCA values, especially in recent years, indicates that the country's competitiveness and international specialization in olive oil exports have increased significantly. To increase its competitiveness in the olive oil sector, Turkey needs to focus on branded, packaged, and high value-added products. Productivity and quality should be improved through investments in R&D and innovation in the sector. A more organized structure should be created by strengthening cooperation between producers, exporters, and cooperatives. Additionally, it is recommended to intensify promotional activities targeting new markets such as North America and the Far East, alongside traditional markets.
Keywords: Competitiveness, olive oil, Balassa index.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

CEVIZDE KANTİTATİF ÖZELLİK LOKUSLARININ (QTL) BELİRLENMESİ: ISLAH ÇALIŞMALARINA MOLEKÜLER YAKLAŞIMLAR

Mesut ADA
Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü
ORCID: 0000-0003-1495-9311

Hayat TOPÇU
Tekirdağ Namık Kemal Üniversitesi Tarımsal Biyoteknoloji Bölümü
ORCID: 0000-0003-3108-4393

Salih KAFKAS
Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü
ORCID: 0000-0002-9037-4764

Özet
Ceviz (*Juglans regia* L.), besinsel değeri, ekonomik önemi ve geniş adaptasyon kabiliyeti ile dünyada yaygın olarak yetiştirilen sert kabuklu meyve türlerinden biridir. Geleneksel seleksiyon temelli ıslah yöntemleri, ceviz gibi uzun gençlik kısırlığı dönemine sahip türlerde zaman alıcı ve sınırlı etkiye sahiptir. Bu nedenle kantitatif özellik lokuslarının (QTL) belirlenmesine yönelik moleküler yaklaşımlar, ceviz ıslah programlarında etkinliği artırmak için önemli bir alternatif sunmaktadır. Bu derlemede, cevizde QTL analizine yönelik yürütülen araştırmalar, kullanılan moleküler markör sistemleri (SSR, SNP, GBS vb.), özellikle verim, hasat tarihi, yapraklanma zamanı, kabuk dayanıklılığı ve yan dal meyve verme gibi önemli tarımsal özelliklerle ilişkili QTL'lerin belirlenebildiği kromozomal bölgeler incelenmiştir. Ayrıca, Türkiye'de yürütülen QTL tabanlı ıslah çalışmaları ve gelecekteki potansiyel uygulamalara da yer verilmektedir.
Anahtar Kelimeler: ceviz, QTL, moleküler markör, SSR, SNP, seleksiyon, ıslah

IDENTIFICATION OF QUANTITATIVE TRAIT LOCI (QTL) IN WALNUT: MOLECULAR APPROACHES IN BREEDING PROGRAMS

Abstract
Walnut (*Juglans regia* L.) is one of the most widely cultivated nut species worldwide due to its nutritional value, economic importance, and broad adaptability. Conventional selection-based breeding methods are time-consuming and have limited effectiveness in species such as walnut, which has a long juvenile period. Therefore, molecular approaches aimed at identifying quantitative trait loci (QTL) offer a significant alternative to increase the efficiency of walnut breeding programs. This review examines research conducted on QTL analysis in walnut, the molecular marker systems used (SSR, SNP, GBS, etc.), and the chromosomal regions where QTLs associated with important agronomic traits—such as yield, harvest date, leafing time, shell strength, and lateral fruiting—have been identified. In addition, QTL-based breeding studies carried out in Türkiye and potential future applications are also discussed.
Keywords: walnut, QTL, molecular marker, SSR, SNP, selection, breeding

Giriş

Ceviz (*Juglans regia* L.), hem beslenme değeri hem de ticari potansiyeli yüksek olan bir meyve türü olup, dünyada ve özellikle Türkiye'de geniş alanlarda yetiştirilmektedir. Uzun gençlik periyodu ve heterozigotluk düzeyinin yüksek olması, klasik ıslah yöntemlerinin etkinliğini sınırlamaktadır (Vahdati et al., 2019). Bu nedenle moleküler markörlerin ıslah süreçlerine entegrasyonu, istenilen karakterlere sahip bireylerin erken safhada seçilmesini mümkün kılarak ıslah verimliliğini artırmaktadır (Aksu, 2015).

Kantitatif özellik lokusları (QTL), verim, fenoloji, meyve kalitesi gibi bir çok gen ile ve çevresel etkilerle değişen karakterlerin genetik kontrolünden sorumlu kromozomal bölgeleri ifade etmektedir. Bu bölgelerin tespiti, hem ıslah çalışmaları için markör geliştirilmesini hem de ilgili genlerin fonksiyonel olarak analiz edilmesini sağlamaktadır (Borevitz & Chory, 2004).

QTL Kavramı ve Haritalama Yöntemleri

QTL, poligenik kontrol altındaki özelliklerle ilişkili kromozomal bölgeleri tanımlamak amacıyla kullanılan bir kavramdır. Bitkilerde birçok önemli agronomik özelliğin kantitatif doğaya sahip olması, bu özelliklerin klasik seleksiyon yöntemleriyle ıslahını zorlaştırmaktadır. QTL haritalama teknikleri sayesinde bu tür özelliklerin genetik kontrol bölgeleri tanımlanabilmekte ve bu bölgeler moleküler markörler yardımıyla izlenebilmektedir (Williams, 1998).

QTL analizleri genellikle iki ana yaklaşımla yürütülmektedir: bağlantı (linkage) haritalama ve ilişkilendirme (association) haritalaması. Bağlantı haritalaması, kontrollü çaprazlamalardan elde edilen popülasyonlarda (örneğin F1, BC1) kullanılırken, ilişkilendirme haritalaması doğal popülasyonlarda genetik çeşitliliğe dayalı olarak yürütülmektedir (Bernard et al., 2020). Son yıllarda gelişen QTL-seq, GBS (genotyping-by-sequencing) ve yüksek yoğunluklu SNP (Single nucleotide polymorphism) dizileme teknolojileri, bu analizlerin çözünürlüğünü ve doğruluğunu büyük ölçüde artırmıştır (Kazan et al., 2024).

Moleküler markör olarak SSR (Simple Sequence Repeat), SNP ve Indel (insertion- deletion) gibi yapılar kullanılmaktadır. Özellikle SNP markörleri, yüksek yoğunluklu haritalar oluşturulmasında ve genom çapında ilişkilendirme çalışmalarında yaygın şekilde tercih edilmektedir (Arab et al., 2019).

Cevizde Yapılan QTL Çalışmaları

Son yıllarda cevizde QTL haritalaması ile birçok önemli özellik ilişkili hale getirilmiş ve ıslah çalışmalarına yön verecek moleküler markerler tanımlanmıştır. Bernard ve ark. (2020), fenolojik özellikler ve yan dal meyve verme kapasitesi gibi verimsel özelliklerle ilişkili QTL'leri belirlemiş; Kazan ve ark. (2024) ise *Chandler* × *Kaplan-86* F1 populasyonu üzerinde yürüttükleri QTL-seq çalışmasıyla hasat tarihiyle ilişkili büyük etkili bir QTL bölgesi tespit etmiştir. Bükücü ve ark. (2020), yapraklanma zamanı ve çiçeklenme başlangıcı gibi fenolojik özellikleri kontrol eden majör QTL'leri ortaya koyarken; Sideli ve ark. (2020a) cevizde kabuk birleşim kuvveti gibi mekanik meyve özelliklerinin kantitatif doğasını genom çapında haritalama yöntemleriyle incelemiş, Sideli ve ark. (2020b) ise pellicle pigmenti gibi görsel kalite unsurlarının genetik temellerini açıklamıştır.

QTL haritalama çalışmaları yalnızca verim, fenoloji ve kalite ile sınırlı olmayıp, bitkilerin stres faktörlerine tepkilerinin genetik kontrol bölgelerinin belirlenmesinde de kullanılmaktadır.

Abiyotik stres açısından Vahdati ve ark. (2019), kuraklık, düşük sıcaklık ve tuzluluk gibi çevresel streslere dayanıklılıkta QTL verilerinin önemini vurgulamış; Vahdati ve Mohseniazar (2016) ise erken meyveye yatan genotiplerin kuraklık adaptasyonundaki genetik avantajına dikkat çekmiştir. Biyotik stres açısından ise Ramasamy ve ark. (2021) *Agrobacterium tumefaciens*, *Phytophthora cinnamomi* ve *P. pini* patojenlerine karşı direnç ile ilişkili, kök sistemi odaklı önemli QTL bölgelerini belirlemiş; Saxe ve ark. (2025) *J. microcarpa* × *J. regia* melezlerinde üç farklı hastalığa karşı direnç ve vegetatif gelişim kapasitesi ile bağlantılı QTL'leri aynı kromozomal bölgelerde (co-location) tespit etmiştir. Ayrıca Land (2019), *J. nigra* populasyonlarında antraknoz hastalığına karşı fenotipik direnç analizleri yürütmüş ve QTL haritalama çalışmalarına temel olacak popülasyonlar geliştirmiştir.

Cevizde QTL temelli ıslah çalışmalarının yalnızca tarımsal verim ve kaliteyi değil, aynı zamanda abiyotik ve biyotik streslere karşı adaptasyonu da kapsadığını, dolayısıyla sürdürülebilir ceviz üretimi için kritik bir araç olduğunu ortaya koymaktadır.

Türkiye, ceviz genetik kaynakları bakımından önemli bir zenginliğe sahiptir ve yerel çeşitler üzerinde yürütülen moleküler düzeydeki çalışmalar her geçen yıl artmaktadır. Uzun yıllar boyunca seleksiyon ıslahı yöntemiyle sürdürülen çalışmalar, son dönemde moleküler markör destekli seleksiyon (MAS) ve QTL haritalama yaklaşımlarıyla desteklenmeye başlanmıştır (Sütyemez et al., 2021).

Topcu ve ark. (2015), *J. nigra* kaynaklı SSR markörleri geliştirerek Türk ceviz populasyonlarının moleküler karakterizasyonuna katkı sağlamışlardır. Bükücü ve ark. (2020), Türkiye menşeli genotiplerde yapraklanma zamanı gibi özelliklere ait büyük etkili QTL bölgeleri belirlemiş ve bu bölgeler üzerinden ileri seleksiyon çalışmalarına ışık tutmuştur. Kazan ve ark. (2024) tarafından yürütülen hasat tarihi ile ilişkili QTL-seq çalışması da, yerel çeşitlerin erken olgunlaşma eğilimlerinin genetik temelini anlamada önemli bir adım olmuştur.

Ayrıca, Orman ve ark. (2020) tarafından yürütülen ilişkilendirme analizleri ile meyve iriliği, kabuk kalınlığı ve yağ oranı gibi ekonomik açıdan önemli özelliklerle ilişkili lokuslar tanımlanmış, bu veriler ıslah programları için doğrudan kullanılabilir hale getirilmiştir. Bu tür çalışmalar, Türkiye'deki ceviz ıslahında moleküler ıslah yaklaşımlarının etkin şekilde entegre edildiğini göstermektedir.

Sonuç ve Gelecek Perspektifi

Ceviz ıslahında moleküler genetik yaklaşımların kullanımı, özellikle QTL haritalama çalışmalarıyla önemli bir ivme kazanmıştır. Çok genli ve çevresel etkiye açık karakterlerin klasik yöntemlerle ıslahı oldukça zor ve zaman alıcı iken, QTL çalışmaları sonucu elde edilen veriler kullanılarak , istenilen özelliklerin genetik düzeyde izlenmesini sağlayarak ıslah süresini kısaltmakta ve verimliliği artırmaktadır.

Son yıllarda hem dünyada hem de Türkiye'de yürütülen çalışmalar, verim, hasat tarihi, fenolojik gelişim, kalite ve stres toleransı gibi birçok önemli özelliğin genetik kontrol bölgelerinin başarıyla tanımlanabildiğini göstermektedir. Bu bilgiler ışığında geliştirilen markör destekli seleksiyon sistemleri, ceviz gibi uzun ömürlü türlerde erken seleksiyon ve yüksek isabet oranıyla yeni çeşit geliştirme süreçlerini hızlandırmaktadır.

Gelecekte, cevizde genomik seleksiyon, gen düzenleme (CRISPR/Cas9) ve fonksiyonel genetik gibi ileri düzey moleküler tekniklerin QTL verileri ile entegre edilmesi, hem temel bilimsel bilgi üretimini hem de uygulamalı ıslah programlarının başarısını artıracaktır. Bu doğrultuda ulusal genetik kaynakların korunması, karakterize edilmesi ve bu kaynakların moleküler ıslaha entegre edilmesi sürdürülebilir ceviz üretiminin anahtarı olacaktır.

Kaynakça

Aksu, M. (2015). Moleküler Markörlerin Meyve Islahında Kullanım Alanları. *Meyve Bilimi*, *2*(1), Article 1.

Arab, M. M., Marrano, A., Abdollahi-Arpanahi, R., Leslie, C. A., Askari, H., Neale, D. B., & Vahdati, K. (2019). Genome-wide patterns of population structure and association mapping of nut-related traits in Persian walnut populations from Iran using the Axiom *J. regia* 700K SNP array. *Scientific Reports*, *9*(1), 6376. https://doi.org/10.1038/s41598-019-42940-1

Bernard, A., Marrano, A., Donkpegan, A., Brown, P. J., Leslie, C. A., Neale, D. B., Lheureux, F., & Dirlewanger, E. (2020). Association and linkage mapping to unravel genetic architecture of phenological traits and lateral bearing in Persian walnut (*Juglans regia* L.). *BMC Genomics*, *21*(1), 203. https://doi.org/10.1186/s12864-020-6616-y

Borevitz, J. O., & Chory, J. (2004). Genomics tools for QTL analysis and gene discovery. *Current Opinion in Plant Biology*, *7*(2), 132-136. https://doi.org/10.1016/j.pbi.2004.01.011

Bükücü, Ş. B., Sütyemez, M., Kefayati, S., Paizila, A., Jighly, A., & Kafkas, S. (2020). Major QTL with pleiotropic effects controlling time of leaf budburst and flowering-related traits in walnut (*Juglans regia* L.). *Scientific Reports*, *10*(1), 15207. https://doi.org/10.1038/s41598-020-71809-x

Chatwin, W., Shirley, D., Lopez, J., Sarro, J., Carlson, J., Devault, A., Pfrender, M., Revord, R., Coggeshall, M., & Romero-Severson, J. (2022). Female flowers first: QTL mapping in eastern black walnut (*Juglans nigra* L.) identifies a dominant locus for heterodichogamy syntenic with that in Persian walnut (*J. regia* L.). *Tree Genetics & Genomes*, *19*(1), 4. https://doi.org/10.1007/s11295-022-01580-9

Kazan, M., Karcı, H., Karaarslan, D., Sutyemez, M., & Kafkas, S. (2024). Identification of a major QTL region and candidate genes responsible for harvest date combining QTL mapping and QTL-seq approaches in walnut (*Juglans regia* L.). *Scientia Horticulturae*, *337*, 113576. https://doi.org/10.1016/j.scienta.2024.113576

Land, S. (2019). Phenotypic Study of Anthracnose Resistance in Black Walnut and Building a Mapping Population. *Graduate Theses/Dissertations*. https://bearworks.missouristate.edu/theses/3451

Orman, E., Ateş, D., Özkuru, E., Hepaksoy, S., Kafkas, S., & Tanyolaç, M. (2020). Association mapping of several nut characters in walnut (*Juglans regia* L.). *Turkish Journal of Agriculture and Forestry*, *44*(2), 208-227. https://doi.org/10.3906/tar-1909-35

Ramasamy, R. K., Luo, M.-C., Leslie, C. A., Velasco, D., Ott, N., McClean, A., Dandekar, A. M., Aradhya, M., Brown, P. J., Browne, G. T., Kluepfel, D. A., Westphal, A., & Dvorak, J. (2021). Co-located quantitative trait loci mediate resistance to Agrobacterium tumefaciens, Phytophthora cinnamomi, and P. pini in Juglans microcarpa × J. regia hybrids. *Horticulture Research*, *8*, 111. https://doi.org/10.1038/s41438-021-00546-7

Saxe, H. J., Leslie, C. A., Brown, P. J., Westphal, A., Kluepfel, D. A., Browne, G. T., & Dandekar, A. M. (2025). Co-Location of QTL for Vigor and Resistance to Three Diseases in *Juglans microcarpa* × *J. regia* Rootstocks. *International Journal of Molecular Sciences*, *26*(3), 903. https://doi.org/10.3390/ijms26030903

Sideli, G. M., Marrano, A., Montanari, S., Leslie, C. A., Allen, B. J., Cheng, H., Brown, P. J., & Neale, D. B. (2020a). Quantitative phenotyping of shell suture strength in walnut (*Juglans regia* L.) enhances precision for detection of QTL and genome-wide association mapping. *PLOS ONE*, *15*(4), e0231144. https://doi.org/10.1371/journal.pone.0231144

Sideli, G. M., McAtee, P., Marrano, A., Allen, B. J., Brown, P. J., Butterfield, T. S., Dandekar, A. M., Leslie, C. A., & Neale, D. B. (2020b). Genetic Analysis of Walnut (*Juglans regia* L.) Pellicle Pigment Variation Through a Novel, High-Throughput Phenotyping Platform. *G3 Genes|Genomes|Genetics*, *10*(12), 4411-4424. https://doi.org/10.1534/g3.120.401580

Sütyemez, M., Boyacı, S., Kuşçuoğlu, N., Özcan, A., Bükücü, Ş. B., Yıldırım, E., & Bardak, A. (2021). A research on the determination of phenological and molecular characterization in open-pollinated genotypes in walnut. *Harran Tarım ve Gıda Bilimleri Dergisi*, *25*(4), Article 4. https://doi.org/10.29050/harranziraat.986501

Topcu, H., Coban, N., Woeste, K., Sutyemez, M., & Kafkas, S. (2015). Developing new microsatellite markers in walnut (*Juglans regia* L.) from Juglans nigra genomic GA enriched library. *Ekin Journal of Crop Breeding and Genetics*, *1*(2), Article 2.

Vahdati, K., & Mohseniazar, M. (2016). Early bearing genotypes of walnut: A suitable material for breeding and high density orchards. *Acta Horticulturae*, *1139*, 101–106. https://doi.org/10.17660/ActaHortic.2016.1139.18

Vahdati, K., Arab, M. M., Sarikhani, S., Sadat-Hosseini, M., Leslie, C. A., & Brown, P. J. (2019). Advances in Persian Walnut (Juglans regia L.) Breeding Strategies. In J. M. Al-Khayri, S. M. Jain, & D. V. Johnson (Eds.), *Advances in Plant Breeding Strategies: Nut and Beverage Crops: Volume 4* (pp. 401–472). Springer International Publishing. https://doi.org/10.1007/978-3-030-23112-5_11

Williams, C. G. (1998). QTL Mapping in Outbred Pedigrees. In *Molecular Dissection of Complex Traits*. CRC Press.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

CEVİZ (*Juglans regia* L.) ISLAHINDA MARKÖRE DAYALI SELEKSİYON: MOLEKÜLER MARKÖRLER, QTL VE GWAS UYGULAMALARI

Mesut ADA
Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü
ORCID: 0000-0003-1495-9311

Hayat TOPÇU
Tekirdağ Namık Kemal Üniversitesi Tarımsal Biyoteknoloji Bölümü
ORCID: 0000-0003-3108-4393

Salih KAFKAS
Çukurova Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü
ORCID: 0000-0002-9037-4764

Özet
Ceviz (*Juglans regia* L.), yüksek besin değeri, geniş ekolojik adaptasyon yeteneği ve uzun ömürlü yapısı ile dünya genelinde önemli bir sert kabuklu meyve türüdür. Ancak, uzun gençlik kısırlığı dönemi, genetik çeşitliliğin yüksekliği ve çevresel faktörlerin fenotipik özellikler üzerindeki güçlü etkileri, geleneksel ıslah programlarının etkinliğini sınırlandırmaktadır. Moleküler markör teknolojilerinin gelişmesi, marköre dayalı seleksiyon (MAS) yönteminin ceviz ıslahına entegre edilmesine olanak sağlamış; bu sayede hedef özelliklere sahip bireylerin erken dönemde belirlenmesi ve seleksiyon süresinin önemli ölçüde kısaltılması mümkün olmuştur. MAS, fenolojik özellikler, meyve kalitesi, besin elementi kompozisyonu, hastalık ve zararlı direnci ile abiyotik stres toleransı gibi çok çeşitli özelliklerde uygulanabilmektedir. Son yıllarda yeni nesil sekanslama yöntemlerinin hız kazanması ve genom çapında ilişkilendirme çalışmaları (GWAS), cevizde birçok önemli özellik ile ilişkili aday gen ve markörlerin tanımlanmasını sağlamış, bu bulgular MAS'ın etkinliğini artırarak modern ıslah stratejilerinin temel bileşeni haline gelmesine katkıda bulunmuştur.
Anahtar Kelimeler: Marköre dayalı seleksiyon, *Juglans regia*, moleküler markörler, GWAS, ceviz ıslahı

MARKER-ASSISTED SELECTION IN WALNUT (*JUGLANS REGIA* L.) BREEDING: MOLECULAR MARKERS, QTL, AND GWAS APPLICATIONS

Abstract
Walnut (*Juglans regia* L.) is an important nut crop worldwide due to its high nutritional value, broad ecological adaptability, and long lifespan. However, the long juvenile period, high genetic diversity, and strong influence of environmental factors on phenotypic traits limit the efficiency of conventional breeding programs. Advances in molecular marker technologies have enabled the integration of marker-assisted selection (MAS) into walnut breeding, allowing for the early identification of individuals with desirable traits and significantly shortening the selection cycle. MAS can be applied to a wide range of traits, including phenological characteristics, nut quality, mineral composition, disease and pest resistance, and tolerance to abiotic stresses. In recent years, the rapid development of next-generation sequencing technologies and genome-wide association studies (GWAS) has facilitated the identification of candidate genes and markers associated with many important traits in walnut.

These findings have enhanced the effectiveness of MAS, contributing to its emergence as a key component of modern breeding strategies.
Keywords: Marker-assisted selection, *Juglans regia*, molecular markers, GWAS, walnut breeding

Giriş

Ceviz (*Juglans regia* L.), tarih boyunca hem besin kaynağı hem de ekonomik değer taşıyan bir tarım ürünü olarak öne çıkmıştır. Ceviz, yüksek oranda doymamış yağ asitleri, protein, vitaminler ve mineraller içermesi nedeniyle insan beslenmesinde önemli bir yere sahiptir (Bernard et al., 2017). Ayrıca ceviz ağaçları uzun ömürlü olması, farklı ekolojik koşullara adaptasyon kabiliyeti ve yüksek piyasa değeri ile küresel tarım ekonomisinde stratejik öneme sahiptir (Vahdati et al., 2019; Manzoor et al., 2023).

Bununla birlikte ceviz ıslahı, biyolojik ve genetik özelliklerinden kaynaklanan önemli zorluklar içermektedir. Öncelikle cevizde gençlik kısırlık dönemi 7–10 yıl gibi uzun bir süreyi kapsamakta, bu da seleksiyon döngülerinin uzamasına ve ıslah süresinin maliyetli hale gelmesine neden olmaktadır (Bernard et al., 2017; Vahdati et al., 2019). Ayrıca cevizin yüksek heterozigotluk düzeyi, çaprazlama sonrası populasyonlarda genetik varyasyonun öngörülmesini zorlaştırmaktadır. Çevresel faktörlerin fenotip üzerinde güçlü etkisi de klasik seleksiyon yöntemlerinin güvenilirliğini sınırlandırmaktadır (Doğan et al., 2014; Mahmoodi et al., 2021).

Moleküler biyoloji tekniklerinin tarımsal ıslah programlarına entegre edilmesi, özellikle 1980'lerden itibaren moleküler markör teknolojilerinin gelişimiyle mümkün olmuştur (Arús i Gorina, 2017). Bu bağlamda MAS, genetik haritalama ve hedef özellik ile ilişkili markörlerin tanımlanmasına dayalı olarak, istenen genotiplerin erken dönemde tespit edilmesini sağlayan güçlü bir araç olarak öne çıkmaktadır (De Mori and Cipriani, 2023). MAS, kantitatif özellik lokuslarının (QTL) haritalanması, genom çapında ilişkilendirme çalışmaları (GWAS) ve aday gen analizleri gibi genomik yaklaşımlar ile doğrudan ilişkilidir (Ji et al., 2021; Akpunar et al., 2024).

Günümüzde cevizde MAS uygulamaları; fenolojik özellikler (yapraklanma zamanı, yan dal verimi gibi), meyve kalitesi (kabuk sertliği, yağ asidi bileşimi), besin elementi birikimi (Ca, P, Fe, Mn), hastalık ve zararlı direnci (antraknoz, bakteriyel yanıklık) ve abiyotik stres toleransı (kuraklık, tuzluluk) gibi geniş bir yelpazede başarıyla uygulanmaktadır (Kefayati et al., 2019; Fallah et al., 2024; Doğanay et al., 2025). Bu araştırmada cevizde MAS çalışmalarına ilişkin mevcut literatürü derleyerek, kullanılan moleküler markör teknolojilerini, QTL ve GWAS temelli bulguları, uygulama alanlarını ve gelecekteki araştırma perspektiflerini kapsamlı şekilde sunmayı amaçlamaktadır.

Moleküler Markörler ve MAS'ın Temel İlkeleri

Moleküler markörler, organizmaların DNA dizilimindeki polimorfizmleri tespit ederek genetik varyasyonu ortaya koyan araçlardır. Bitki ıslahında, fenotipik ölçümlerin yanı sıra genotipik bilgilerin de değerlendirilmesi, özellikle uzun gençlik kısırlığı periyoduna sahip türlerde seleksiyon süresini kısaltma ve ıslah programlarının etkinliğini artırma potansiyeline sahiptir (Arús i Gorina, 2017; De Mori and Cipriani, 2023). Ceviz gibi odunsu türlerde, moleküler markörlerin kullanımı yalnızca genetik çeşitliliğin belirlenmesiyle sınırlı kalmamış, aynı zamanda QTL haritalanması ve MAS uygulamalarının geliştirilmesine de olanak sağlamıştır (Doğan et al., 2014; Mahmoodi et al., 2021).

Moleküler Markör Tipleri ve Özellikleri

Ceviz araştırmalarında farklı moleküler markör teknikleri kullanılmıştır. Bu teknikler, markörün özellikleri, polimorfizm seviyeleri ve uygulama alanlarına göre farklı avantajlar ve sınırlılıklar sunmaktadır. Moleküler karakterizasyon deneyleri, bitkilerdeki genetik çeşitliliğin değerlendirilmesi için etkili bir araç sağlar (Mahmoodi et al., 2021). Çeşitli moleküler belirteç türleri (RFLP (Restriction Fragment Length Polymorphism), RAPD (Random Amplified Polymorphic DNA), SSR (Single Nucleotide Polymorphism), SRAP (Sequence Related Amplified), ISSR (Inter Simple Sequence Repeats), AFLP (amplified fragment length polymorphisms), SCOT (Start Codon Targeted Polymorphism)) ceviz türlerindeki genetik çeşitlilik düzeylerini değerlendirmek için başarıyla kullanılmıştır (Doğan ve Kafkas, 2018; Yaman ve ark. 2020; Arús i Gorina, 2017; De Mori and Cipriani, 2023; Ji et al., 2021; De Mori and Cipriani, 2023; Doğanay et al., 2025; Zarinkolah et al., 2025). SSR markörleri, genetik çeşitlilik analizleri (Yıldız et al., 2021), bağlantı haritalarının oluşturulması (Kefayati et al., 2019) ve QTL tespiti (Zhu et al., 2015) çalışmalarında önemli rol oynamıştır.

MAS'ın İşleyiş Prensipleri

Markera Dayalı Seleksiyon (MAS), fenotipik ölçümlerden ziyade genotipik bilgilere dayanarak seleksiyon yapılmasını sağlar. Bu süreç üç temel aşamadan oluşur:

İlk olarak hedef özelliğin genetik temelinin belirlenmesi;

öncelikle hedeflenen agronomik özelliğin (yapraklanma zamanı, kabuk sertliği, besin elementi birikimi, hastalık direnci) genetik temeli belirlenir. Bu amaçla QTL haritalama veya GWAS analizleri ile özellik ile ilişkili gen bölgeleri tanımlanır (Kefayati et al., 2019; Akpunar et al., 2024).

İkinci olarak markörlerin geliştirilmesi ve doğrulanması;

İlgili gen bölgeleri ile bağlantılı moleküler markörler (SSR, SNP vb.) geliştirilir. Geliştirilen markörler, farklı genetik materyaller üzerinde test edilerek doğrulanır (Fallah et al., 2024; Doğanay et al., 2025).

Son olarak seleksiyon programına entegrasyonu;

Doğrulanmış markörler, ıslah populasyonlarında erken evrede seleksiyon amacıyla kullanılır. Böylece istenen özelliklere sahip genotipler, fenotipik değerlendirme yapılmadan belirlenebilir. Bu durum özellikle gençlik kısırlığı dönemi uzun olan ceviz gibi türlerde ıslah süresini önemli ölçüde kısaltır (Vahdati et al., 2019).

MAS'ın Avantajları

MAS, klasik seleksiyon yöntemlerine göre pek çok avantaja sahiptir. Bunlar arasında: Gençlik kısırlığı döneminin uzun olduğu türlerde erken seleksiyon imkânı, Çevresel faktörlerin fenotip üzerindeki etkilerinden bağımsız olarak genotip seçimi en önemli avantajları arasındadır. Bununla birlikte, MAS'ın etkinliği, doğru markörlerin seçilmesi, yeterli populasyon büyüklüğü ve doymuş genetik haritaların oluşturulması gibi faktörlere bağlıdır. Ayrıca MAS, yüksek başlangıç maliyetleri ve laboratuvar altyapısı gerektirebilir (De Mori and Cipriani, 2023).

Cevizde QTL ve GWAS Çalışmaları

Ceviz ıslahında mMAS'ın etkin şekilde uygulanabilmesi için öncelikle hedef özelliklerle ilişkili gen bölgelerinin tanımlanması gereklidir. Bu amaçla kullanılan başlıca yaklaşımlar, QTL haritalama ve GWAS çalışmalarıdır (Kefayati et al., 2019; Ji et al., 2021). QTL haritalama, iki ebeveyn arasındaki melezleme sonucu elde edilen genetik olarak ayrışma gösteren melez populasyon genotip ve fenotip verilerini birleştirerek belirli özelliklerin kromozomal konumlarını ortaya çıkarırken; GWAS, geniş doğal populasyonlarda yüksek yoğunluklu moleküler markör verilerini kullanarak hedef özelliklerle ilişkili allelleri tanımlar (Kefayati et al., 2019; Ji et al., 2021).

QTL Haritalama ve GWAS Çalışmaları

Cevizde QTL haritalama çalışmaları, özellikle fenolojik özellikler ve hastalık direnci üzerinde yoğunlaşmıştır. Kefayati et al. (2019), ceviz için ilk SSR tabanlı genetik bağlantı haritasını oluşturmuş ve yapraklanma zamanı ile ilişkili majör bir QTL tanımlamıştır. Çalışmada, *J. regia* populasyonu üzerinde 338 SSR markörü kullanılmış, toplam 15 bağlanma grubu tanımlanmış ve yapraklanma zamanı ile ilişkili QTL'nin belirlenmesi, don zararına dayanıklılık açısından önemli bir seleksiyon kriteri sunmuştur. Zhu et al. (2015), *Juglans regia*'da yüksek yoğunluklu genetik harita kullanarak antraknoz (Gnomonia leptostyla) direncinden sorumlu bir QTL bölgesini tanımlamıştır. Çalışmada, spesifik uzunluk amplifiye fragman (SLAF) markörleri kullanılarak 3.000'den fazla yüksek kaliteli SNP elde edilmiş ve hastalık direncinin genetik kontrolü ortaya konulmuştur. Jablonski (2022), *Juglans nigra* L. için meyve kalite özellikleri ve verim unsurlarıyla ilişkili ilk QTL'leri rapor etmiş, bu bulguların *J. regia* ıslah programlarına aktarılabileceğini önermiştir. Bu çalışmalar, QTL haritalamanın ceviz ıslahında MAS için temel veri sağladığını göstermektedir. Ancak, kontrollü melezleme populasyonlarının oluşturulmasının uzun zaman alması, bu yöntemin pratik uygulamalarını sınırlayan bir faktördür.

GWAS, cevizde genetik analizlerde son yıllarda giderek artan şekilde kullanılmaktadır. Bu yöntem, doğal populasyonlarda yüksek çözünürlüklü SNP verilerini kullanarak hedef özelliklerin genetik mimarisini çözmede avantaj sağlar (Ji et al., 2021).

Akpunar et al. (2024), ceviz meyvesinde kalsiyum (Ca) ve fosfor (P) birikimi ile ilişkili SNP markörlerini belirlemek amacıyla GWAS gerçekleştirmiştir. Axiom *J. regia* 700K SNP dizilimi kullanılarak yapılan analiz, Ca ve P birikimiyle ilişkili çok sayıda aday genin belirlenmesini sağlamış, bu genlerin hücre duvarı yapısı ve metabolizma ile ilişkili biyolojik süreçlerde görev aldığı bulunmuştur. Doğanay et al. (2025), ceviz yapraklarında demir (Fe) ve mangan (Mn) birikimini kontrol eden aday genleri tanımlamıştır. Bu çalışmada da yüksek yoğunluklu SNP verileri kullanılmış ve metal iyon taşınımı ile ilgili gen bölgeleri tespit edilmiştir. Bernard et al. (2025), *J. regia* yapraklarında progesteron içeriğinin genetik mimarisini incelemiş, hormon biyosentezi ve metabolizmasıyla ilişkili gen bölgelerini ortaya koymuştur. Famula et al. (2018), karbon izotop diskriminasyonu ve yaprak morfolojisi ile ilişkili gen bölgelerini tespit etmiş ve bu özelliklerin kuraklık adaptasyonu ile bağlantılı olabileceğini belirtmiştir. Ji et al. (2021), cevizde kapsamlı bir genom varyasyon haritası oluşturmuş ve bu harita üzerinden adaptasyon ve tarımsal özelliklerin genetik temeline yönelik önemli bilgiler sağlamıştır.

GWAS çalışmaları, doğal populasyonlarda allel çeşitliliğini koruyarak daha geniş genetik kapsama sahip olduklarından, ceviz ıslahında MAS için QTL haritalamaya kıyasla daha esnek bir yaklaşım sunmaktadır. Ancak, fenotipik verilerin yüksek doğrulukla elde edilmesi ve populasyon yapısının dikkatle analiz edilmesi bu yöntemin başarısı için kritik öneme sahiptir.

QTL ve GWAS Bulgularının MAS'a Entegrasyonu

QTL ve GWAS çalışmalarından elde edilen markörler, MAS programlarına entegre edilerek fenotipik değerlendirme yapılmadan seleksiyon yapılmasını sağlar. Kefayati et al. (2019) tarafından tanımlanan yapraklanma zamanı QTL'si, geç yapraklanan ve don zararına dayanıklı ceviz çeşitlerinin erken dönemde seçilmesine imkân tanımaktadır. Benzer şekilde, Akpunar et al. (2024) ve Doğanay et al. (2025) çalışmalarında belirlenen besin elementi birikimi ile ilişkili SNP'ler, mineral besin içeriği yüksek çeşitlerin geliştirilmesinde kullanılabilir.

QTL ve GWAS verilerinin birleştirilmesi, daha yüksek doğrulukta seleksiyon yapılmasına ve karmaşık özelliklerin genetik kontrolünün daha iyi anlaşılmasına olanak tanımaktadır (Bernard et al., 2025; Ji et al., 2021).

MAS'ın Ceviz Islahındaki Uygulama Alanları

MAS, ceviz ıslahında klasik seleksiyon yöntemleri ile uzun yıllar sürebilecek genetik iyileştirme sürecini önemli ölçüde kısaltma potansiyeline sahiptir. MAS'ın avantajı, hedef özelliklerle ilişkili markörlerin kullanılması sayesinde, fenotipik değerlendirmeye gerek kalmadan genç fidan aşamasında seleksiyon yapılabilmesidir (Vahdati et al., 2019; De Mori and Cipriani, 2023). Günümüzde cevizde MAS uygulamaları fenolojik özelliklerden meyve kalitesine, besin elementi birikiminden hastalık ve zararlı direncine ve abiyotik stres toleransına kadar geniş bir yelpazeyi kapsamaktadır.

Fenolojik Özellikler ile ilgili MAS çalışmaları

Fenolojik özellikler, özellikle yapraklanma zamanı gibi büyüme başlangıcıyla ilgili özellikler, ceviz yetiştiriciliğinde büyük önem taşır. Geç yapraklanan genotipler, ilkbahar geç donlarından daha az zarar görür ve bu nedenle belirli ekolojik bölgelerde tercih edilir (Bernard et al., 2017). Kefayati et al. (2019), SSR tabanlı bağlantı haritası üzerinde yapraklanma zamanı ile ilişkili majör bir QTL tanımlamış ve bu QTL'nin geç yapraklanma özelliğinin seleksiyonunda kullanılabileceğini göstermiştir. Fallah et al. (2024), İran populasyonlarında yapraklanma zamanı için geliştirilmiş markörlerin farklı populasyonlarda doğrulanmasını yapmış ve bu markörlerin geniş coğrafi yayılıma sahip seleksiyon programlarında etkin olarak kullanılabileceğini rapor etmiştir. Fenolojik MAS uygulamaları, ıslah programlarında don zararına dayanıklı ve belirli iklim koşullarına uyum sağlayan çeşitlerin geliştirilmesinde stratejik öneme sahiptir.

Meyve Kalitesi ve Verim Unsurları ile ilgili MAS çalışmaları

Cevizde meyve kalite özellikleri; kabuk sertliği, iç doluluk oranı, meyve şekli ve ağırlığı gibi ticari değeri doğrudan etkileyen parametrelerdir. Ayrıca yağ asidi kompozisyonu, fenolik bileşikler ve antioksidan içeriği de besin değeri açısından önemlidir (Bernard, Lheureux, and Dirlewanger, 2017; Sharma et al., 2025). Sharma et al. (2025), cevizde genomik ve transkriptomik verileri entegre ederek kalite özellikleri ile ilişkili gen bölgelerini tanımlamış, bu bilgilerin MAS ile seleksiyon sürecine dahil edilebileceğini belirtmiştir. Bernard et al. (2017), ceviz ıslahında kalite parametrelerinin genetik kontrolünün karmaşık olduğunu, bu nedenle çoklu QTL ve SNP markörlerinin birlikte kullanılmasının seleksiyon doğruluğunu artırabileceğini vurgulamıştır. *J. nigra* yapılan QTL çalışmalarının (*Jablonski, 2022*) kabuk yapısı ve iç oranı gibi özellikler açısından *J. regia* ıslahına aktarılabileceği öne sürülmüştür. Bu tür çalışmalar, yüksek pazar değeri taşıyan ceviz çeşitlerinin geliştirilmesinde MAS'ın rolünü pekiştirmektedir.

Besin Elementi Birikimi ile ilgili MAS çalışmaları

Ceviz meyve ve yapraklarının mineral içeriği, hem besin kalitesi hem de insan sağlığı açısından kritik öneme sahiptir. Akpunar et al. (2024), meyvede kalsiyum (Ca) ve fosfor (P) birikimi ile ilişkili SNP markörlerini GWAS yöntemiyle belirlemiş, bu markörlerin Ca ve P açısından zengin çeşitlerin geliştirilmesinde kullanılabileceğini göstermiştir. Doğanay et al. (2025), demir (Fe) ve mangan (Mn) birikimi ile ilişkili aday genleri tanımlamış, bu genlerin metal iyon taşınımı ve homeostazisi ile ilişkili biyolojik süreçlerde görev yaptığını bildirmişti rBu tür MAS uygulamaları, mineral içeriği yüksek ceviz çeşitlerinin ıslahında doğrudan kullanılabilecek önemli araçlardır.

Hastalık ve Zararlı Direnci ile ilgili MAS çalışmaları

Ceviz üretiminde önemli verim kayıplarına yol açabilen hastalık ve zararlılar, ıslah programlarının öncelikli hedefleri arasındadır. Zhu et al. (2015), antraknoz direnciyle ilişkili QTL'yi yüksek yoğunluklu genetik harita kullanarak belirlemiştir. Frett (2016), şeftali ve nektarinde *Xanthomonas arboricola pv. pruni* direnci için geliştirilen MAS protokollerinin, cevizde bakteriyel yanıklık gibi hastalıklara karşı direnç ıslahı çalışmalarına model olabileceğini belirtmiştir. Hastalık direnci için geliştirilen markörlerin kullanılması, kimyasal ilaç kullanımını azaltarak çevresel sürdürülebilirliğe katkı sağlayabilir.

Abiyotik Stres Toleransı ile ilgili MAS çalışmaları

Küresel iklim değişikliğine bağlı olarak artan sıcaklık, kuraklık ve toprak tuzluluğu, ceviz yetiştiriciliğinde verim ve kaliteyi olumsuz etkileyen başlıca abiyotik stres faktörleridir. Manzoor et al. (2023), kuraklık ve sıcaklık stresi ile ilişkili adaptif özelliklerin genomik temellerini incelemiş ve bu bilgilerin MAS uygulamalarına entegre edilebileceğini vurgulamıştır. Vahdati et al. (2019), abiyotik stres toleransının kompleks bir genetik yapıya sahip olduğunu, bu nedenle çoklu markör ve genomik seleksiyon yaklaşımlarının kullanılmasının daha etkili sonuçlar vereceğini belirtmiştir. Abiyotik stres toleransına yönelik MAS çalışmaları, özellikle iklim değişikliğinin etkilerinin yoğun hissedildiği bölgelerde ceviz üretiminin sürdürülebilirliği açısından kritik önemdedir.

Gelecek Perspektifi

Marköre dayalı seleksiyon, ceviz ıslahında son yirmi yılda önemli ilerlemeler sağlamış olsa da, moleküler biyoloji ve genomik teknolojilerdeki yeni gelişmeler, bu yöntemin gelecekte çok daha güçlü ve kapsamlı hale gelmesini mümkün kılmaktadır. Önümüzdeki yıllarda, genomik seleksiyon (GS), gen düzenleme teknikleri (CRISPR/Cas), yüksek verimli fenotiplendirme sistemleri ve *Juglans* türleri arası gen transferi gibi yenilikçi yaklaşımlar, MAS'ın etkinliğini artıracak başlıca stratejiler olarak öne çıkmaktadır.

Sonuç

Marköre dayalı seleksiyon, ceviz ıslahında genetik ilerlemeyi hızlandıran, seleksiyon doğruluğunu artıran ve klasik yöntemlerin sınırlılıklarını önemli ölçüde azaltan bir yaklaşımdır. Genetik haritalama çalışmaları ve yüksek yoğunluklu markör teknolojileri sayesinde, hedef özelliklerle ilişkili gen bölgelerinin tanımlanması mümkün hale gelmiş ve bu bilgi, genç fidan aşamasında yüksek doğrulukta seleksiyon yapılmasına olanak tanımıştır. MAS, fenolojik adaptasyon, kalite parametreleri, besin elementi içeriği, hastalık direnci ve abiyotik stres toleransı gibi özelliklerin geliştirilmesinde stratejik bir araç konumundadır.

Önümüzdeki yıllarda genomik seleksiyon, gen düzenleme teknikleri ve yüksek verimli fenotiplendirme sistemleri ile entegre edilerek, cevizde ıslah programlarının etkinliği ve başarı oranı daha da artırılacaktır. Bu bütüncül yaklaşım, hem ticari üretimde hem de genetik kaynakların korunmasında sürdürülebilir ve verimli çözümler sunma potansiyeline sahiptir.

Kaynakça

Akpunar, B. E., Orman, E., Yagmur, B., Tanyolac, M. B., and Ates, D. (2024). Identification of SNP markers linked to calcium and phosphorus accumulation in walnut (*Juglans regia* L.) fruit by GWAS. *Scientia Horticulturae, 335,* 113341. https://doi.org/10.1016/j.scienta.2024.113341

Arab, M. M., Marrano, A., Abdollahi-Arpanahi, R., Leslie, C. A., Askari, H., Neale, D. B., and Vahdati, K. (2019). Genome-wide patterns of population structure and association mapping of nut-related traits in Persian walnut populations from Iran using the Axiom *J. regia* 700K SNP array. *Scientific Reports, 9,* 6376. https://doi.org/10.1038/s41598-019-42940-1

Arús i Gorina, P. (2017). Molecular markers for plant genetics and breeding. *Contributions to Science, 13,* 9–15. https://doi.org/10.2436/20.7010.01.256

Bernard, A., Bénéjam, J., Roth, M., Lheureux, F., and Dirlewanger, E. (2025a). Genomic prediction in Persian walnut: Optimization levers according to genetic architecture of complex traits. *The Plant Genome, 18*(2), e70047. https://doi.org/10.1002/tpg2.70047

Bernard, A., Dirlewanger, E., Delmas, M., Racofier, D., Greil, M.-L., Lainé, A.-L., Porte, C., Gennetay, D., Keller, M., and Chemineau, P. (2025b). Genome-wide association study dissects the genetic architecture of progesterone content in Persian walnut leaves (*Juglans regia* L.). *BMC Genomics, 26,* 145. https://doi.org/10.1186/s12864-025-11341-2

Bernard, A., Lheureux, F., and Dirlewanger, E. (2017). Walnut: Past and future of genetic improvement. *Tree Genetics and Genomes, 14*(1), 1. https://doi.org/10.1007/s11295-017-1214-0

De Mori, G., and Cipriani, G. (2023). Marker-assisted selection in breeding for fruit trait improvement: A review. *International Journal of Molecular Sciences, 24*(10), 8984. https://doi.org/10.3390/ijms24108984

Doğan, Y., Kafkas, S., Sütyemez, M., Akça, Y., and Türemiş, N. (2014). Assessment and characterization of genetic relationships of walnut (*Juglans regia* L.) genotypes by three types of molecular markers. *Scientia Horticulturae, 168,* 81–87. https://doi.org/10.1016/j.scienta.2014.01.024

Doğan, Y., and Kafkas, S. (2018). Cevizde (*Juglans regia* L.) DNA markörleri ile genetik haritalama. Ç.Ü Fen ve Mühendislik Bilimleri Dergisi Cilt: 36-5

Doğanay, Ö., Orman, E., Yağmur, B., Tanyolaç, M., and Ateş, D. (2025). A genome-wide association study to detect candidate genes controlling iron and manganese accumulation in walnut (*Juglans regia* L.). *Turkish Journal of Agriculture and Forestry, 49*(1), 63–74. https://doi.org/10.55730/1300-011X.3249

Fallah, M., Paizila, A., Karcı, H., Arab, M. M., Sarikhani, S., Suprun, I., Rasouli, M., Hassani, D., Kafkas, S., and Vahdati, K. (2024). Validation and implementation of marker-assisted selection (MAS) for the leafing date trait in Persian walnut populations from Iran. *Euphytica, 220*(2), 25. https://doi.org/10.1007/s10681-023-03281-3

Famula, R. A., Richards, J. H., Famula, T. R., and Neale, D. B. (2018). Association genetics of carbon isotope discrimination and leaf morphology in a breeding population of *Juglans regia* L. *Tree Genetics and Genomes, 15*(1), 6. https://doi.org/10.1007/s11295-018-1307-4

Foroni, I., Rao, R., and Woeste, K. (2005). Molecular characterization of *Juglans regia* L. cultivars with SSR markers. *Acta Horticulturae, 705,* 207–213. https://doi.org/10.17660/ActaHortic.2005.705.25

Jablonski, B. (2022). *First quantitative trait loci detected for bearing habit and nut quality traits in eastern black walnut (Juglans nigra L.)* (Master's thesis). ProQuest Dissertations Publishing. https://www.proquest.com/docview/2851578921

Ji, F., Ma, Q., Zhang, W., Liu, J., Feng, Y., Zhao, P., Song, X., Chen, J., Zhang, J., Wei, X., Zhou, Y., Chang, Y., Zhang, P., Huang, X., Qiu, J., and Pei, D. (2021). A genome variation map provides insights into the genetics of walnut adaptation and agronomic traits. *Genome Biology, 22,* 300. https://doi.org/10.1186/s13059-021-02517-6

Kefayati, S., Ikhsan, A. S., Sütyemez, M., Paizila, A., Topçu, H., Bükücü, Ş. B., and Kafkas, S. (2019). First simple sequence repeat-based genetic linkage map reveals a major QTL for leafing time in walnut (*Juglans regia* L.). *Tree Genetics and Genomes, 15*(1), 13. https://doi.org/10.1007/s11295-019-1318-9

Mahmoodi, R., Dadpour, M. R., Hassani, D., Zeinalabedini, M., Vendramin, E., and Leslie, C. A. (2021). Composite core set construction and diversity analysis of Iranian walnut germplasm using molecular markers and phenotypic traits. *PLOS ONE, 16*(3), e0248623. https://doi.org/10.1371/journal.pone.0248623

Manzoor, I., Samantara, K., Bhat, M. S., Farooq, I., Bhat, K. M., Mir, M. A., and Wani, S. H. (2023). Advances in genomics for diversity studies and trait improvement in temperate fruit and nut crops under changing climatic scenarios. *Frontiers in Plant Science, 13,* 1048217. https://doi.org/10.3389/fpls.2022.1048217

Shah, R. A., Bakshi, P., Jasrotia, A., Itoo, H., Padder, B. A., Gupta, R., Kour, G., and Dolkar, D. (2023). Morphological to molecular markers: Plant genetic diversity studies in walnut (*Juglans regia* L.)—A review. *Erwerbs-Obstbau, 65*(5), 1499–1511. https://doi.org/10.1007/s10341-023-00892-x

Sharma, S., Sharma, S., and Kumar, P. (2025). Structural and functional genomics of walnut (*Juglans* spp.): Implications for breeding and genetic resource management. *Plant Molecular Biology Reporter.* https://doi.org/10.1007/s11105-025-01589-z

Vahdati, K., Arab, M. M., Sarikhani, S., Sadat-Hosseini, M., Leslie, C. A., and Brown, P. J. (2019). Advances in Persian walnut (*Juglans regia* L.) breeding strategies. In J. M. Al-Khayri, S. M. Jain, and D. V. Johnson (Eds.), *Advances in plant breeding strategies: Nut and beverage crops* (Vol. 4, pp. 401–472). Springer. https://doi.org/10.1007/978-3-030-23112-5_11

Yaman, M., Yıldız, E., Pınar, H., Uzun, A., Sümbül, A., and Alkan, Ş. (2020). Seleksiyonla Elde Edilmiş Bazı Ceviz Genotiplerinde SRAP Tekniği Kullanılarak Genetik Çeşitliliğin Belirlenmesi. *Turkish Journal of Agriculture - Food Science and Technology*, *8*(12), 2577–2582. https://doi.org/10.24925/turjaf.v8i12.2577-2582.3743

Yıldız, E., Pınar, H., Uzun, A., Yaman, M., Sumbul, A., and Ercisli, S. (2021). Identification of genetic diversity among *Juglans regia* L. genotypes using molecular, morphological, and fatty acid data. *Genetic Resources and Crop Evolution, 68*(4), 1425–1437. https://doi.org/10.1007/s10722-020-01072-6

Zarinkolah, M., Karimi, H. R., Esmaeilzadeh, M., Malekzadeh, K., and Sahhafi, S. R. (2025). Study of association between nut traits and SCOT molecular marker in some old Iranian walnut trees. *Plant Molecular Biology Reporter, 43*(2), 897–909. https://doi.org/10.1007/s11105-024-01524-8

Zhu, Y., Yin, Y., Yang, K., Li, J., Sang, Y., Huang, L., and Fan, S. (2015). Construction of a high-density genetic map using specific length amplified fragment markers and identification of a quantitative trait locus for anthracnose resistance in walnut (*Juglans regia* L.). *BMC Genomics, 16,* 614. https://doi.org/10.1186/s12864-015-1822-8

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

TÜRKİYE'NİN İÇ ANADOLU BÖLGESİ'NDE KİMYON (*CUMİNUM CYMİNUM* L.) ÜRETİMİNİ SINIRLAYAN FUNGAL ETMENLERİN (*ALTERNARİA BURNSİİ* VE *FUSARİUM OXYSPORUM* F. SP. *CUMİNİ*) YAYGINLIĞI

Sevinç DEMİR
T.C. Tarım ve Orman Bakanlığı, Tarla Bitkileri Merkez Araştırma Enstitüsü
ORCID: 0000-0003-4745-685X

Dr. Emine Burcu TURGAY
T.C. Tarım ve Orman Bakanlığı, Tarla Bitkileri Merkez Araştırma Enstitüsü
ORCID: 0000-0003-1150-4901

Merve Nur ERTAŞ ÖZ
T.C. Tarım ve Orman Bakanlığı, Tarla Bitkileri Merkez Araştırma Enstitüsü
ORCID: 0000-0001-9689-179X

Dr. Reyhan BAHTİYARCA
T.C. Tarım ve Orman Bakanlığı, Tarla Bitkileri Merkez Araştırma Enstitüsü
ORCID: 0000-0002-8749-8416

Sefa AYTEN
T.C. Tarım ve Orman Bakanlığı, Tarla Bitkileri Merkez Araştırma Enstitüsü
ORCID: 0000-0002-7459-4716

ÖZET

Türkiye, dünya kimyon (*Cuminum cyminum* L.) üretiminde önemli bir yere sahiptir. Ekim alanlarının yaklaşık %91'i İç Anadolu Bölgesi'nde, özellikle Ankara, Kayseri ve Konya illerinde yoğunlaşmaktadır (TÜİK, 2024). Kimyon, yüksek uçucu yağ ve antioksidan içeriği nedeniyle gıda, ilaç ve kozmetik sektörlerinde değerli bir bitkidir. Ancak son yıllarda gözlenen fungal hastalıklar üretimde ciddi verim ve kalite kayıplarına yol açmaktadır.

Bu çalışma, Türkiye'nin İç Anadolu Bölgesi'nde kimyon üretim alanlarında görülen *Alternaria burnsii* (Alternaria yanıklığı) ve *Fusarium oxysporum* f. sp. *cumini* (Fusarium solgunluğu) hastalıklarının yaygınlığını belirlemek amacıyla 2022–2024 yılları arasında yürütülmüştür. Saha sürveyleri, laboratuvar izolasyonları, patojen tanımlamaları ve yaygınlık analizlerinden oluşan çok aşamalı bir yöntem uygulanmıştır. Ankara ve Konya illerinde yapılan sürveylerde hastalık belirtisi gösteren bitkilerden alınan örnekler laboratuvarda değerlendirilmiştir. İzolasyon ve patojenisite testleri sonucunda Alternaria yanıklığının yaygınlığı Ankara'da %71,6, Konya'da %56,4; Fusarium solgunluğunun ise sırasıyla %27,4 ve %24,7 olarak belirlenmiştir. En yüksek hastalık oranları Ankara'nın Haymana ve Polatlı, Konya'nın Cihanbeyli ilçelerinde kaydedilmiştir.

Sonuçlar, *Alternaria burnsii*'nin Türkiye'de kimyon üretiminde baskın bir patojen olduğunu; *Fusarium oxysporum* f. sp. *cumini*'nin ise kök çürüklüğü ve solgunluk belirtileriyle ekonomik kayıplara yol açtığını ortaya koymuştur. Elde edilen bulgular, dayanıklı çeşit geliştirme ve bölgesel hastalık yönetimi strtejilerinin planlanması açısından önemli bir bilimsel temel sunmaktadır.

Anahtar Kelimeler: *Alternaria burnsii*, *Fusarium oxysporum* f. sp. *cumini*, kimyon, yaygınlık, Türkiye

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PREVALENCE OF FUNGAL PATHOGENS (*ALTERNARIA BURNSII* AND *FUSARIUM OXYSPORUM* F. SP. *CUMINI*) LIMITING CUMIN (*CUMINUM CYMINUM* L.) PRODUCTION IN THE CENTRAL ANATOLIA REGION OF TURKEY

ABSTRACT

Turkey is one of the major producers of cumin (*Cuminum cyminum* L.), with approximately 91% of the cultivation areas located in the Central Anatolia Region, particularly in Ankara, Kayseri, and Konya provinces (TUIK, 2024). Cumin is a valuable crop due to its high essential oil and antioxidant content, widely used in the food, pharmaceutical, and cosmetic industries. However, fungal diseases have recently become more prevalent, leading to substantial yield and quality losses.

This study aimed to determine the prevalence of *Alternaria burnsii* (Alternaria blight) and *Fusarium oxysporum* f. sp. *cumini* (Fusarium wilt) in cumin-growing areas of Central Anatolia between 2022 and 2024. The research involved multi-stage procedures including field surveys, laboratory isolations, pathogen identification, and prevalence calculations. Field surveys were conducted in the provinces of Ankara and Konya, where symptomatic plant samples were collected and examined in the laboratory. Based on isolation and pathogenicity tests, the prevalence of Alternaria blight was determined as 71.6% in Ankara and 56.4% in Konya, while Fusarium wilt occurred at 27.4% and 24.7%, respectively. The highest infection rates were recorded in Haymana and Polatlı districts of Ankara and Cihanbeyli of Konya.

The results demonstrated that *Alternaria burnsii* is the dominant pathogen restricting cumin production in Turkey, while *Fusarium oxysporum* f. sp. *cumini* also poses a significant threat through root rot and wilt symptoms. These findings provide essential data for breeding resistant varieties and developing regional disease management strategies.

Keywords: *Alternaria burnsii*, *Fusarium oxysporum* f. sp. *cumini*, cumin, prevalence, Turkey

GİRİŞ

Kimyon (*Cuminum cyminum* L.), Apiaceae familyasına ait tek yıllık, ekonomik değeri yüksek bir tıbbi ve aromatik bitkidir. Dünya genelinde başlıca üretici ülkeler Hindistan, İran, Suriye ve Türkiye olup, bu ülkeler küresel üretimin %95'inden fazlasını gerçekleştirmektedir(FAO, 2023). Kimyon, gıda endüstrisinde baharat olarak kullanılmasının yanı sıra, uçucu yağında yer alan kuminaldehit, p-simen, γ-terpinen, β-pinen gibi bileşikler sayesinde farmasötik, kozmetik ve geleneksel tıp alanlarında da geniş kullanım potansiyeline sahiptir. Bu bileşenler antimikrobiyal, antioksidan, antienflamatuvar ve sindirimi düzenleyici özellikleriyle kimyonun terapötik değerini artırmakta; aynı zamanda doğal koruyucu, aroma verici ve biyopestisit olarak değerlendirilmesine olanak sağlamaktadır(Singh et al., 2022).

Türkiye'de kimyon üretimi büyük ölçüde İç Anadolu Bölgesi'nde yoğunlaşmakta olup, ülke toplam üretiminin yaklaşık %91'i bu bölgeden sağlanmaktadır (TÜİK., 2024). Ancak son yıllarda üretim alanlarında artan fungal hastalıklar, hem verim hem de kalite açısından önemli sorunlar yaratmaktadır.

Kimyon üretiminde en yaygın ve ekonomik açıdan en ciddi kayıplara neden olan hastalıkların başında Alternaria yanıklığı (*Alternaria burnsii*) ve Fusarium solgunluğu (*Fusarium oxysporum* f. sp. *cumini*) gelmektedir(Ahmad et al., 2023; Gupta et al., 2022) . *A. burnsii*, yaprak, sap ve kapsüllerde oluşturduğu dairesel, kahverengi lekelerle fotosentez kapasitesini düşürür; çiçeklenme dönemindeki enfeksiyonlar tohum dolumunu ve kalitesini belirgin biçimde azaltır (Ranganathan et al., 2025).

Uygun çevresel koşullarda hastalık hızla epidemik hale gelmekte ve %60–80'e varan verim kayıplarına yol açabilmektedir (Sharma et al., 2020; Wadud et al., 2021).

Öte yandan, *F. oxysporum* f. sp. *cumini* tarafından oluşturulan solgunluk ve kök çürüklüğü hastalığı, kimyon üretimini sınırlayan en yıkıcı toprak kaynaklı patojenlerden biridir (Abo-Elyousr et al., 2022). Patojen, kök sisteminden bitki dokularına girerek iletim demetlerini tıkar, su ve besin akışını engeller; bu durum bitkilerde solgunluk, sararma, bodurlaşma ve erken ölümle sonuçlanır(Leslie & Summerell, 2006). Fusarium türleri toprakta uzun süre klamidiospor formunda canlı kalabildiğinden, bulaşma yıllarca devam edebilir(Khaledi & Hassani, 2021; Özer & Bayraktar, 2015)Bu özellik, ekim nöbeti uygulamalarının yetersiz olduğu alanlarda hastalığın sürekli olarak yeniden ortaya çıkmasına neden olmaktadır.

Türkiye'de kimyon üretim alanlarında yürütülen çalışmalar, *A. burnsii* ve *F. oxysporum* f. sp. *cumini*'nin özellikle İç Anadolu Bölgesi'nde yüksek oranda yaygın olduğunu göstermektedir. Özer ve Bayraktar (2015), Ankara ve Konya illerinde yürüttükleri araştırmada *A. burnsii*, *F. oxysporum*, *F. solani* ve *Macrophomina phaseolina* gibi patojenlerin kimyon tarlalarında yüksek oranda bulunduğunu bildirmiştir. Bu bulgular, Türkiye'nin iklim ve toprak koşullarının söz konusu patojenlerin gelişimi için oldukça elverişli olduğunu ortaya koymaktadır.

Benzer sonuçlar uluslararası çalışmalarla da desteklenmektedir. Rathi et al. (2021), Hindistan'da yürüttükleri araştırmada *A. burnsii* enfeksiyonlarının kimyon tarlalarının %60'ında görüldüğünü ve yaprak kayıplarının %70'e kadar çıktığını belirtmiştir. Singh et al. (2022) ise Rajasthan bölgesinde *F. oxysporum* f. sp. *cumini*'nin %40'ın üzerinde yaygınlık gösterdiğini, toprak sıcaklığı ve nemin epidemik gelişmede belirleyici rol oynadığını rapor etmiştir. İran'da Hosseini et al. (2023), kurak iklim koşullarında *F. oxysporum* inokulum yoğunluğunun toprak organik madde içeriğiyle ters orantılı olduğunu bildirmiştir. Bu bulgular, çevresel faktörlerin patojen gelişimi ve hastalık yayılımında temel rol oynadığını göstermektedir.

Alternaria burnsii'nin epidemiyolojisi üzerine yapılan çalışmalar, yüksek nem (%80–90) ve 25–30 °C sıcaklık koşullarının enfeksiyon için optimum ortam sağladığını ortaya koymuştur (Kumar et al., 2021). Hastalık genellikle çiçeklenme sonrası dönemde şiddetlenir; yaprak yüzeyindeki lekeler birleşerek geniş nekrotik alanlar oluşturur. *F. oxysporum* f. sp. *cumini* için optimum gelişme sıcaklığı 25–28 °C, toprak pH'sı ise 6,5–7,5 aralığındadır (Ahmad et al., 2023). Bu koşullar, İç Anadolu Bölgesi'nin ilkbahar–yaz dönemi iklimiyle büyük ölçüde örtüşmekte ve hastalıkların bölgede kalıcılığını açıklamaktadır.

Son yıllarda yürütülen moleküler ve biyoteknolojik çalışmalar, bu patojenlere karşı dayanıklılığın genetik temellerini ortaya koymaya başlamıştır. Dharajiya et al. (2023), *F. oxysporum* f. sp. *cumini*'ye dayanıklı "GC-4" kimyon genotipinde belirli savunma genlerinin ve patogenezle ilişkili proteinlerin yüksek düzeyde ifade edildiğini bildirmiştir. Benzer şekilde, Kumar et al. (2024), *A. burnsii* enfeksiyonuna karşı fenilpropanoid yoluna ait genlerin savunma mekanizmasında önemli rol oynadığını ortaya koymuştur. Bu çalışmalar, dayanıklı çeşit geliştirme programlarının genetik kaynaklarla desteklenmesinin önemini açıkça göstermektedir.

Kimyon hastalıklarının yönetiminde geleneksel yöntemler arasında ekim nöbeti, tohum dezenfeksiyonu, uygun sulama rejimi, fungisit uygulamaları ve biyolojik kontrol ajanlarının kullanımı yer almaktadır (Gupta et al., 2022). Singh et al. (2025), *A. burnsii*'ye karşı dört biyokontrol mikroorganizmasından oluşan bir kombinasyonun hastalık indeksini %60 oranında azalttığını ve bitki savunma enzimlerinin aktivitesini artırdığını bildirmiştir. Ancak üreticilerin büyük bir kısmı hâlen kimyasal mücadeleye bağımlı olup, bu durum çevresel kalıcılık ve pestisit direnci gibi yeni sorunlar doğurmaktadır.

Günümüzde sürdürülebilir üretim için entegre hastalık yönetimi (IPM) yaklaşımlarının önemi giderek artmaktadır(Abo-Elyousr et al., 2022; Ahmad et al., 2023).
Türkiye özelinde, özellikle İç Anadolu Bölgesi'nde fungal hastalıkların yaygınlığına ilişkin araştırmalar oldukça sınırlıdır. Mevcut veriler genellikle kısa dönemli sürvey çalışmalarına dayanmakta, uzun dönemli izleme, patojen çeşitliliğinin genetik olarak belirlenmesi ve dayanıklı genotiplerin test edilmesi konularında önemli eksiklikler bulunmaktadır. Bu bağlamda, 2022–2024 yılları arasında yürütülen bu çalışma, *Alternaria burnsii* ve *Fusarium oxysporum* f. sp. *cumini*'nin İç Anadolu Bölgesi kimyon üretim alanlarındaki yaygınlığını belirlemeyi, bölgesel hastalık dinamiklerini ortaya koymayı ve dayanıklı çeşit geliştirme programları için temel veri sağlamayı amaçlamaktadır.

AMAÇ

Bu çalışmada, Türkiye'nin İç Anadolu Bölgesi'nde kimyon üretim alanlarında görülen *Alternaria burnsii* (Alternaria yanıklığı) ve *Fusarium oxysporum* f. sp. *cumini* (Fusarium solgunluğu) hastalıklarının yaygınlığının belirlenmesi hedeflenmiştir. Araştırma 2022–2024 yılları arasında yürütülmüş olup, saha verileri laboratuvar analizleriyle desteklenmiştir.
Çalışma beş ana aşamadan oluşmuştur: Saha örneklemesi, Laboratuvar izolasyonu, Etmen tanısı, Hastalık yaygınlığı hesabı, Veri analizi.
Saha çalışmaları Ankara (Haymana, Polatlı) ve Konya (Cihanbeyli) ilçelerinde yürütülmüştür. Her ilçede kimyon ekili parsellerde rastgele örnekleme yöntemiyle hastalık belirtisi gösteren bitkiler seçilmiştir. Toplanan örnekler laboratuvara taşınarak etmen izolasyonları yapılmış, saf kültürler elde edilmiştir. Hastalık yaygınlık oranı Bora and Karaca (1970) yöntemine göre hesaplanmış, iller arası ortalama oranlar karşılaştırılmıştır.
Bu yöntem, saha gözlemlerinden laboratuvar analizlerine kadar sürecin sistematik ve tekrarlanabilir biçimde yürütülmesini sağlamıştır.

MATERYAL ve YÖNTEM

Araştırma Alanı

Çalışma, Türkiye'nin İç Anadolu Bölgesi'nde kimyon üretiminin en yoğun olduğu Ankara (Haymana, Polatlı) ve Konya (Cihanbeyli) ilçelerinde gerçekleştirilmiştir. Bölge karasal iklim özellikleri göstermektedir; yazları sıcak ve kurak, kışları soğuk ve kar yağışlıdır. Ortalama yıllık yağış 350–400 mm, sıcaklık ortalaması ise 11–12 °C'dir(MGM, 2024) . Bu iklim koşulları, *A. burnsii* ve *F. oxysporum* gibi patojenlerin gelişimi için uygun mikroklimatik ortam oluşturmaktadır (Gupta et al., 2022).

Bitki Materyali ve Örnekleme

Sürveyler, kimyon ekili alanlarda rastgele seçilen parsellerde yürütülmüştür. Her tarladan hastalık belirtisi gösteren bitkilerden örnekler alınmış, toplam örnek sayısı kayıt altına alınmıştır. Bitki örnekleri (yaprak, sap, kök) kese kâğıtlarına konulmuş ve laboratuvara soğuk zincirle taşınmıştır. Her tarla için alan (da) ve gözlenen hastalık oranı (%) kaydedilmiştir. Gözlemler sırasında hastalık semptomları fotoğraflanmış, görsel kayıtlar arşivlenmiştir.

Resim 1. Ankara İli Polatlı İlçesi Kimyon Ekim Alanları Survey Çalışmasından Görüntüler

Resim 2. Ankara İli Haymana İlçesi Kimyon Ekim Alanları Survey Çalışmasından Görüntüler

Resim 3. Konya İli Cihanbeyli ilçesi Kimyon Ekim Survey Çalışmasından Görüntüler

Laboratuvar Çalışmaları ve Patojenisite Testleri

Sürveyler sonucunda toplanan hastalıklı kimyon bitkilerinden fungal patojenlerin izolasyonu gerçekleştirilmiştir. İzolasyon işlemi, hastalıklı ve sağlıklı dokuyu birlikte içeren 0,2–0,5 cm uzunluğundaki bitki parçalarının hazırlanmasıyla başlatılmıştır. Parçalar yüzeysel dezenfeksiyon amacıyla %1'lik sodyum hipoklorür (NaOCl) çözeltisinde 2–3 dakika tutulmuş, ardından üç kez steril saf sudan geçirilmiştir. Örnekler steril filtre kâğıtları arasında kurutulduktan sonra, patojen gelişimini destekleyen PDA (Potato Dextrose Agar, Merck) ortamı içeren petri kaplarına beşer adet olacak şekilde yerleştirilmiştir.

Petri kapları 23 ± 1 °C sıcaklıkta, 12 saat aydınlık/12 saat karanlık fotoperiyotta inkübe edilmiştir. Yedi ila on gün süren inkübasyon sonrasında gelişen fungus kolonilerinden tek spor izolasyonu yapılarak saf kültürler elde edilmiştir. Kültürler PDA eğik agarda +4 °C'de muhafaza edilmiştir.

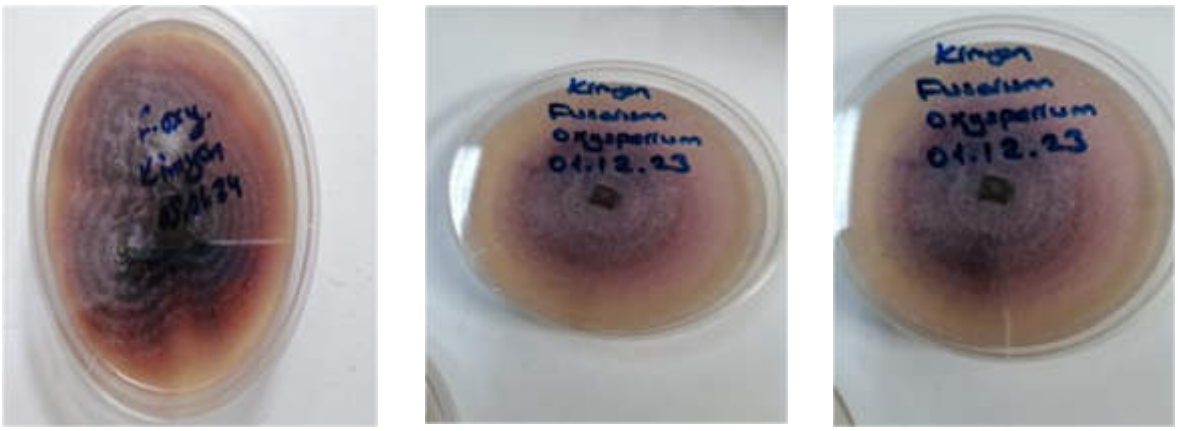
Fungal tanı çalışmaları için farklı besin ortamları kullanılmıştır. Alternaria burnsii izolatları PDA ve %2'lik su agarda (WA), *Fusarium oxysporum* f. sp. *cumini* izolatları ise sentetik besi ortamı (SNA: KH_2PO_4 1,0 g; KNO_3 1,0 g; $MgSO_4 \cdot 7H_2O$ 0,5 g; KCl 0,5 g; glikoz 0,2 g; sakkaroz 0,2 g; agar 20 g; saf su 1 L) üzerinde geliştirilmiştir.

Kolonilerin renk, doku, misel yapısı ve spor morfolojileri stereomikroskop ve ışık mikroskobunda incelenmiş; tür tanısı literatürdeki teşhis anahtarlarına göre yapılmıştır. Etmenlere ait patojenisite çalışması aşağıda belirtildiği şekilde gerçekleştrilmiştir.

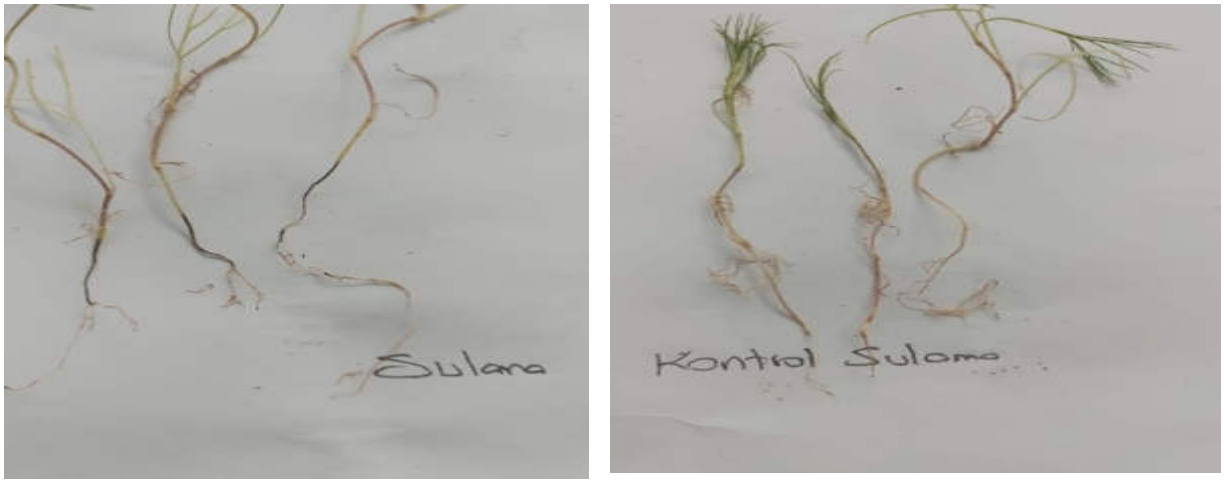
Fusarium oxysporum* f. sp. *cumini

Patojenisite testleri, Nene ve Haware (1980) tarafından bildirilen toprak inokulasyon yönteminin modifiye edilmesiyle yürütülmüştür. İnokulum üretimi için 45 g elenmiş kum ve 5 g mısır unu karışımı içeren 200 mL'lik şişeler sterilize edilmiştir. On günlük PDA kültürlerinden alınan beş adet 0,7 cm çapındaki disk bu şişelere eklenmiş, 24 ± 1 °C'de 12 saat aydınlık/12 saat karanlık koşullarda 14 gün inkübe edilmiştir.

Elde edilen inokulum, 10:1 (v/v) oranında steril toprak harcıyla (bahçe toprağı: yıkanmış dere kumu: yanmış çiftlik gübresi = 1 : 1 : 1) karıştırılmış ve 5–6 gün ön inkübasyona bırakılmıştır. Tohumlar ekimden önce %1'lik NaOCl çözeltisinde 3–5 dakika yüzeysel dezenfeksiyona tabi tutulmuş, her saksıya beş tohum ekilmiştir. Kontrol saksılarına ise inokulum içermeyen mısır unu–kum karışımı eklenmiştir. Hastalık değerlendirmeleri inokulasyondan üç hafta sonra yapılmıştır.



Resim 4. *Fusarium oxysporum f. sp. cumini izolatları*



a –Enfekteli kök b-Sağlam Kök

Resim 5. (a) *Fusarium oxysporum f. sp. cumini* enfekteli bitki, (b)Kimyon sağlıklı bitki ve

Alternaria burnsii

Alternaria etmeni için patojenisite testleri, spor süspansiyonunun toprak üstü bitki kısımlarına püskürtülmesi yöntemiyle gerçekleştirilmiştir. PDA ortamında 19–21 °C'de 7–8 gün geliştirilen izolatların sporları Thoma lamı ile sayılmış, 1,2 × 10^6 spor/mL yoğunlukta süspansiyon hazırlanmıştır. Üç–dört yapraklı dönemdeki bitkilere basınçlı el pülverizatörüyle inokulum uygulanmış, bitkiler 3–4 gün süreyle nemli torbalar altında tutulmuştur. İnokulasyondan 10 gün sonra hastalık değerlendirmeleri yapılmıştır.

Resim 6. *Alternaria burnsii* izolatları

a **b** **c**

Resim 7. (a) Kimyon sağlıklı bitki ve (b-c) *Alternaria burnsii* enfekteli bitki

Hastalık Yaygınlığı ve Şiddetinin Hesaplanması

Ankara ve Konya illerindeki kimyon üretimin yaygın olarak yapıldığı alanlarında *Alternaria burnsii* (kimyon yanıklığı) ve *Fusarium oxysporum* f. sp. *cumini* (Fusarium solgunluğu) etmenlerinin yaygınlığını belirlemek amacıyla, hastalık belirtilerinin yoğun olarak gözlendiği çiçeklenme öncesi ve sonrası dönemleri boyunca sistematik sürveyler gerçekleştirilmiştir (Aktaş, 2001; Finci & Yılmazdemir, 1982).

Hastalık Oranı (%) =Toplam Bitki Sayısı/Hastalıklı Bitki Sayısı×100

Elde edilen tarlaya özgü hastalık oranları daha sonra Bora and Karaca (1970) formülüne göre illere ait genel hastalık yaygınlığının belirlenmesinde kullanılmıştır:

Hastalığın yaygınlığı(%)=Incelenen Toplam Alan (da)∑(Tarladaki Hastalık Oranı×Tarlanın Alanı (da)) ×100

Her tarladaki hastalık oranı görsel değerlendirme ile belirlenmiş, iller arasındaki yaygınlık farkları Alternaria ve Fusarium etmenleri için ayrı ayrı değerlendirilmiştir. Böylece her iki hastalığın bölgesel dağılımı, yaygınlık yüzdesi ve alanla ilişkili risk düzeyi ortaya konmuştur.

BULGULAR ve SONUÇ

Alternaria burnsii Hastalığının İllere ve Köylere Göre Yaygınlık Oranları

Çizelge 1. *Alternaria burnsii* hastalığının illere ve köylere göre yaygınlık oranları

İl / Yer	Alan (da)	Hastalık Oranı (%)	Yaygınlık (%)	Etmen
Ankara / Haymana / Sunduran	15	40	–	*A. burnsii*
Ankara / Haymana / Sinanlı	30	70	–	*A. burnsii*
Ankara / Haymana / Kerpiç	35	60	–	*A. burnsii*
Ankara / Haymana / Saatli-1	15	80	–	*A. burnsii*
Ankara / Haymana / Saatli-2	95	50	–	*A. burnsii*
Ankara / Polatlı	86	90	-	*A. burnsii*
Ankara			71,6	*A. burnsii*
Konya / Cihanbeyli / Tüfekçipınar	100	60	–	*A. burnsii*
Konya / Cihanbeyli / Yünlü	75	60	–	*A. burnsii*
Konya / Cihanbeyli / Kelhasan	15	80	–	*A. burnsii*
Konya / Cihanbeyli / Kandil-Yünlü	60	40	-	*A. burnsii*
Konya			56,4	*A. burnsii*

Çizelge 1'e göre, *A. burnsii* hastalığı Ankara'nın güney kesimlerinde ve Polatlı çevresinde daha yoğun olarak belirlenmiştir. Bu bölgelerde ilkbahar yağışlarının ardından artan nem oranı, Alternaria enfeksiyonlarının şiddetlenmesine neden olmuştur. Benzer biçimde, Rathi et al. (2021) Hindistan'ın Rajasthan bölgesinde, ortalama nemin %75'in üzerine çıktığı dönemlerde *A. burnsii*'nin hızla yayıldığını rapor etmiştir.
Yüksek yaygınlık oranı, patojenin hem tohumla hem de bitki artıklarıyla taşınabilmesiyle ilişkilidir (Gupta et al., 2022).Ankara'daki yüksek oranlar, aynı parsellerde tekrarlanan kimyon ekimleri ve monokültür uygulamalarıyla açıklanabilir. Konya'da nispeten düşük oranların görülmesi, daha uzun rotasyon uygulamalarının hastalık gelişimini sınırladığını düşündürmektedir.
Elde edilen sonuçlar, *A. burnsii*'nin İç Anadolu Bölgesi'nde kimyon üretimini sınırlayan baskın patojen konumunda olduğunu açıkça göstermektedir.

Fusarium Solgunluğu (*Fusarium oxysporum* f. sp. *cumini)* Yaygınlığı

Çizelge 2. *Fusarium oxysporum* f. sp. *cumini* hastalığının illere ve köylere göre yaygınlık oranları

İl / Yer	Alan (da)	Hastalık Oranı (%)	Yaygınlık (%)	Etmen
Ankara / Polatlı	86	30		*Fusarium oxysporum* f. sp. *cumini*
Ankara / Haymana / Kerpiç	30	20		*Fusarium oxysporum* f. sp. *cumini*
Konya / Cihanbeyli / Tüfekçipınar	100	20		*Fusarium oxysporum* f. sp. *cumini*
Ankara			%27.4	*Fusarium oxysporum* f. sp. *cumini*
Konya / Cihanbeyli / Yünlü	75	30		*Fusarium oxysporum* f. sp. *cumini*
Konya / Cihanbeyli / Kelhasan	15	30		*Fusarium oxysporum* f. sp. *cumini*
Konya			%24.7	*Fusarium oxysporum* f. sp. *cumini*

Ankara ve Konya illerinde yapılan incelemelerde *F. oxysporum* f. sp. *cumini*'nin yaygınlığı sırasıyla %27,4 ve %24,7 olarak belirlenmiştir. Çizelgeler incelendiğinde, hastalığın özellikle Ankara–Polatlı ve Konya–Yünlü bölgelerinde yoğunlaştığı görülmektedir. Bu durum, patojenin toprakta uzun süre canlı kalabilmesi ve drenajı zayıf alanlarda gelişiminin hızlanmasıyla ilişkilidir (Abo-Elyousr et al., 2022).
Hastalık belirtileri genellikle alt yapraklarda solma, damar kararması ve gövde boğazında siyahımsı lekeler şeklinde gözlenmiştir. Bu semptomlar, literatürde tanımlanan klasik *Fusarium* solgunluğu belirtileriyle uyumludur (Leslie & Summerell, 2006).
Her iki il arasında hastalık oranları bakımından anlamlı farklılıklar belirlenmiştir. *A. burnsii* için Ankara'da ortalama %71,6 yaygınlık değeri, Konya'ya göre anlamlı düzeyde yüksek bulunmuştur. *F. oxysporum* için fark daha düşük olmakla birlikte, Ankara örneklerinde ortalama yaygınlık oranı yaklaşık %3 daha fazladır.

TARTIŞMA VE SONUÇ

Bu çalışma, Türkiye'nin İç Anadolu Bölgesi'nde kimyon üretim alanlarında fungal hastalıkların yaygınlığını sistematik biçimde değerlendiren ilk saha çalışması olma özelliğini taşımaktadır. Üç yıllık sürvey verileri, *Alternaria burnsii*'nin bölgedeki baskın patojen olduğunu*; Fusarium oxysporum* f. sp. *cumini*'nin ise daha düşük oranlarda görülmesine karşın üretim açısından kalıcı bir tehdit oluşturduğunu ortaya koymuştur.

Alternaria enfeksiyonlarının özellikle ilkbahar yağışlarının ardından yüksek nem koşullarında şiddetlendiği belirlenmiştir. Bu bulgu, Rathi et al. (2021) ve Gupta et al. (2022)tarafından bildirilen, nem oranının %75'in üzerine çıktığı dönemlerde *A. burnsii*'nin hızlı yayılım gösterdiğini ortaya koyan sonuçlarla örtüşmektedir. Fusarium solgunluğu ise drenajı yetersiz ve monokültür yapılan alanlarda yoğun olarak gözlenmiştir. Benzer şekilde Abo-Elyousr et al. (2022), *F. oxysporum* f. sp. *cumini*'nin toprakta uzun süre (6 yıla kadar) canlı kalabildiğini ve rotasyon yapılmayan tarlalarda hastalığın epidemik hale gelebildiğini bildirmiştir.

Elde edilen bulgular, Ankara ve Konya illeri arasında hastalık yaygınlık oranları bakımından iklimsel farklılıkların belirleyici rol oynadığını göstermektedir. Ankara örneklerinde daha yüksek yaygınlık oranları, bölgedeki daha kısa rotasyon aralıkları ve yüksek nem koşullarıyla ilişkilendirilmiştir. Konya'da ise daha geniş ekim nöbeti uygulamaları ve düşük nem oranları hastalık şiddetini sınırlandırmıştır.

Bu sonuçlar, entegre hastalık yönetimi (EHY) stratejilerinin oluşturulmasında önemli bilimsel temeller sunmaktadır. Özellikle: Dayanıklı kimyon çeşitlerinin geliştirilmesi, Tohum dezenfeksiyonu ve hastalık izleme programlarının yaygınlaştırılması, Rotasyon süresinin uzatılması ve toprak sağlığının iyileştirilmesi, Biyolojik kontrol ajanlarının (*Trichoderma harzianum* vb.) saha koşullarında denenmesi gelecekteki çalışmalarda öncelikli alanlar olarak öne çıkmaktadır.

Sonuç olarak, *Alternaria burnsii* ve *Fusarium oxysporum* f. sp. *cumini* etmenleri, İç Anadolu koşullarında kimyon üretimini sınırlayan başlıca fungal patojenlerdir. Bu çalışma, bölgesel hastalık dinamiklerinin anlaşılmasına katkı sağlamış; sürdürülebilir kimyon üretimi için dayanıklı genotiplerin ıslahı, erken uyarı sistemlerinin kurulması ve entegre hastalık yönetimi programlarının geliştirilmesi yönünde önemli bir bilimsel altyapı oluşturmuştur.

KAYNAKLAR

Abo-Elyousr, K. A., Ibrahim, O. H., Al-Qurashi, A. D., Mousa, M. A., & Saad, M. M. (2022). Biocontrol potential of endophytic fungi for the eco-friendly management of root rot of *Cuminum cyminum* caused by Fusarium solani. *Agronomy*, *12*(11), 2612.

Ahmad, N., Sharma, R., & Singh, M. (2023). Fusarium wilt of cumin: Pathogen biology, host resistance and management approaches. Journal of Plant Pathology, 105(2), 315–326. *Journal of Plant Pathology*, *105(2)*, 315–326.

Bora, T., & Karaca, İ. (1970). *Bitki Hastalıkları Surveyi, Kültür Bitkilerinde Hastalığın ve Zararın Ölçülmesi,* . Yayın No: 167, Ege Üniversitesi Matbaası, Bornova.

FAO. (2023). *Spices statistics database: Cumin production by country.* https://www.fao.org/faostat/en/#data/QCL.

Gupta, V., Rathi, S., & Meena, P. (2022). Alternaria blight of cumin: Current status and management strategies. *Crop Protection*, *159*, 106048.

Hosseini, M., Yadollahi, A., & Shafiei, M. (2023). Environmental determinants of *Fusarium oxysporum* f. sp. *cumini* incidence in arid soils of Iran. *Iranian Journal of Plant Pathology*, *59(1)*, 44–55.

Khaledi, N., & Hassani, F. (2021). Effect of seed-borne Fusarium species on constituents of essential oils from seeds of black cumin populations. *Journal of Plant Protection Research*, *61 (3), 2021*.

Kumar, A., Rathi, P., & Sharma, S. (2024). Molecular insights into host defense against *Alternaria burnsii* in cumin. *Physiological and Molecular Plant Pathology*, *138, 102971*.

Kumar, R., Patel, M., & Singh, P. (2021). Epidemiology and management of cumin diseases in semi-arid regions. *Indian Phytopathology*, *74(3)*, 489–496.

Leslie, J. F., & Summerell, B. A. (2006). *The Fusarium laboratory manual. Blackwell Publishing.*

MGM. (2024). *Ankara ve Konya illeri uzun yıllar ortalamaları.* https://www.mgm.gov.tr

Özer, N., & Bayraktar, H. (2015). Identification and pathogenicity of fungal pathogens associated with cumin in Turkey. *Phytoparasitica*, *43(3)*, 383–395.

Ranganathan, P., Meena, P. D., & Sharma, A. (2025). Alternaria blight of cumin: Emerging threats and integrated management options. *Journal of Spices and Aromatic Crops*, *34(1),*, 17–28.

Rathi, S., Meena, P., & Gupta, V. (2021). Survey and assessment of Alternaria blight in cumin-growing areas of Rajasthan, India. *Plant Disease Research*, *36(2)*, 90–97.

Sharma, R., Gupta, P., & Singh, D. (2020). Impact of Alternaria blight on yield and seed quality of cumin under field conditions. *Journal of Mycology and Plant Pathology,*, *50(1)*, 15–22.

Singh, A., Sharma, N., Bansal, S., Singh, R., & Singh, G. (2025). BpGDB: A genomic resource database of Bunium persicum for genetics and breeding. *Journal of Applied Research on Medicinal and Aromatic Plants*, *46*, 100630.

Singh, G., Marimuthu, P., De Heluani, C. S., & Catalan, C. A. N. (2022). Chemical composition and biological activities of essential oil of *Cuminum cyminum* L. from India. *Food Chemistry*, *371, 131125.* https://doi.org/10.1016/j.foodchem.2021.131125

TÜİK. (2024). *Bitkisel Üretim İstatistikleri – Kimyon Ekim Alanı ve Üretim Miktarları. Türkiye İstatistik Kurumu.* https://data.tuik.gov.tr

Wadud, M., Rathi, S., & Meena, P. (2021). Pathogenic variability among *Alternaria burnsii* isolates infecting cumin. *Frontiers in Plant Pathology*, *12,*, 103–115.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

BUĞDAYDA HIZLI ISLAH YÖNTEMİ UYGULAMALARI

Doç. Dr. Bekir ATAR
Isparta Uygulamalı Bilimler Üniversitesi, Atabey Meslek Yüksekokulu, Bitkisel Ve Hayvansal Üretim Bölümü
ORCID: 0000-0002-1446-5699

ÖZET
İlk olarak Watson et al. (2018) tarafından tanımlanan hızlı ıslah (speed breeding) yöntemi, yalnızca buğdayda değil birçok bitkide ıslah sürecini hızlandırmak, stres toleransı çalışmaları yapmak, nadir tohumları çoğaltmak, genetik çeşitliliği korumak, yeni çeşitleri üretmek ve acil gıda üretimi sağlamak gibi çeşitli alanlarda potansiyel kullanım sunmaktadır. Buğdayda normalde yılda 1 nesil elde edilirken, bu yöntemle yılda 5 nesil üretilebilmektedir. Yazlık buğday vejetasyon süresi 60–65 günde, kışlık buğday ise hızlandırılmış vernalizasyon ile 75–80 günde tamamlanabilmektedir. Böylece yeni bir çeşidin geliştirilmesi birkaç yıla indirilebilmektedir.
Yöntem, iklim koşullarını değiştirerek vejetasyon süresini kısaltma esasına dayanmaktadır. Ayrıca hızlı ıslah uygulamaları; markör destekli seleksiyon, genomik seleksiyon ve CRISPR/Cas9 gibi gen düzenleme teknolojileriyle entegre edilerek stres toleransı, verim artışı ve iklim adaptasyonu gibi karmaşık özelliklerin daha etkin şekilde sabitlenmesini sağlamaktadır. Bu amaçla kontrollü iklim odaları veya cam sera koşulları kullanılmaktadır.
Yöntemde fotoperiyot günde 22 saate kadar uzatılmaktadır. Aydınlatmada LED ışıklar kullanılarak 400–700 nm dalga boyu aralığında fotosentetik aktif radyasyon sağlanmaktadır. Işık şiddeti deseni şu şekildedir: çıkış–sapa kalkma evresi için yaklaşık 300 µmol m^{-2} s^{-1}, sapa kalkma–başaklanma evresi için yaklaşık 700 µmol m^{-2} s^{-1}, çiçeklenme sonrası için yaklaşık 400 µmol m^{-2} s^{-1}. Bu desen, sabit 700 µmol m^{-2} s^{-1} uygulamasına göre %30 enerji tasarrufu sağlayabilmektedir.
Sıcaklık, buğday için ideal büyüme dereceleri olan gündüz 22–24°C ve gece 17–19°C olarak ayarlanmaktadır. Vernalizasyon ihtiyacı çeşide bağlı olarak iki haftaya kadar indirilebilmektedir. Kışlık bitkilerde ise 8°C'de 4 hafta süreyle bekletme, vernalizasyon ihtiyacını karşılayabilmektedir.
Sistemde ilk kurulum, aydınlatma, ısıtma ve soğutma maliyetleri ile bazı genotiplerin fotoperiyoda düşük yanıtı sorun olarak ortaya çıkmaktadır. Güneş ışığından faydalanabilen sistemler ise maliyetleri önemli ölçüde düşürmektedir.
Anahtar Kelimeler: Buğday, Hızlı ıslah, Kontrollü ortam

SPEED BREEDING METHOD APPLICATIONS IN WHEAT

ABSTRACT
Watson et al. (2018) were the first to talk about the rapid breeding method. It could be useful for more than just wheat; it could also be used to speed up the breeding process, study stress tolerance, grow rare crops, preserve genetics, create new crops, and provide emergency food production. While conventional wheat breeding typically yields 1–2 generations per year, speed breeding allows for 4–6 generations annually. In spring wheat genotypes, one generation can be completed in approximately 60–65 days, whereas winter genotypes require 75–80 days with accelerated vernalization. This significantly shortens the time needed to develop new cultivars.

The method is based on shortening the vegetative period by modifying climate conditions. Moreover, speed breeding can be integrated with marker-assisted selection, genomic selection, and gene editing technologies such as CRISPR/Cas9 to more effectively fix complex traits like stress tolerance, yield improvement, and climate adaptation. Controlled climate chambers or glasshouse conditions are used for this purpose.

Photoperiods are extended up to 22 hours per day. LED lighting provides photosynthetically active radiation (PAR) in the 400–700 nm wavelength range. The light intensity pattern is as follows: ~300 µmol m^{-2} s^{-1} during emergence to stem elongation, ~700 µmol m^{-2} s^{-1} from stem elongation to heading, and ~400 µmol m^{-2} s^{-1} after flowering. This pattern can save up to 30% energy compared to a constant 700 µmol m^{-2} s^{-1} setup.

The temperature is set to the best conditions for wheat to grow: 22–24°C during the day and 17–19°C at night. Vernalization requirements can be reduced to as little as two weeks depending on the genotype. For winter crops, a 4-week exposure at 8°C is sufficient to meet vernalization needs.

Challenges include initial setup costs for lighting, heating, and cooling systems, as well as low photoperiod responsiveness in certain genotypes. Systems that utilize natural sunlight can significantly reduce operational costs.

Keywords: Wheat, Speed breeding, Controlled environment

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

KULUÇKADA UYGULANAN LAVANTA ESANS YAĞI KOKUSUNUN KULUÇKA ÖZELLİKLERİNE ETKİSİ

Fatma YENİLMEZ
Çukurova Üniversitesi, Tufanbeyli Meslek Yüksekokulu
ORCID: 0000-0001-5470-7974

Özet
Kanatlılarda üretimin en önemli sorunlarından biri, genetik kapasitenin artırılmasına yönelik yapılan ıslah çalışmaları sonucu verimdeki artışa paralel olarak gelişen metabolizmadaki duyarlılığın artmasıdır. Verim bakımından yüksek seviyelere ulaşan etlik piliçler daha fazla ihtimamlı bakım ve beslemeye ihtiyaç duyarlar. Kuluçka çıkışı sonrası oldukça hassas olan civcivler kümese yerleştirilip su ve yeme ulaşıp kendi bağışıklık sistemini oluşturuncaya kadar değişik stres faktörleriyle karşı karşıya kalırlar. Bu dönemde yaşanan stres civciv ölümlerinin artmasıyla sonuçlanır ve performansı önemli düzeyde etkiler. Lavanta esans yağının insanlarda ve bıldırcın, etlik piliç, hindi gibi değişik kanatlı hayvanlarda bağışıklık sistemine olan olumlu ve sakinleştirici etkisi yanında performansa olan etkileri birçok araştırmaya konu olmuş ve olumlu sonuçlar elde edilmiştir. Buradan hareketle yapılan çalışmanın amacı embriyonal dönemin sonunda (19-21. gün) ve çıkış günü lavanta esans yağı koku uygulamasının, yumurtadan yeni çıkmış civcivlerde çıkış sonrası oluşan stresle mücadelede lavanta esans yağı kokusunun etkilerini araştırmaktı. Bu kapsamda 41 haftalık Ross 308 etlik piliçlerden elde edilen 800 adet kuluçkalık yumurta uygulama (lavanta esans yağı) ve kontrol grubu olmak üzere iki gruba ayrılmış ve iki ayrı kuluçka makinesine yerleştirmiştir. Uygulama grubuna kuluçkanın çıkış döneminde (son 3 gün) makine içerisinde lavanta esans yağı uygulaması (4ml/gün) yapılmıştır. Araştırmada kuluçka özellikleri ve civciv kalitesi incelenmiştir. Araştırma sonuçlarına göre kuluçkada uygulanan lavanta esans yağı kokusunun kuluçka randımanı ve çıkış gücü üzerine olan etkisinin lavanta grubunda (88.3-92.4) kontrol grubuna göre (88.0-91.0) daha yüksek olduğu tespit edilmiştir. Lavanta kokusu uygulanan grubun civcivlerinin kalitesi (91.7) kontrol grubuna göre (89.0) daha yüksek olarak belirlenmiştir. Kuluçkada lavanta kokusu uygulaması kuluçka sonuçlarını ve civciv kalitesini olumlu etkilemiştir. Sonuçlar civciv kalitesini artırmak için kuluçkada lavanta esans yağı kokusunun kullanılabileceğini göstermektedir.
Anahtar kelimeler: Lavanta esans yağı, kuluçka, civciv kalitesi, kuluçka randımanı, çıkış gücü

Bu çalışma Çukurova Üniversitesi Araştırma Projeleri Birimi tarafından desteklenmiştir (Proje No: FBA-2024-16959)

EFFECT OF LAVENDER ESSENTIAL OIL SCENT APPLIED DURING INCUBATION ON HATCHING CHARACTERISTICS

Abstract
One of the most significant challenges in poultry production is the increased sensitivity of metabolism, which occurs in parallel with the increase in productivity resulting from breeding efforts aimed at improving genetic capacity. Broiler chickens, which reach high production levels, require more meticulous care and feeding. After hatching, the highly sensitive chicks are placed in the coop and exposed to various stress factors until they have access to water and feed and have developed their immune system.

The stress experienced during this period results in increased chick mortality and has a significant impact on performance. The positive and calming effects of lavender essential oil on the immune system, as well as its effects on performance, have been the subject of numerous studies in humans and various poultry, such as quail, broiler chickens, and turkeys, with positive results. Therefore, this study aimed to investigate the effects of lavender essential oil scent application at the end of the embryonic period (days 19-21) and on the day of hatching and the effects of lavender essential oil scent on combating post-hatch stress in newly hatched chicks. In this context, 800 hatching eggs obtained from 41-week-old Ross 308 broiler chickens were divided into two groups as treatment (lavender essential oil) and control groups and placed in two separate incubators. Lavender essential oil (4 ml/day) was applied to the treatment group during the hatching period (last 3 days) in the machine. Hatching characteristics and chick quality were examined in the study. According to the results of the study, it was determined that the effect of lavender essential oil scent applied in incubation on hatchability of set eggs and hatchability of fertile eggs was higher in the lavender group (88.3-92.4) than in the control group (88.0-91.0). The quality of the chicks in the lavender-scented group (91.7) was determined to be higher than in the control group (89.0). Application of lavender scent in incubation positively affected hatching results and chick quality. The results indicate that lavender essential oil scent can be used in incubation to improve chick quality.
Keywords: Lavender essential oil, incubation, chick quality

This study was supported by the Cukurova University Research Projects Unit (Project No: FBA-2024-16959)

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

İKLİM DEĞİŞİKLİĞİNİN TARİHİ TAŞ YAPILAR ÜZERİNE ETKİSİ: TRAJAN SU KEMERLERİ ÖRNEĞİ

Dr. Ayşe DOLAR
Hatay Mustafa Kemal Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü
ORCID: 0000-0002-5933-9442

Prof. Dr. Erol ATAY
Hatay Mustafa Kemal Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü
ORCID: 0000-0002-5274-1025

Prof. Dr. Murat DAL
Munzur Üniversitesi, Güzel Sanatlar Tasarım ve Mimarlık Fakültesi, İç Mimarlık Tasarımı Bölümü
ORCID: 0000-0001-5330-1868

ÖZET
Yirmi birinci yüzyılın başında insanlığın geleceğini tehdit eden en önemli konu iklim değişikliğidir. İklim değişikliği, dünya genelinde kültürel miras varlıkları üzerinde yıkıcı etkilere yol açmaktadır. "Kültürel miras" kelimesi, toplumun ve kültürün değerli maddi ve manevi bileşenlerinin tamamını ifade eder. Anıtlar, tarihi binalar ve arkeolojik alanlar gibi kültürel miras varlıkları, yerel sakinlere bir kimlik duygusu ve estetik refah sağlar. Kültürel miras alanları, sıcaklık, yağış, atmosferik nem ve rüzgâr yoğunluğundaki yavaş değişimlerin yanı sıra yükselen deniz seviyeleri ve değişen şiddetli hava olayları ile kendini gösteren iklim değişikliğinden hâlihazırda etkilenmektedir. Tarihi taş yapılar, bu değişikliklerden fiziksel, kimyasal ve biyolojik süreçlerle zarar görmektedir. Bu çalışma, Türkiye'nin Hatay iline bağlı Defne ilçesinde yer alan tarihi su kemerleri üzerinden iklim değişikliğinin tarihi taş yapılara olan etkilerini değerlendirmeyi amaçlamaktadır. IMRAD yapısına göre kurgulanan çalışma, literatür taraması ve saha gözlemlerine dayanmakta, elde edilen bulgular doğrultusunda koruma stratejileri önerilmektedir. Bölgedeki iklimsel değişikliklerin bu yapı üzerindeki biyolojik, fiziksel ve kimyasal bozunmaları nasıl etkilediği incelenmiş, saha gözlemleri ve literatür taramaları yoluyla yapının güncel durumu değerlendirilmiştir. Elde edilen bulgular, tarihi taş yapıların korunmasında iklim değişikliği faktörünün göz önünde bulundurulması gerektiğini göstermektedir (Brimblecombe, 2014).
Anahtar Kelimeler: Bozunma, iklim değişikliği, Trajan su kemerleri

THE IMPACT OF CLIMATE CHANGE ON HISTORIC STONE STRUCTURES: THE CASE OF THE TRAJAN AQUEDUCTS

ABSTRACT
The most important issues endangering humanity's future at the start of the twenty-first century are climate change. Climate change has devastating effects on cultural heritage assets worldwide. The word "cultural heritage" refers to all of the valuable material and immaterial components of society and culture. Cultural heritage assets such as monuments, historical buildings, and archeological sites give local residents a sense of identity and aesthetic well-being. Cultural heritage sites are already affected by climate change, which is characterised by slow changes in temperature, precipitation, atmospheric humidity and wind intensity, as well as rising sea levels and changing severe weather events. Historic stone structures are damaged by these changes through physical, chemical and biological processes.

This study aims to evaluate the effects of climate change on historical stone structures through historical aqueducts located in Defne district of Hatay province, Turkey. The study, structured according to the IMRAD format, is based on literature review and field observations, and proposes conservation strategies in line with the findings. The impact of climatic changes in the region on the biological, physical and chemical deterioration of this structure has been examined, and the current state of the structure has been assessed through field observations and literature reviews. The findings indicate that the climate change factor should be taken into consideration in the conservation of historical stone buildings (Brimblecombe, 2014).
Keywords: Climate change, degradation, Trajan aqueducts

GİRİŞ

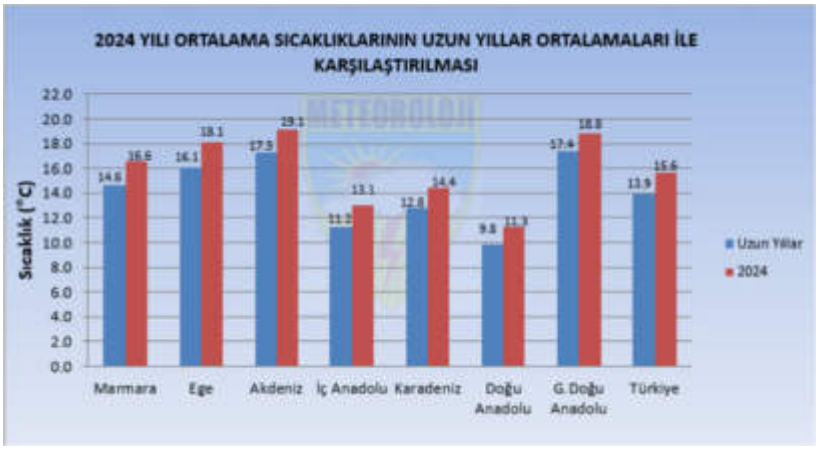
Küresel iklim değişikliği, sadece doğal çevre üzerinde değil, aynı zamanda kültürel miras üzerinde de ciddi tehditler oluşturmaktadır. İnsanlık tarihinin en yakın tanıkları olan taş anıtlar, inşa edildikleri dönemlerin ve uygarlıkların ekonomik, kültürel ve sanatsal birikimlerinin aydınlatılmasına yardımcı olan önemli dünya mirası örnekleridir. Günümüze ulaşan taş anıtların geleceğe aktarılması toplumsal bir sorumluluktur (Hatır, 2020). Taş yapılarda gözlemlenen fiziksel, kimyasal ve biyolojik bozunmalar büyük ölçüde çevresel değişikliklere bağlıdır (Leissner, Kilian, Kotova, Jacob, Mikolajewicz ve Broström, 2015). Türkiye'de yer alan tarihi su kemeri yapıları, özellikle Akdeniz iklim kuşağındaki Trajan Su Kemerleri, bu etkilere karşı oldukça hassastır. Küresel ölçekte artan iklim değişikliği, tarihi ve kültürel yapıları tehdit etmektedir (IPCC, 2002). Sıcaklık artışları, düzensiz yağışlar, nem dalgalanmaları ve ekstrem doğa olayları; taş yapıların fiziksel bütünlüğünü ve uzun ömürlülüğünü olumsuz etkilemektedir (Fitzner, 2002; Camuffo, 2014). Trajan Su Kemerleri, Roma dönemine tarihlenen ve yerel taşlarla inşa edilmiş, bölgenin en önemli tarihi su kemeri yapılarındandır (T.C. Kültür ve Turizm Bakanlığı, 2020). Bu kemerler, günümüzde iklimsel stres faktörleri nedeniyle çeşitli bozunmalar göstermektedir. Bu bağlamda çalışma, Trajan Su Kemerleri özelinde iklim değişikliğinin etkilerini bilimsel bir çerçevede değerlendirmeyi amaçlamaktadır.

YÖNTEM

Bu çalışma bir araştırma makalesi olarak planlanmış, nitel ve nicel analiz yöntemler birlikte kullanılmıştır. Defne ilçesinde yer alan su kemerleri yerinde görsel incelenerek fotoğraflarla desteklenmiştir. Taş türlerinin incelenmesi ve gözlenen bozunmaların sınıflandırılması (Smith, Gómez-Heras ve McCabe, 2020), literatür taramasıyla bozunma tiplerinin iklimle bağlantısının kurulması (Turkington ve Paradise, 2005), Meteoroloji Genel Müdürlüğü'nden alınan 30 yıllık iklim verilerinin analizi, ulusal ve uluslararası bilimsel yayınlar, IPCC raporları ve saha çalışmaları incelenmiştir. Fiziksel, kimyasal ve biyolojik bozunma türleri sınıflandırılmış ve örnek olay üzerinden ilişkilendirilmiştir.

ARAŞTIRMA VE BULGULAR

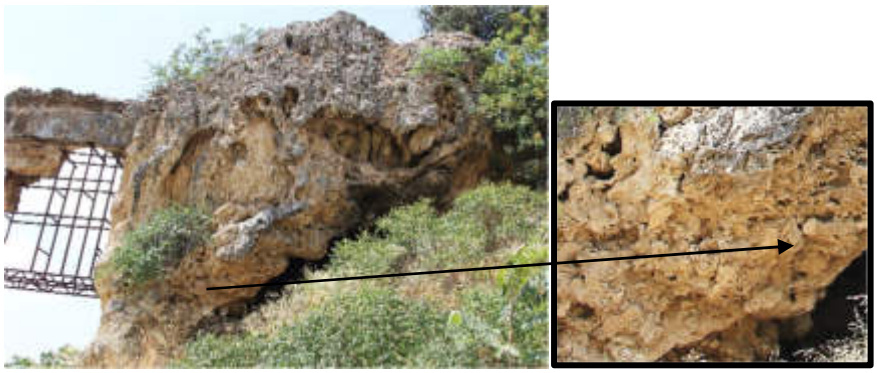
Meteorolojik verilerde, 2024 yılı Türkiye ortalama sıcaklığı 15.6 °C ile 1991–2020 ortalaması olan 13.9 °C'nin 1.7°C üzerinde gerçekleşerek son 54 yılın rekorunu kırmıştır. Bu değer, bir önceki rekor olan 2010 yılının 15.5 °C değerini 0.1 °C geçmiştir (Şekil 1) (MGM, 2024). Ekstrem hava olaylarının (ani yağışlar, kuraklık periyotları) sıklığı 2000 sonrası iki kat artmıştır (IPCC, 2021).



Şekil 1. 30 yıllık iklim verilerinin analizi (URL-1).

Fiziksel Bozunmalar

Trajan Su Kemerleri'nde meydana gelen fiziksel bozunmalar petek gözlülük, çatlak, parça kopmaları ve aşınma olarak gözlenmiştir (Şekil 2).



Trajan Su Kemerleri'nde petekgözlülük

Trajan Su Kemerleri'nde çatlak

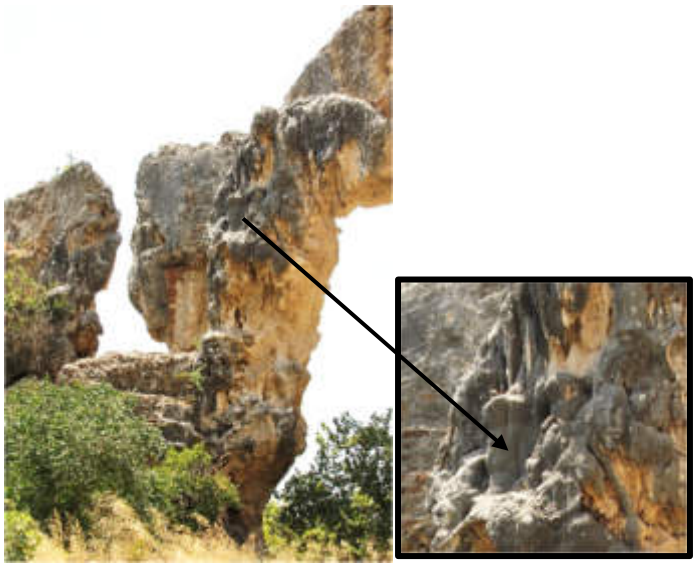
Trajan Su Kemerleri'nde parça kopması

Trajan Su Kemerleri'nde aşınma

Şekil 2. Trajan Su Kemerleri'nde fiziksel bozunmalar

Kimyasal Bozunmalar

Bölgede artan hava kirliliği nedeniyle asidik yağışlar taş yüzeyde çözülmelere yol açmış kararma ve tozlaşma görülmüştür (Fitzner, 2002). Gözenekli kireç taşlarının bu reaksiyonlara karşı hassas olduğu belirlenmiştir (Şekil 3).



Trajan Su Kemerleri'nde kararma

Trajan Su Kemerleri'nde tozlaşma

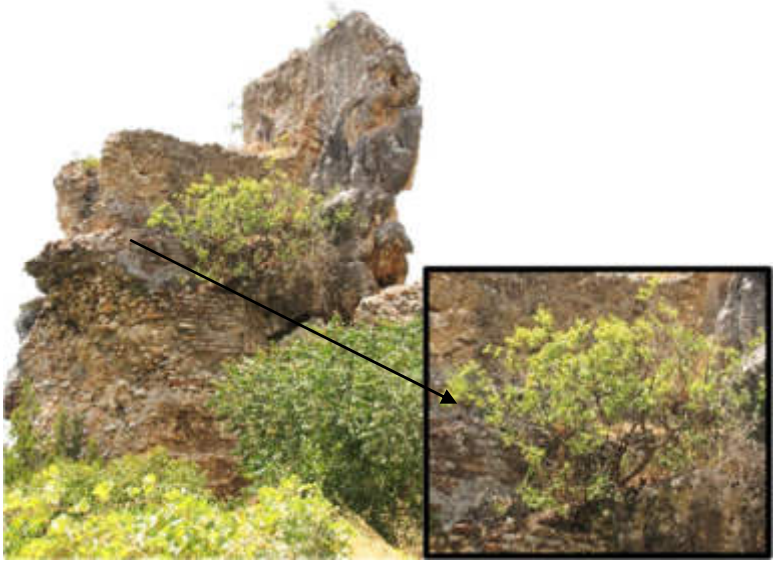
Şekil 3. Trajan Su Kemerleri'nde kimyasal bozunmalar

Biyolojik Bozunmalar

Kemer yapısında hayvan yuvaları, liken ve bitki köklerinin geliştiği görülmüş; bu oluşumlar taş yüzeyde kimyasal bozunmayı da hızlandırmaktadır (Şekil 4) (Özdemir ve Yıldız, 2020).

Trajan Su Kemerleri'nde kara yosunu, beyaz ve turuncu liken

Trajan Su Kemerleri'nde böcek ve sürüngen yuvaları



Trajan Su Kemerleri'nde bitki oluşumu

Şekil 4. Trajan Su Kemerleri'nde biyolojik bozunmalar

TARTIŞMA

Literatür ve yerel gözlemler doğrultusunda, iklim değişikliğinin tarihi taş yapılar üzerindeki etkileri açık şekilde görülmektedir. Trajan Su Kemerleri, bu etkilerin tipik örneklerini barındırmakta; biyolojik, fiziksel ve kimyasal bozunmalar yapının taşıyıcı sistemini tehdit etmektedir. Yapıya ait detaylı koruma planlarının eksik olduğu görülmektedir. Oysa iklim değişikliğine karşı yapının düzenli izlenmesi, nefes alabilir koruyucu kaplamaların kullanılması, bitkisel temizliğin kontrollü yapılması gibi önlemler acil olarak uygulanmalıdır (Camuffo, 2014; Özdemir ve Yıldız, 2020). İklim değişikliğinin tetiklediği çevresel süreçler, taş yapıların dayanıklılığını azaltmaktadır (Grossi ve Brimblecombe, 2007). Ayrıca nem döngüsünün bozunması, taşların içindeki tuzların kristalleşmesine ve bunun sonucunda yüzey kayıplarına yol açmaktadır (Doehne ve Price, 2010). Trajan Su Kemerleri örneğinde bu bozunmalar açık şekilde gözlemlenmiştir.

İklim Değişikliğinin Bozunmaya Etkisi

Güneş, don, tuz, rüzgâr, yağmur ve kirlilik gibi abiyotik faktörler anıtların, heykellerin ve diğer sanat eserlerinin bozunmasına neden olur. Ne yazık ki, tüm kültürel miras türleri depremler, seller, iklim değişikliğinin yol açtığı fırtınalar, yangınlar ve çatışmalar gibi doğal afetler nedeniyle geri dönüşü olmayan bir şekilde zarar görmektedir. Mimari kültürel miras malzemelerine zarar verdiği bilinen başlıca unsurlarından biri yağışlardır. Yağışların artması, binalarda biyolojik aktivitenin artmasına ve malzeme kaybına da yol açmaktadır (Sesana ve ark., 2021). Yüksek nem, kirletici maddelerin birikmesini ve kimyasal reaksiyonları teşvik edebilir, bu da metal korozyonuna ve diğer sonuçlara yol açabilir (Brimblecombe, 2013). Sanayileşme ve insan faaliyetlerinin bir sonucu olarak atmosfere salınan karbondioksit, kükürt dioksit ve karbon monoksit gibi tehlikeli gazlar, temiz havadaki N_2O, CO, H_2, SO_2 ve bazı hidrokarbonların miktarını artırmaktadır. Bu gazlar, hem kuru hem de nemli ortamlarda yapı malzemelerine zarar vermektedir (Bayık ve Bedirhanoğlu, 2022). Yapının bir parçası olsun ya da olmasın, her taş yüzey, hava şartlarına maruz kaldığı anda çeşitli aşınma süreçlerine karşı savunmasızdır ve bu da atmosferik etkiler nedeniyle taşın kısmen veya tamamen bozunmasına yol açabilir (Korkanç ve Savran, 2015; Fener ve Ince, 2015).

Güçlü rüzgarlar, kum gibi ince taneli unsurları yerden alıp eserlerin yüzeyine çarptığında, eserlerin yüzeyini büyük ölçüde aşındırma ve görünümünü değiştirme özelliğine sahiptir (Öcal ve Dal, 2012). Doğal afetler (heyelanlar, seller, depremler gibi), savaşlar, kazalar veya insan faaliyetlerinin yol açtığı zararlar nedeniyle zaman içinde zarar görmüş doğal ve kültürel mirası korumak ve muhafaza etmek zorlu bir iştir. Hasarın bir örneği, nehir kıyısında bulunan bir binanın su seviyesindeki ani artıştan etkilenmesidir. Isıtma sistemleri, yakıt kullanımı ve araba egzoz dumanları, doğal yapı taşlarının aşınmasına ve kabuklanmasına neden olan faktörlerden sadece birkaçıdır (Hasbay ve Hattap, 2017). Yangın, kültürel miras nesnelerinde maddi kayıp ve bozunmaya neden olmasının yanı sıra, mevcut yapıların çatlamasına veya kırılmasına da neden olabilir (ICOMOS İklim Değişikliği ve Miras Çalışma Grubu, 2019).

Dayanıklı Şehirler Perspektifinden Değerlendirme

İklim değişikliğine karşı dirençli toplumlar oluşturma hedefi, son yıllarda "dayanıklı şehirler" (resilient cities) kavramını ön plana çıkarmıştır. Bu yaklaşım, yalnızca altyapısal değil, aynı zamanda kültürel ve tarihi unsurların da risklere karşı güçlendirilmesini içerir (Leichenko, 2011). Bu bağlamda, Trajan Su Kemerleri gibi tarihi yapılar yalnızca pasif koruma nesneleri değil, aynı zamanda kentsel hafızanın aktif bileşenleri olarak görülmelidir. Dayanıklı şehirler stratejileri kapsamında bu yapıların mikroiklim düzenleyici etkileri (gölgeleme, nem dengeleme), sürdürülebilir su yönetimi mirası olarak yeniden yorumlanması, toplumsal bilinç artırma ve afet sonrası toparlanma süreçlerine kültürel katkısı önemli avantajlar sağlamaktadır. Bu yaklaşımla, su kemerleri hem geçmişin bilgeliğini hem de geleceğin sürdürülebilirliğini taşıyan yapılar olarak değerlendirilebilir (Vale ve Campanella, 2005).

SONUÇ

Trajan Su Kemerleri örneği, iklim değişikliğinin tarihi taş yapılar üzerindeki çok yönlü etkilerini gözler önüne sermektedir. Yapının birçok bölümlerinde hayvan yuvaları, liken ve bitki oluşumu kaynaklı biyolojik büyümeler artış göstermektedir. Bu durum, özellikle artan sıcaklık ve nem değişimleriyle ilişkilidir (Fitzner, 2004). Bölgedeki yoğun hava kirliliği nedeniyle kararma ve tozlaşma meydana gelmiştir. Taş yüzeylerinde aşınma, parça kopması ve petekgözlülük gözlenmiştir. Kültürel mirasın sürdürülebilir biçimde korunabilmesi için, yapılar çevresel etkilere karşı düzenli izlenmeli, bilimsel temelli koruma planları oluşturulmalı ve toplumsal farkındalık artırılmalıdır. Bu bağlamda, Trajan Su Kemerleri'nde tespit edilen bozunmalar, iklim değişikliğinin kültürel miras üzerindeki etkilerini somut olarak göstermektedir. Bu yapılar için geliştirilecek koruma stratejilerinde sadece mevcut çevresel koşullar değil, aynı zamanda gelecekteki iklim senaryoları da dikkate alınmalıdır. Bu bağlamda, adaptif koruma yöntemleri, düzenli izleme sistemleri ve yerel dayanıklılık analizleri önemli rol oynamaktadır (Leissner, Kilian, Kotova, Jacob, Mikolajewicz ve Broström, 2015; IPCC, 2021). Ayrıca, bu tür yapılar dayanıklı şehirler vizyonunun bir parçası olarak değerlendirilmelidir. Kültürel mirasın korunması, kentlerin iklim değişikliğine karşı hem fiziksel hem de toplumsal uyum kapasitesinin arttırılmasında bir fırsat niteliğindedir.

KAYNAKÇA

1. Bayık, H., & Bedirhanoğlu, İ., 2022. Tarihi Yapılarda Kullanılan Doğal Taşlarda Bozunmalar.

2. Brimblecombe, P., 2013. Temporal humidity variations in the heritage climate of south East England. Herit. Sci. 1 (1), 3.

3. Brimblecombe, P. *Reflections on climate change effects on cultural heritage.* Scientia Sinica Terrae, (2014), 57(10), 2716–2723.

4. Camuffo, D. Microclimate for Cultural Heritage (2nd ed.). Elsevier, (2014).

5. Doehne, E., & Price, C. A. *Stone Conservation: An Overview of Current Research* (2nd ed.). Getty Conservation Institute, (2010).

6. Fener, M. ve Ince, I., 2015, Effects of the freeze–thaw (F–T) cycle on the andesitic rocks (Sille-Konya/Turkey) used in construction building, Journal of African Earth Sciences, 109, 96-106.

7. Fitzner, B. Damage diagnosis on stone monuments—weathering forms, damage categories and damage indices. Building and Environment, (2002), 37(12), 1099–1110.

8. Fitzner, B., Heinrichs, K., & La Bouchardiere, D. *Weathering damage on pharaonic sandstone monuments in Luxor-Egypt*. Building and Environment, (2004), 39(9), 1081–1092.

9. Grossi, C. M., & Brimblecombe, P. *Effect of long-term changes in air pollution and climate on the decay and blackening of European stone buildings.* Building and Environment, (2007), 42(12), 3880–3889.

10. Hasbay, U., Hattap, S., 2017. Doğal Taşlardaki Bozunma (Ayrışma) Türleri ve Nedenleri, Munzur. Ü. Bilim ve Gençlik Dergisi ISSN:2148-0273, Cilt:5, Sayı:1.

11. Hatır, M. E., 2020. Determining the weathering classification of stone cultural heritage via the analytic hierarchy process and fuzzy inference system. Journal of Cultural Heritage, 44, 120-134.

12. ICOMOS Climate Change and Heritage Working Group., 2019. The future of our pasts: Engaging cultural heritage in climate action. Outline of Climate Change and Cultural Heritage. Retrieved from https://indd.adobe.com/view/a9a551e3-3b23-4127-99fd-a7a80d91a29e

13. IPCC. Climate Change Synthesis Report. Intergovernmental Panel on Climate Change, (2023).

14. IPCC. *Climate Change 2021: The Physical Science Basis.* Intergovernmental Panel on Climate Change, (2021).

15. Korkanç, M. and Savran A., 2015. Impact of the surface roughness of Stones used in historical buildings on biodeterioration, Construction and Building Materials 80 279–294

16. Leichenko, R. Climate change and urban resilience. Current Opinion in Environmental Sustainability, (2011), 3(3), 164–168.

17. Leissner, J., Kilian, R., Kotova, L., Jacob, D., Mikolajewicz, U., & Broström, T. *Climate for Culture: assessing the impact of climate change on the future indoor climate in historic buildings using simulations.* Heritage Science, (2015), 3(1), 1-15.

18. MGM. (2024). *Türkiye İklim Raporu 2024.* Meteoroloji Genel Müdürlüğü.

19. Öcal, A. D. ve Dal, M., 2012. Doğal Taşlardaki Bozunmalar / Weathering of Natural Stone, Mimarlık Vakfı İktisadi İşletmesi

20. Özdemir, M., & Yıldız, S. İklim değişikliğinin tarihi yapılara etkisi: Türkiye'den örnekler. Mimarlık ve Restorasyon Dergisi, (2020), 8(1), 45–58.

21. Sesana, E., Gagnon, A. S., Ciantelli, C., Cassar, J., Hughes, J. J., 2021. Climate change impacts on cultural heritage: a literature review. WIREs Climate Change 12 (4).

22. Smith, B. J., Gómez-Heras, M., & McCabe, S. *Understanding the decay of stone-built cultural heritage.* Progress in Physical Geography, (2020), 44(2), 171–192.

23. T.C. Kültür ve Turizm Bakanlığı. Hatay Kültür Envanteri: Erzin Su Kemerleri. Kültür Varlıkları ve Müzeler Genel Müdürlüğü, (2020).

24. Turkington, A. V., & Paradise, T. R. (2005). *Sandstone weathering: a century of research and innovation.* Geomorphology, 67(1–2), 229–253.

25. Vale, L. J., & Campanella, T. J. The Resilient City: How Modern Cities Recover from Disaster. Oxford University Press, (2005). URL-1. https://www.mgm.gov.tr/veridegerlendirme/sicaklik-analizi.aspx

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

ALPİN OĞLAKLARINDA TESTİS ÖLÇÜMLERİNE OĞLAK YAŞI, ANNE YAŞI VE DOĞUM TİPİNİN ETKİSİ

Dr. Öğr. Üyesi Murat DURMUŞ
Department of Animal Science, Faculty of Agriculture, Cukurova University
ORCID: 0000-0002-4221-7449

Arş. Gör. Dr. Melis ÇELİK GÜNEY
Department of Animal Science, Faculty of Agriculture, Cukurova University
ORCID ID: 0000-0002-6825-6884

ÖZET
Çalışmanın amacı, Alpin erkek oğlaklarında oğlak yaşı, anaç yaşı ve doğum tipi gibi faktörlerin testis ölçümleri üzerine etkilerini araştırmaktır. Bu amaçla çalışma, Çukurova Üniversitesi Ziraat Fakültesi Süt Keçisi Yetiştiriciliği Araştırma ve Uygulama Birimi, Adana, Türkiye'de yetiştirilen 82 erkek Alpin erkek oğlağı üzerinde yürütülmüştür. Alpin oğlaklarında vücut ağırlığı ve altı testis parametresi üç farklı dönemde (bir, iki ve üç aylık yaş) ölçülmüştür: testis çapı (TD), testis uzunluğu (TL), skrotum çevresi (SC), skrotum uzunluğu (SL), skrotum hacmi (SV) ve testis hacmi (TV). Sonuçlar, doğum tipinin testis çapı, skrotum hacmi ve testis hacmi üzerinde önemli bir etkiye sahip olduğunu, ana yaşının ise testis uzunluğu üzerinde önemli bir etkiye sahip olduğunu göstermiştir ($P < 0.05$ ve $P < 0.01$). Ayrıca, oğlak yaşının testis çapı ve skrotum uzunluğu hariç tüm testis ölçümleri üzerinde önemli bir etkisi olduğu bulunmuştur ($P < 0.05$). Vücut ağırlığı ile tüm testis ölçümleri arasındaki korelasyon katsayıları pozitif, yüksek ve istatistiksel olarak anlamlıydı ($P < 0.01$). Bu bulgular, Alpin erkek oğlaklarında testis gelişiminin doğum tipi, ana yaşı ve oğlak yaşı gibi faktörlerden önemli ölçüde etkilendiğini ortaya koymakta olup, bu parametrelerin damızlık seçiminde dikkate alınmasının üreme performansını artırmada faydalı olabileceğini göstermektedir.
Anahtar kelimeler: Alpin oğlağı, damızlık seçimi, testis ölçümü, canlı ağırlık.

EFFECTS OF KID AGE, DAM AGE AND BIRTH TYPE ON TESTICULAR MEASUREMENTS IN ALPINE KIDS

ABSTRACT
The aim of the study is to investigate the effects of factors such as kid age, dam age and birth type on testicular measurements in Alpine male kids. For this purpose, the study was conducted on 82 male Alpine kids raised at Cukurova University, Faculty of Agriculture, Dairy Goat Breeding Research and Application Unit, Adana, Türkiye. Body weight and six testicular parameters were measured at three different periods (one, two and three months) in Alpine kids: testicular diameter (TD), testicular length (TL), scrotal circumference (SC), scrotal length (SL), scrotal volume (SV) and testicular volume (TV). The results showed that birth type had a significant effect on testicular diameter, scrotal volume, and testicular volume, while dam age had a significant effect on testicular length ($P < 0.05$ and $P < 0.01$). Additionally, kid age had a significant effect on all testicular measurements except testicular diameter and scrotal length ($P < 0.05$). The correlation coefficients between body weight and all testicular measurements were positive, high and statistically significant ($P < 0.01$).

These findings indicate that testicular development in Alpine male kids is significantly influenced by factors such as birth type, dam age and kid age suggesting that considering these parameters in breeding selection may contribute to improved reproductive performance.
Keywords: Alpine kid, breeding selection, testicular measurement, body weight.

INTRODUCTION

Goats are an important livestock species worldwide, valued for their production of milk, meat, and hides. Among goat breeds, the Alpine goat is notable for its high milk yield potential, adaptability to diverse climatic conditions and ease of management. Because a single breeding male mates with multiple females, the reproductive performance of bucks is critical to flock productivity, and testicular characteristics are considered when evaluating this performance. Some testicular traits are directly associated with sperm production capacity (Coulter and Foote, 1977; Blockey, 1980; Öziş and Kaymakçı, 2003) and are therefore key criteria in buck selection (Koyuncu et al., 2005a; Fonseca et al., 2021). Early period testicular measurements in male kids help predict future fertility performance (Akçapınar, 2000). In addition, testicular development is influenced not only by genetic factors but also by environmental and maternal factors such as body weight, age, type of birth, dam age, and nutrition. The literature generally reports positive and significant correlations between testicular measurements and body weight in small ruminants (Rege et al., 2000; Salhab et al., 2001; Karakuş et al., 2010). Similarly, increases in certain testicular dimensions are observed with advancing age (Sarı et al., 2013), paralleling increases in sperm production capacity. Studies investigating the effects of maternal factors such as type of birth and dam age on testicular development are limited, and findings specific to Alpine goat kids remain insufficient. A detailed examination of these parameters would therefore strengthen the criteria used in buck selection and enhance the effectiveness of flock improvement programs.

The aim of this study is to investigate the effects of factors such as kid age, birth type, and dam age on testicular measurements in Alpine goats, while controlling for the influence of body weight as a covariate. The overarching goal is to develop scientifically grounded criteria to support the early selection of male kids as breeding bucks.

MATERIAL AND METHOD

The present study was conducted in the eastern Mediterranean region, where subtropical climatic conditions prevail. The province of Adana, where the study was conducted, is a province in the Mediterranean region located at 37º north latitude and 35º east longitude and 40 meters above sea level. Summers in the region are hot and dry, while winters are warm and rainy. The annual average humidity is 66% and the prevailing winds come from the north and south. Due to the differences in pressure throughout the seasons, the winds can blow from both directions. However, in summer they generally blow from the south and southwest and in winter from the north.

The present study was conducted on 82 male kid obtained from Alpine goats raised in Cukurova University, Faculty of Agriculture, Dairy Goat Breeding Research and Application Unit, Adana, Türkiye. Sixteen kids were from two-year-old dams, 17 were from three-year-old dams, 43 were from four-year-old dams and 6 were obtained from dams five or more years old. Ten of the kids were single, 37 were twins, and 35 were triplets. The kids used for the experiment were weaned according to standard farm routines. Accordingly, the kids were fed a sufficient amount of colostrum in the first few days after birth. They then remained with their dams until they were one month old and began to consume roughage and concentrates from the second week onwards.

When the kids were one month old, they were separated from their dams during the day and reunited with them overnight after the evening milking. At the age of 1.5 months, the kids were then allowed to stay with their dams for two hours after both the morning and evening milking. When the kids were three months old, they were completely weaned. After the 2nd weeks to kids were fed with concentrated feed having 16% HP and 2400 kcal/kg energy content and alfalfa hay having about 14% HP content as roughage.

After birth, the body weight and testicular measurements (testicular diameter, testicular length, scrotal circumference, scrotal length, scrotal volume and testicular volume) of the kids were determined at one, two and three months of age. Accordingly, the body weight (BW) of the kids was determined at one, two, and three months of age by individual weighing with a digital scale (TEM, EKO-600) with an accuracy of 50 g on the same day. The testicular diameter and testicular length of the kids were measured with a caliper, scrotal circumference and scrotal length were measured with a tape and scrotal volume was measured with a measuring container. Testicular volume of kids were determined according to Godfrey et al. (1998). Testicular measurements were taken as follow.

Testicular diameter (TD, cm): The testicular diameter was determined by measuring the widest part of each testicle.

Testicular length (TL, cm): Testicular length was determined by measuring the length between the tip of the testis and the epididymis.

Scrotal circumference (SC, cm): Scrotal circumference was determined by measuring the circumference of a pair of testicles at the widest point.

Scrotal length (SL, cm): Scrotal length was determined by measuring the distance from the point where the scrotum joins the inguinal region to the tip.

Scrotal volume (SV, cm^3): The scrotal volume was determined by measuring the amount of water displaced by the testis from a measuring container.

Testicular volume (TV, cm^3): 0.0396 × (average testis length) × (scrotal circumference)².

The mathematical model used in the evaluation of the data is given by Equation (1) (Aygün and Yılmaz, 2002; Yılmaz and Cengiz, 2006).

$$Y_{ijkl} = \mu + \tau_i + \gamma_j + \delta_k + \beta\left(X_{ijkl} - \overline{X}\right) + \varepsilon_{ijkl} \quad (1)$$

Where Y_{ijkl} is the observed value of the dependent variable for the l-th individual in the i-th level of age of the kid, j-th level of age of mother, and k-th level of type of birth, μ is overall mean, τ_i is the effect of the i-th level of the age of the kid, γ_j is the effect of the j-th level of the age of mother, δ_k is the effect of the k-th level of the type of birth, $\beta\left(X_{ijkl} - \overline{X}\right)$ is the covariate effect, X_{ijkl} is body weight of kids, β is the regression of any measurements on body weight (kg), $\overline{X}$ is the overall mean of the covariate, $\varepsilon_{ijkl}$is error term. Bonferroni post hoc test was used for multiple comparisons. The SPSS, Version 21 has been used in all statistical analyses.

RESULTS AND DISCUSSION

The mean testicular diameter (TD), testicular length (TL), scrotal circumference (SC), scrotal length (SL), scrotal volume (SV), and testicular volume (TV) for each factor, adjusted for body weight, are presented as the estimated marginal mean (EMM) ± standard error (SE) in Table 1. All estimated marginal means for testicular measurements were adjusted to the overall mean body weight (11.966 kg).

Table 1. Estimated marginal means and standard errors of selected testicular measurements in Alpine kids

Factors	N	Testicular measurements TD $\bar{X} \pm S_{\bar{X}}$	TL $\bar{X} \pm S_{\bar{X}}$	SC $\bar{X} \pm S_{\bar{X}}$	SL $\bar{X} \pm S_{\bar{X}}$	SV $\bar{X} \pm S_{\bar{X}}$	TV $\bar{X} \pm S_{\bar{X}}$
Kid age (month)							
1	82	1.925±0.084	3.844±0.121	8.801±0.370	59.209±1.940	30.236±3.424	16.717±1.787
2	82	2.085±0.059	4.105±0.085	10.121±0.260	56.668±1.363	41.269±2.405	18.496±1.256
3	82	1.968±0.089	3.734±0.127	9.333±0.389	54.144±2.041	56.014±3.601	13.112±1.880
Dam age							
2	48	1.948±0.054	3.884±0.078	9.197±0.239	56.755±1.253	42.278±2.212	15.819±1.155
3	51	1.931±0.076	3.741±0.109	8.937±0.334	55.079±1.750	41.858±3.089	13.894±1.612
4	129	2.105±0.041	4.112±0.059	9.919±0.181	58.543±0.950	44.503±1.676	18.243±0.875
5 and ↑	18	1.987±0.092	3.842±0.132	9.622±0.404	56.319±2.116	41.387±3.734	16.479±1.949
Type of birth							
Single	30	2.145±0.084	4.063±0.120	10.106±0.368	57.331±1.930	44.241±3.405	19.087±1.778
Twin	111	1.896±0.041	3.748±0.059	8.851±0.179	55.041±0.939	39.568±1.657	13.740±0.865
Triplet	105	1.938±0.048	3.873±0.070	9.298±0.213	57.650±1.115	43.711±1.968	15.498±1.027

TD: testicular diameter, TL: testicular length, SC: scrotal circumference, SL: scrotal length, SV: scrotal volume, TV: testicular volume.

The effect of kid age was statistically significant ($P < 0.05$) for all testicular measurements except testicular diameter and scrotal length. Bonferroni results showed a significant difference in testicular length between 2 and 3 month-old animals. A significant difference in scrotal circumference was observed between 1 and 2 month-old animals. Significant differences in scrotal volume were found between 1 and 2 months, 1 and 3 months, and 2 and 3 months. A significant difference in testicular volume was observed between 2 and 3 month-old animals. The effect of dam age was statistically significant for testicular length ($P < 0.01$). Bonferroni results showed a significant difference in testicular length between dams aged 3 and 4 years, with no significant differences among the remaining dam age groups. Similarly, Koyuncu et al. (2005b) found the effect of dam age on testicular length to be statistically significant. The effect of birth type on testicular diameter, scrotal volume, and testicular volume was statistically significant ($P < 0.05$). Bonferroni results showed significant differences in testicular diameter, scrotal circumference, and testicular volume between single and twin birth types.

As is well known, especially during the first six months after birth, kids experience a rapid growth phase associated with the development of the musculoskeletal system. This growth in the body is directly proportional to an increase in body weight. Therefore, body weight and all types of body measurements are closely related. In this context, body weight was used as a covariate so that testicular measurements could be evaluated independently of body weight. When Table 1 is examined, it is expected that all testicular measurements will increase in parallel with the rise in body weight as the kids age. A similar pattern is observed with respect to birth type. As the number of offspring increases, decreases in all measurement values are anticipated. However, using body weight as a covariate eliminated these expected effects and the means have changed. This indicates that a substantial proportion of testicular development is explained by body weight. When body weight was not used as a covariate, mean testicular measurements increased in parallel with age.

The mean testicular measurements and body weights at one, two, and three months of age were as follows: TD (1.50, 2.08 and 2.37), TL (3.11, 4.16 and 4.50), SC (7.27, 10.12 and 10.75), SL (48.53, 57.27 and 65.47), SV (13.50, 42.47 and 74.05), TV (6.97, 18.60 and 22.40), and BW (8.00, 12.05 and 15.84), respectively. Similarly, when body weight was not included as a covariate, mean testicular measurements decreased as the number of kids per birth increased. The mean testicular measurements and body weights of single, twin and triplet-born kids were TD (2.36, 2.00 and 1.86), TL (4.47, 3.95 and 3.74), SC (10.80, 9.37 and 8.99), SL (63.46, 57.48 and 54.86), SV (52.75, 44.13 and 39.83), TV (24.43, 15.95 and 13.63), and BW (13.97, 12.28 and 11.06), respectively. Regarding the effect of dam age on testicular measurements, no clear increase or decrease in testicular measurements was observed with increasing or decreasing dam age. This can be explained by differences in body weight and birth types among dams of different ages. The birth weight of offspring, which is approximately 8-10% of the dam's body weight, and consequently testicular size, is closely related to the dam's body weight. Furthermore, if more than one offspring is born, the birth weight is divided among the offspring.

Additionally, examination of the correlation between body weight and all testicular measurements revealed a strong relationship (Table 2). The strong association between body weight and testicular development observed in the present study supports the use of body weight as a covariate. In their study on Bafra lambs, Çam and Yılmaz (2024) calculated positive and significant ($P < 0.001$) correlations between body weight and testicular length ($r = 0.790$), testicular diameter ($r = 0.873$), scrotal circumference ($r = 0.797$), scrotal volume ($r = 0.659$), and scrotal length ($r = 0.746$). These correlations are very similar to those found in our study. Sarı et al. (2013) and Koyuncu et al. (2005b) also found strong and statistically significant correlations between body weight and all testicular measurements in their studies on Tuj and Kıvırcık lambs. Salhab et al. (2001) reported that various testicular measurements in Awassi lambs were positively and significantly ($P < 0.01$) correlated with each other.

Table 2. Correlations coefficients testicular measurements and body weights

Measurements	Body weight	Testicular diameter	Testicular length	Scrotal circumference	Scrotal length	Scrotal volume	Testicular volume
Body weight	1	0.774**	0.790**	0.716**	0.732**	0.859**	0.725**
Testicular diameter		1	0.897**	0.874**	0.763**	0.788**	0.859**
Testicular length			1	0.901**	0.840**	0.795**	0.899**
Scrotal circumference				1	0.757**	0.803**	**0.964****
Scrotal length					1	0.760**	0.740**
Scrotal volume						1	0.797**
Testicular volume							1

**: p<0.01, Marked is the highest correlation.

When Table 2 is examined, correlation coefficients are positive and high, and all correlations are found to be statistically significant ($P < 0.01$). Erdoğan Ataç and Kaymakçı (2021) reported that the correlation between testicular diameter, testicular length, scrotal circumference, scrotal length and testicular volume measurements in Chios ram lambs was significant ($P < 0.01$). The highest correlation is between scrotal circumference and testicular volume ($r = 0.964$) in this study. The second highest correlation is between scrotal circumference and testicular length ($r = 0.901$). Similarly, Erdoğan Ataç and Kaymakçı (2021) found the correlation between scrotal circumference and testicular volume to be 0.9583, and the correlation between scrotal circumference and testicular length to be 0.9339. The changes in testicular measurements (cm and cm^3) according to body weight are shown in Figures 1 and 2.

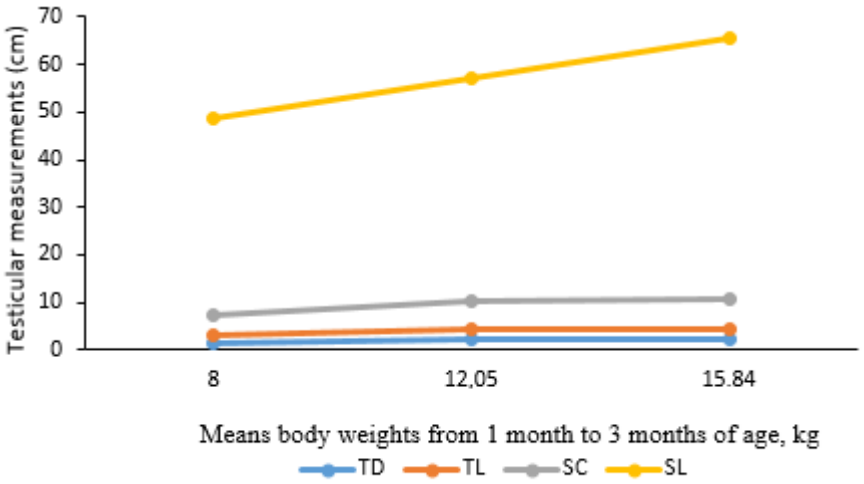


Figure 1. Change in testicular measurements (cm) by body weight

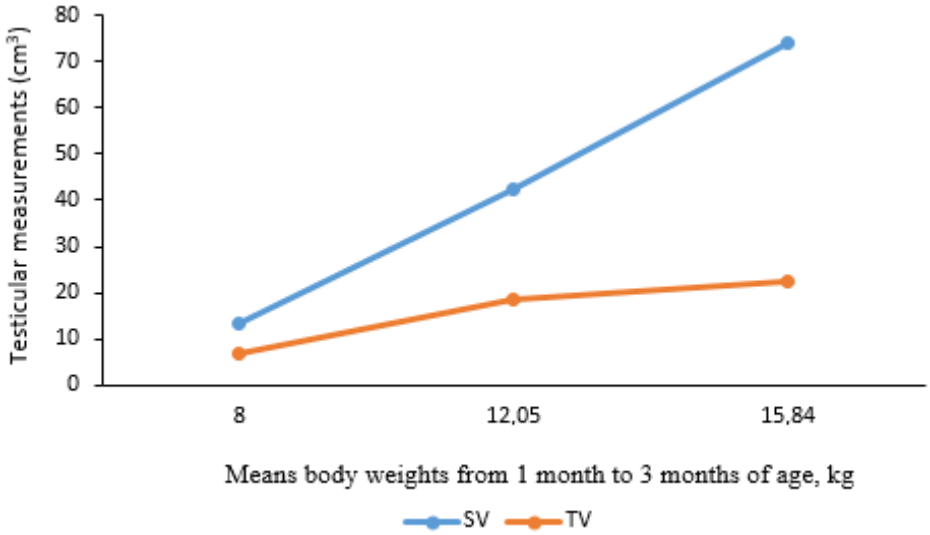


Figure 2. Change in testicular measurements (cm^3) by body weight

All testicular measurements (TD, TL, SC, SL, SV and TV) increased as body weight increased (Figure 1 and Figure 2). These figures demonstrate that testicular development is positively correlated with the animal's overall body development and growth.

CONCLUSION

In this study, the effects of kid age, dam age, birth type, and body weight on testicular development in Alpine male kids were evaluated. The findings showed that these factors significantly influence testicular measurements. Therefore, early testicular measurements in Alpine male kids can serve as effective indicators for predicting future reproductive potential. Including these factors in breeding programs may improve reproductive performance and genetic progress within the herd. In conclusion, testicular development in Alpine kids is influenced by multiple factors, and a comprehensive evaluation of environmental, maternal, and growth-related parameters is essential for successful breeding selection. This approach may provide a strategic advantage for enhancing productivity and sustainability in small ruminant production systems. All of male offspring from high milk-yielding goats, such as the Alpine breed, that are not suitable for breeding or are surplus cannot be marketed as breeding animals. Keeping these animals on the farm for extended periods, considering the low demand for goat meat in Türkiye increases costs related to mortality, feeding and care. Therefore, immediately after weaning, a sufficient number of male breeding animals should be selected to join the herd by examining testicular structure and measurements, first considering the dams' milk yields and then twin births. The remaining male animals not suitable for breeding should be sold as soon as they are weaned to avoid negatively affecting the farm's economy.

REFERENCES

Akçapınar, H., 2000. Koyun Yetiştiriciliği. İsmat Matbaacılık Ltd. Şti. Ankara. sf; 45.

Aygün, T., & Yılmaz, A. (2002). Norduz erkek oğlaklarında bazı testis özellikleri. Turk J. Vet. Anim Sci. 27, 1441-1445.

Blockey, M.A. (1980). Getting the most out of rams and boars. Proc. Aust. Soc. Anim. Prod. 13, 46.

Coulter, G.H, & Foote, RH. (1977). Relationship of body weight to testicular size and consistency ingrowing Holstein bulls. Anim. Sci. 44, 107-109.

Çam, M.A., & Yılmaz, Ö.F. (2024). Effects of early weaning on live weight and testis sizes of lambs. 5th International Congress On Khazar Scientific Research and Innovation, Taraz, Kazakistan, 26 - 28 Aralık 2024, Cilt.1, Ss.313-320.

Erdoğan Ataç, F. & Kaymakçı, M. (2021). Reproductive characteristics of chios ram lambs during the first year of life in rural farm conditions. Journal of Agricultural Sciences, 27(1), 98-105.

Fonseca, J. D. S., Pimenta, J. L. L. D. A., Moura, L. S. D., Souza, L. C. D., Silva, T. L. D., Fonseca, C. E. M. D., & Oliveira, R. V. D. (2021). Correlations between body measures with live weight in young male goats. Acta Scientiarum. Animal Sciences, 43, e52881.

Godfrey, R.W., Collins, J.R. & Gray, M.L. (1998). Evaluation of sexual behavior of hair sheep rams in a tropical environment. Journal of Animal Science, 76(3), 714-717. https://doi.org/10.2527/1998.763714x

Karakuş, K., Eyduran, E., Aygün, T., & Javed K. (2010). Appropriate growth model describing some testicular characteristics in norduz male lambs. The J. Anim. Plant Sci. 20(1), 1-4.

Koyuncu, M., Kara Uzun, S., Öziş, Ş., & Duru, S. (2005a). Kıvırcık kuzularında bazı testis özellikleri. Tarım Bilimleri Dergisi, 11(1), 7-11.

Koyuncu, M., Kara Uzun, S., Özis, S., & Duru, S. (2005b). Development of testicular dimensions and size, and their relationship to age and body weight in growing Kivircik (Western Thrace) ram lambs. Czech J. Anim. Sci, 50(6), 243-248.

Öziş, Ş., & Kaymakçı, M. (2003). Tekelerde eşeysel davranışlar. Hayvansal Üretim, 44(1), 69-75.

Rege, J.E., Toe, F., Mukasa-Mugerwa, E., Tembely, S., Anindo, D., Baker, R.L., & Lahlou-Kassi, A. (2000). Reproductive characteristics of Ethiopian highland sheep. II. Genetic parameters of semen characteristics and their relationhips with testicular measurements in ram lambs. Small Rumin. Res. 37(4), 173-187.

Salhab, S.A., Zarkawi, M., Wardeh, M.F., Al-Masri, M.R. & Kassem, R. (2001). Development of testicular dimensions and size, and their relationship to age, body weight and parental size in growing awassi ram lambs. Small Rum. Res., 40, 187-191.

Sarı, M., Önk, K., & Aksoy, A. R. (2013). Tuj kuzularında testis ölçüleri ve bu ölçülerle canlı ağırlık ve yaş arasındaki ilişkiler. Mehmet Akif Ersoy Üniversitesi Sağlık Bilimleri Enstitüsü Dergisi, 1(2), 64-74.

Yılmaz, A., & Cengiz F. (2006). Norduz erkek kuzularında testis özellikleri ve serum testosteron konsantrasyonun yaşa göre değişimi. Ankara Üniversitesi Ziraat Fakültesi Tarım Bilimleri Dergisi, 12(3), 277-284.

PLANT EXTRACT-BASED INTEGRATED DEVELOPMENT OF BIOACTIVE AND BIO-SENSITIVE FILMS FOR ACTIVE PACKAGING APPLICATIONS AND SUSTAINABLE DESIGN

Djihane Romayssa MAHAMMED
Laboratory of Natural Products, Department of Biology, Faculty of Natural and Life Sciences, Earth and Universe Sciences, University of Tlemcen

Nabila BELYAGOUBI-BEHNHAMMOU
Laboratory of Natural Products, Department of Biology, Faculty of Natural and Life Sciences, Earth and Universe Sciences, University of Tlemcen
ORCID: 0000-0001-5624-4627

Asmaa DICH
Laboratory of Natural Products, Department of Biology, Faculty of Natural and Life Sciences, Earth and Universe Sciences, University of Tlemcen

Larbi BELYAGOUBI
Laboratory of Natural Products, Department of Biology, Faculty of Natural and Life Sciences, Earth and Universe Sciences, University of Tlemcen

Sarra BENAISSA
Laboratory of Macromolecules, Department of Chemistry, Faculty of Sciences, University of Tlemcen

Kamal BENMANSOUR
Laboratory of Macromolecules, Department of Chemistry, Faculty of Sciences, University of Tlemcen

Gabriele DI MARCO
Department of Biology, University of Rome Tor Vergata, Via della Ricerca Scientifica

Alessia D'AGOSTINO
Department of Biology, University of Rome Tor Vergata, Via della Ricerca Scientifica

Antonella CANINI
Department of Biology, University of Rome Tor Vergata, Via della Ricerca Scientifica

Angelo GISMONDI
Department of Biology, University of Rome Tor Vergata, Via della Ricerca Scientifica
ORCID: 0009-0001-0513-6308

Abstract
The conversion of analytically characterised plant-derived extracts into multipurpose bioactive and biosensitive films for active packaging and sustainable design is the subject of this interdisciplinary study. Natural polymers (xanthan and chitosan) enhanced with plant extracts *Salvia officinalis* essential oil, *Opuntia ficus-indica* fatty oil, and the anthocyanin-rich portion of *Hibiscus sabdariffa* were used to create biodegradable membranes.

Comprehensive phytochemical and physicochemical investigations were carried out using chromatographic techniques (HPLC-DAD and GC-MS), quantitative spectrophotometric assays (total phenolic, flavonoid, and antioxidant capabilities), and preliminary screening. These analyses identified terpenoids like epimanool, α-caryophyllene, and β-caryophyllene in S. officinalis essential oil, fatty acids like 9,12-octadecadienoic acid and hexadecanoic acid in *O. ficus-indica* oil, and phenolic acids like 3-hydroxytyrosol, vanillic acid, and 4-hydroxybenzoic acid in *H. sabdariffa* extract.

Because of the anthocyanin content, the resultant biofilms displayed colorimetric behaviour that was responsive to both pH and temperature, making them intelligent markers of food freshness. While UV-Vis spectra showed effective light-barrier qualities, FTIR analysis verified strong molecular interactions between the bioactive chemicals and the polymer matrix. Tests of biodegradation revealed a quick rate of breakdown, demonstrating the films' environmentally favourable qualities. Significant scavenging capacity and robust suppression of bacterial and fungal growth were demonstrated by antioxidant and antimicrobial assays (MBC/MFC < 250 µg/mL).

This study offers promising applications in eco-design and active food packaging by fusing data-driven material design with laboratory-based bioactivity validation. This creates a reproducible framework for creating bio-sensitive, biodegradable, and functional materials that bridge scientific rigour with sustainability.

Keywords: Degradable biofilms; Xanthan; Chitosan; Plant extracts; Antioxidant effects; Antimicrobial properties.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PLANT RESPONSES TO WATER STRESS REVEALED FROM SOIL MOISTURE DYNAMICS

SAGHOURI EL IDRISSI Imane
Laboratory of physiology and genetic improvement of cereals, National Institute of Agronomic Research (INRA)
Laboratory of Biodiversity and Natural Resources, Department of Biology, Faculty of Sciences, University of Ibn Tofail, University Campus

KETTANI Rajae
Laboratory of physiology and genetic improvement of cereals, National Institute of Agronomic Research (INRA)

KHALFI Chemsdoha
Laboratory of physiology and genetic improvement of cereals, National Institute of Agronomic Research (INRA)

FERRAHI Moha
Laboratory of physiology and genetic improvement of cereals, National Institute of Agronomic Research (INRA)

BRHADDA Najiba
Laboratory of Biodiversity and Natural Resources, Department of Biology, Faculty of Sciences, University of Ibn Tofail, University Campus

ABSTRACT
Drought is a major constraint on agricultural production. It is therefore important to optimize the water supply according to the real needs of the crop, taking into account environmental conditions. The objective of this study is to assess the effect of water stress on germination, early seeding growth, and agronomic and physiological parameters of sixteen durum wheat genotypes *(triticum durum)* at the flowering stage. For this purpose, two experiments were conducted in the experimental field of the National Institute of Agricultural Research at Douyet Fès (34°2 N, 5°W, 416 m) under rainfall conditions over two growing seasons (2019/20, 2020/21). The assessment involved several morphological, physiological, biochemical and agronomic traits. The results obtained show that the various water regime treatments had an effect on the majority of the parameters studied. As a result, the water deficit caused a small decrease in seedling growth (decrease in plant height and relative water content). Similarly, there has been a decrease in photosynthetic yield and in the number of seeds per plant, particularly under severe stress. The existence of positive correlations between the reduction of photosynthetic activity and the decrease in chlorophyll content and number of seeds, on the other hand, indicates that the reduction in the number of seeds under the effect of water stress would be a consequence of the reduction in photosynthetic activity, explained by a decrease in leaf area and chlorophyll content. Moreover, for most of the parameters studied, the 16 varieties reacted differently to water stress.
Keywords: Drought, durum wheat, water stress.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PHYSICO-CHEMICAL AND BACTERIOLOGICAL QUALITY OF IRRIGATION WATER AND ITS IMPACT ON AGRICULTURAL SOILS, IN THE PERI-URBAN AREA OF BÉNI MELLAL (MOROCCO)

Professor Bouzekraoui Hicham
Laboratory of Landscape Dynamics, Risks and Heritage, Faculty of Letters and Humanities, University Sultan Moulay Slimane
ORCID: 0000-0002-3980-4378

Mouaddine Atika
Geomatics, Georesources and Environment Laboratory, Faculty of Sciences and Techniques, Sultan Moulay Slimane University
ORCID: 0009-0002-9668-1033

Doctor El Garnaoui Mohamed
Data4Earth Laboatory, Faculty of Sciences and Techniques, Sultan Moulay Slimane University
ORCID: **0000-0001-8151-3876**

Doctor Hilali Abdessamad,
Regional Centre of Agricultural Research of Tadla, National Institute of Agricultural Research (INRA)
ORCID: 0000-0002-1715-3391

ABSTRACT
This study aims to assess the quality of irrigation water originating from the Aïn Asserdoune spring and the agricultural soils located in the suburbs of Béni Mellal, Béni Mellal-Khénifra region, Morocco. The spring water is conveyed to the surrounding agricultural lands through gutters that cross urban districts, during which it becomes loaded with liquid and solid pollutants, leading to a deterioration of its physico-chemical quality. Despite this contamination, these waters are often reused for irrigating orchards and cultivated lands. The study is based on a comparative analysis of the physico-chemical and bacteriological parameters of the gutter waters and the soils irrigated with these waters. Four sampling points were selected along the course, from the upstream section at the source to the downstream limit between the urban area and agricultural lands. Water samples were analyzed in the laboratory to determine pH, electrical conductivity (EC), nitrate (NO_3^-) and nitrite (NO_2^-) concentrations, as well as bacteriological indicators (total and fecal coliforms, intestinal enterococci). In parallel, soil samples from plots cultivated with cereals, alfalfa, plum, and olive trees were analyzed to determine their texture, pH, salinity, organic matter (OM) content, calcium carbonate ($CaCO_3$) content, moisture, and bulk density (BD). The results show that the water is basic in nature, moderately mineralized, with nitrate concentrations exceeding WHO standards, and exhibits fecal contamination downstream. The soils are clayey, basic, moderately saline, low in organic matter, and contain an average amount of calcium carbonate. A clear correlation between water and soil quality highlights the direct impact of irrigation on soil fertility. These findings emphasize the need for sustainable and integrated management of water and soil resources in the suburban area of Béni Mellal.
Keywords: Quality, fertility, pollution, irrigation water, agricultural soils, physico-chemical parameters, Béni Mellal.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

ANTIOXYDANT ACTIVITY AND ACUTE TOXICITY OF METHANOLIC EXTRACT OF LEMON VERBENA

Sara Qouissah
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0009-0001-3340-7208

Houda ELYacoubi
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0000-0001-8017-6732

Aboukhalaf Abdelghani
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0000-0003-2654-130X

Laila Bikjdaouene
Laboratory of Biology and Health, Neurosciences, Neuro-immunology and Behaviour Unit, Faculty of Science, Ibn Tofail University
ORCID: 0009-0000-5347-7273

Oumaima Abouyaala
Laboratory of Biology and Health, Neurosciences, Neuro-immunology and Behaviour Unit, Faculty of Science, Ibn Tofail University
ORCID: 0009-0004-5020-8253

Asmaa ELYamani
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0009-0003-8047-9698

Jamila Riyahi
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0009-0004-0822-5316

Atmane Rochdi
Natural Resources & Sustainable Development Laboratory, "AgroPhysiology, Biotechnology & Environment Research Unit, Faculty of Science, Ibn Tofail University
ORCID: 0000-0002-8185-9866

ABSTRACT
Lemon verbena named *Lippia citriodora* or *Aloysia citriodora* scientifically, belonged to the family *Verbenaceae*, is a medicinal plant frequently used by Morocco population for its antioxidant, anti-inflammatory, antibacterial and antifungal properties...

This study aims to evaluate the antioxidant activity and acute toxicity of the methanolic extract of lemon verbena.
The antioxidant activity was carried out in vitro by the DPPH test, the effectiveness of the methanolic extract at different concentrations (1000, 500 and 250 µg/ml) was compared with ascorbic acid as a reference standard. The results indicated an antioxidant activity indicating an ability to neutralize free radicals.
The acute toxicity was carried out in vivo in Wistar rats according to OECD 423 recommendations. The oral single dose injection of 2000mg/kg showed no signs of toxicity or mortality with an LD50 greater than this dose. The biochemical and hematological parameters analyzed.
To conclude, lemon verbena showed antioxidant activity and no acute toxicity, further studies are underway to explore its therapeutic properties.
Keywords: lemon verbena -methanolic extract -antioxidant activity -acute toxicity -LD50

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

INTEGRATED EPIDEMIOLOGICAL AND MOLECULAR ANALYSIS OF CARBAPENEM RESISTANCE AMONG CLINICAL ISOLATES

Fatima Mourabiti
Laboratory of Health, Environment and Biotechnology, Team of Physiopathology, Molecular Genetics and Biotechnology, Faculty of Sciences Ain Chock, Hassan II University of Casablanca

Fatima Zahra Jouga
Laboratory of Health, Environment and Biotechnology, Team of Physiopathology, Molecular Genetics and Biotechnology, Faculty of Sciences Ain Chock, Hassan II University of Casablanca

Yasmina Mouzoun
Laboratory of Health, Environment and Biotechnology, Team of Physiopathology, Molecular Genetics and Biotechnology, Faculty of Sciences Ain Chock, Hassan II University of Casablanca

Abdelaziz Soukri
Laboratory of Health, Environment and Biotechnology, Team of Physiopathology, Molecular Genetics and Biotechnology, Faculty of Sciences Ain Chock, Hassan II University of Casablanca

Bouchra El Khalfi
Laboratory of Health, Environment and Biotechnology, Team of Physiopathology, Molecular Genetics and Biotechnology, Faculty of Sciences Ain Chock, Hassan II University of Casablanca

Abstract
Carbapenem resistance genes in Gram-negative bacteria (CR-GNB) are a significant cause of critical infections and are considered a pressing public health concern. The present study aimed to describe the prevalence of CR-GNB and the dissemination of carbapenemase genes in clinical isolates from Casablanca, Morocco. Firstly, the strains were collected and identified using phenotypic and biochemical methods. Then, the antibiotic susceptibility was evaluated by the disc diffusion assay to screen for isolates resistant to carbapenems. Secondly, the in-house Carba-NP was performed to predict the carbapenemase production by the included strains. Finally, conventional PCR was utilized to validate and detect the carbapenemase genes. Concerning the results, out of the identified 122 strains, 48 were CR isolates, including 30 *Klebsiella pneumoniae*, 13 *Escherichia coli*, and 5 *Pseudomonas aeruginosa*. Furthermore, these strains presented a high level of resistance. Moreover, the PCR analysis revealed a high occurrence of carbapenemase genes in the included clinical strains, and most strains harbored multiple resistance genes. Our findings suggest that the three existing methods have some limitations, and a validation study is still necessary for carbapenemase diagnostics.
Keywords: Carbapenem-resistance; Carbapenemases; Gram-negative bacteria; Carba-NP.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PHYTOCHEMICAL PROFILING AND ASSESSMENT OF THE ANTIMICROBIAL ACTIVITY OF THE PHENOLIC EXTRACT FROM THE LEAVES OF *URTICA DIOICA*

Keddar Fayza
University Hassiba Benbouali, Faculty of Natural and Life Sciences, Department of Biotechnology, Laboratory of Local Natural Bioresource (LBRN)

Boualem Malika
University Abdelhamid Ibn Badis, Faculty of Natural and Life Sciences, Department of Agronomie, Laboratory of Plant Protection

Brada Moussa
University of Djilali Bounaama, Faculty of sciences and technology, Department of science and technology, Laboratory of Valorization of Natural Substances

Abstract
Urtica dioica L., a medicinal plant belonging to the Urticaceae family, is widely used in traditional medicine for its numerous therapeutic properties. The aim of this study was to characterize the phytochemical composition of the plant, extract its polyphenols, and evaluate their antimicrobial activity. Phytochemical screening based on colorimetric reactions was performed to identify the major bioactive compounds. The extraction was carried out by steam distillation. Antibacterial activity was tested against three reference bacterial strains (*Klebsiella* ATCC 70603, *Pseudomonas aeruginosa* ATCC 27853, and *Proteus mirabilis* ATCC 35659) using the disc diffusion method, and the minimum inhibitory concentrations (MICs) were determined by the microdilution method in 96-well microplates. The extraction yield obtained was 28.54%. The phytochemical tests confirmed the presence of flavonoids, gallic tannins, sterols, terpenes, and saponins, and the absence of alkaloids. The phenolic extract exhibited antimicrobial activity against all three strains, with MIC values of 0.3 mg/mL for *Klebsiella* and *Proteus mirabilis*, and 0.15 mg/mL for *Pseudomonas aeruginosa*. These results indicate that *Urtica dioica* L. possesses significant antimicrobial potential.
Keywords: *Urtica dioica* L., phenolic extract, antimicrobial activity, phytochemical screening

FROM PAN TO PLATE: HOW TRADITIONAL COOKING METHODS ALTER ROHU FISH LIPID PROFILES AND HEALTH BENEFITS

Chowdhury, Bappy
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Saha, Anik
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Ghosh, Srikanta
Department of Applied Chemistry and Chemical Technology, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Sadekeen, Nafis
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Acharjee, Mahima Ranjan
Department of Aquaculture, Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University

Datta, Narayan
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Tarin, Omme Johora
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Rahman, Ahmedur
Department of Applied Chemistry and Chemical Technology, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Haque, Mohammad Mozibul
Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Ahmad, Monsur
Department of Applied Chemistry and Chemical Technology, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University

Abstract

Introduction/Background: Fish serves as a vital source of high-quality protein and long-chain omega-3 polyunsaturated fatty acids (PUFAs), particularly EPA and DHA. However, these bioactive compounds are highly sensitive to heat, raising concerns about nutrient loss during traditional cooking.

In developing nations, where freshwater fish like Rohu (Labeo rohita) are dietary staples, understanding the impact of cooking on nutritional integrity is essential for public health.
Objective: This study aimed to evaluate the influence of five common cooking methods-frying, grilling, deep-frying, baking, and braising-on the proximate composition, lipid quality, and fatty acid integrity of Rohu, with emphasis on nutritional quality indices.
Methodology: Fresh Rohu samples were subjected to the designated cooking methods. Proximate composition, chemical characteristics, fatty acid profiles, and nutritional indices (including PUFA/SFA ratio) of the extracted oils were determined following AOAC standard protocols.
Results: Significant variations ($p < 0.05$) were observed across cooking techniques. Raw Rohu showed the highest moisture content (18.76 ± 0.15%), while fat content peaked in deep-fried samples (23.04 ± 0.12%). Fatty acid analysis revealed that deep-frying retained the greatest levels of EPA and DHA (0.25 ± 0.008 mg/100 g), whereas grilling resulted in the lowest PUFA concentration (21.95 ± 0.06 mg/100 g). Nutritional quality indices indicated that grilled samples exhibited the highest PUFA/SFA ratio (4.06 ± 0.009).
Conclusions: Traditional cooking methods markedly affect the nutritional quality and fatty acid integrity of Rohu. While deep-frying enhanced lipid retention, grilling favored higher PUFA/SFA ratios. These findings highlight the importance of choosing appropriate cooking strategies to maximize omega-3 PUFA preservation, offering practical dietary guidance for populations in developing nations that rely heavily on freshwater fish.
Keywords: Rohu (Labeo rohita), cooking methods, fatty acid profile, nutritional quality index, omega-3 PUFA.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

COMPARATIVE STUDY OF THE PHYTOCHEMICAL COMPOSITION OF *FUMARIA PARVIFLORA* FROM THREE REGIONS OF MOROCCO

Salma MAKDOUF
Laboratory of Health and Environment, Faculty of Sciences Ain Chok, Hassan II University of Casablanca

Yasmine TABOUKTIRT
Laboratory of Care, Health and Sustainable Development, Higher Institute of Nursing and Health Techniques

Karima El Bouqdaoui
Laboratory of Health and Environment, Faculty of Sciences Ain Chok, Hassan II University of Casablanca
Laboratory of Care, Health and Sustainable Development, Higher Institute of Nursing and Health Techniques

Abdelhakim El Makssoudi
Laboratory of Organic Synthesis, Extraction and Valorization (LSOEV), Ain Chok, Hassan II University of Casablanca

Mounia Cherki
Laboratory of Health and Environment, Faculty of Sciences Ain Chok, Hassan II University of Casablanca

Abstract
Species of the *Fumaria* genus are medicinal plants known for their anti-inflammatory, antioxidant, and antidiabetic effects. Our species, *Fumaria parviflora*, locally known under different names, is a green, herbaceous, annual plant that grows in wheat fields, plains, and low hills. It is a ubiquitous species that can be found in Europe, Africa, America, Australia, and especially in high prevalence in India, Pakistan, and Iran.
In traditional medicine, this species has been used to treat numerous diseases and infections such as diabetes, digestive disorders, eczema, burns, fever, flu, headaches and toothaches, poisoning, hepatobiliary dysfunction, blood disorders, urinary diseases, and male infertility.
Despite these remarkable therapeutic potentials, few scientific studies have aimed to evaluate its biological activities. Hence, the objective of our research is to carry out a comparative study of the phytochemical composition of *F. parviflora* harvested from three different Moroccan regions (Casablanca, El Jadida, and Khouribga).
Lipids, carbohydrates, proteins, minerals, and pigments were determined using standard methods. Secondary metabolites were assessed through screening techniques. Our results showed that the chemical composition varies depending on the harvesting region, with the Casablanca sample being particularly rich in polyphenols.
Thus, we can conclude that the environmental conditions of each region influence the chemical composition of this plant.
Keywords: *Fumaria*; chemical composition; harvesting region; comparative study.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

CHALLENGES FACED BY MARKETER IN MARKETING OF NON-TIMBER FOREST PRODUCTS: EVIDENCE FROM AFRICAN OIL BEAN SEED MARKETING

Nzennwa Rosemary Chiamaka
Department of Agricultural Economics, University of Nigeria

Attah, Chidera Happiness
Department of Agricultural Economics, University of Nigeria

Abstract
This study focused on challenges faces by marketer in marketing of African Oil Bean Seed marketing in Enugu State, Nigeria. The specific objectives were to: describe the socio-economic characteristics of African oil bean seed marketers; examine the distribution channels of African oil bean marketing and identify constraints faced by the African oil bean seed marketers. A multi-stage sampling technique was employed using structured questionnaires to interview 180 respondents comprising of 139 wholesalers and 41 retailers. Descriptive statistics, and likert-type scale were used in data analysis. Results indicate that marketing of African Oil Bean Seed is dominated by females (82.8%) with a mean age of 46.31. Majority of the respondents had formal education with a mean of 7.9 years spent in school, about 87.2% were married and the average household size was 5 which were very important to supply the needed labour in the marketing activities thus reducing the extra cost of hiring labour. The likert scale result of the African Oil Bean marketing constraints reveals that the high cost of oil bean seed, scarcity of seeds because of deforestation, unstable price, seasonality of fruiting, problem of finance, high transport fare, lack of storage facilities for excess product, poor market information and lack of improved varieties. The study calls for development and distribution of improved African Oil Bean Seed cultivars by the government which will increase availability of seeds for the marketers and enhance marketing, government should put favorable policies that will ease the processes of accessing credit; organization of the marketers at the local level into groups of cooperators will help in improving their marketing network, bargaining power, information flow, and micro enterprise development, appropriate preservation facilities should be provided for the marketers to curb the current rate of post-harvest losses during production season, construction of rural road network is essential to reduce cost and difficulties associated with transportation of products, there is need to also encourage the establishment of the African Oil Bean Seed trees plantation so as to serve as source of steady supply.
Keywords: Non-timber, Forest, Deforestation and Constraints

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

DEVELOPING AGRICULTURAL TOURISM IN AN BINH WARD, CAN THO CITY, VIETNAM: A STAKEHOLDER PERSPECTIVE

Tri Thong Truong
Faculty of Tourism and Hospitality Management, Nam Can Tho University

Ngoc Canh Dao
Faculty of Tourism and Hospitality Management, Nam Can Tho University

Abstract
Agritourism has increasingly become an important pathway for diversifying rural livelihoods and promoting sustainable tourism in developing countries. This study explores the potentials, advantages, and challenges in developing agritourism in An Binh Ward, Can Tho City, from a stakeholder perspective. A qualitative approach was employed through semi-structured interviews with 8 tourism experts, 8 travel enterprises, and 5 local households engaged in agritourism activities. The collected data were analyzed thematically to identify key aspects. The findings reveal that An Binh possesses multiple advantages for agritourism development, including favorable natural conditions and abundant agricultural resources, the distinctive cultural identity of the riverine garden lifestyle, diverse seasonal fruit products, convenient geographical location, strong community consensus, and supportive orientations from local authorities. Nevertheless, several barriers persist, such as underdeveloped infrastructure, limited service quality and human resources, weak stakeholder linkages, financial constraints, seasonal dependency, and insufficient marketing. This research contributes empirical evidence to the literature on multi-stakeholder perspectives in the Vietnamese context, while underscoring the importance of integrated planning, capacity building, and public–private partnerships to ensure sustainable agritourism development. Managerial implications, study limitations, and directions for future research are also discussed.
Keywords: Agricultural tourism, An Binh Ward, Can Tho City, Stakeholder perspective, Vietnam

1. Introduction

In the context of globalization and the growing demand for novel travel experiences, agritourism has emerged as an important trend that contributes to diversifying tourism products and fostering sustainable rural development. Agritourism is defined as the combination of agricultural activities and tourism services, allowing visitors to directly engage in farming practices, experience rural culture, and enjoy agricultural products on-site (Roman & Kawęcki, 2024). In many countries, this form of tourism not only provides supplementary income for farm households but also helps preserve landscapes, cultural heritage, and traditional lifestyles, thereby becoming a vital tool for sustainable rural development.

Numerous studies have highlighted the diverse socio-economic benefits of agritourism. Barbieri and Mahoney (2009) conceptualized agritourism as a diversification strategy that enables farmers to increase income, reduce risks, and enhance competitiveness amid volatile agricultural markets. From a community perspective, Knežević et al. (2025) demonstrated that agritourism in South Tyrol (Italy) contributes to preserving agroheritage while empowering local residents through co-creation of tourism products. Similarly, Ćirić et al. (2021) affirmed that positive attitudes and proactive participation of local communities are prerequisites for sustainable agritourism development.

However, alongside opportunities, agritourism also faces multiple challenges. Grillini et al. (2023) argued that agritourism development may exert environmental pressures if not properly managed, while emphasizing the necessity of clean production and organic farming models. In a subsequent study, Grillini et al. (2025) revealed that tourists' involvement in farming activities can encourage farmers to transition to organic production, thus strengthening long-term sustainability. Moreover, Pham et al. (2023) warned that rapid urbanization in Vietnam is exerting tremendous pressure on agricultural spaces, posing dual challenges for agritourism in terms of planning and resource conservation.

In Vietnam, agritourism is considered a promising pathway to capitalize on the country's tropical agricultural advantages while advancing green and sustainable tourism. A case study in Ben Tre showed that agritourism not only generated employment and increased farmers' income but also enhanced community awareness of environmental protection and sustainable development (Phan, 2021). Meanwhile, Nguyen Hoang Thanh and Lee (2025), analyzing the case of Vinh Long, confirmed that public–private partnership (PPP) plays a critical role in mobilizing resources, coordinating activities, and improving agritourism management efficiency. For Can Tho City—the heart of the Mekong Delta—An Binh Ward has emerged as a promising site due to its abundant fruit orchards, interlaced waterways, and distinctive ecological landscapes. Although An Binh has long been associated with ecotourism, community-based tourism, and garden tourism, agritourism has not yet been systematically or strategically developed. Despite its great potential, agritourism development in An Binh faces several barriers, including insufficient infrastructure, unskilled human resources, fragmented products, and weak coordination among government, businesses, and the community.

This situation highlights an important research gap: the need for a stakeholder perspective to better understand the drivers, advantages, challenges, and future directions of agritourism at the local level. Therefore, this study aims to explore the views of key stakeholders—including tourism experts, travel enterprises, and farming households—on the development of agritourism in An Binh Ward, Can Tho City. By employing a qualitative approach with semi-structured interviews and thematic content analysis, the study is expected to contribute theoretically by enriching the body of knowledge on agritourism in Vietnam, and practically by proposing managerial implications for sustainable agritourism development in An Binh.

2. Literature Review

Agritourism has emerged as a significant global trend, contributing to the diversification of tourism products, increasing farmers' income, and simultaneously preserving cultural and natural resources. In many countries, agritourism is considered a bridge between traditional agriculture and the growing demand for novel experiences from urban tourists. In Vietnam, agritourism is regarded as a promising pathway toward sustainable tourism development, particularly in the Mekong Delta, which offers abundant advantages in terms of natural resources, waterways, and fruit orchards. However, this development still faces multiple challenges, including weak infrastructure, lack of community linkages, pressures from urbanization, and climate change.

The concept of agritourism has been approached from multiple perspectives. According to Barbieri and Mahoney (2009), agritourism is a diversification strategy in farming that enhances income while reducing dependence on traditional agricultural production. This definition emphasizes agritourism as an "economic tool" for farmers. Meanwhile, Roman and Kawęcki (2024), from an academic standpoint, argue that agritourism is not merely an economic activity but also a distinctive tourism product that integrates agricultural production with visitor experiences, in which tourists directly engage in farming, harvesting, processing,

and consuming agricultural products on site. Roman further classifies agritourism studies into several streams: cultural experiences, community participation, socio-economic impacts, and sustainable development strategies. Similarly, Bhatt (2023), in a review of community-based agritourism, stresses that the concept must be situated within the relationship with local communities. According to the author, agritourism is not simply an intersection of "agriculture" and "tourism," but a co-creation process among tourists, farmers, and other stakeholders. It is the active involvement of the community that ensures authenticity and sustainability of this form of tourism.

Thus, the evolution of agritourism as a concept has moved from a narrow interpretation—an additional source of income for farmers—towards a broader understanding: a sustainable tourism model that harmonizes economic, social, and environmental objectives.

Agritourism also possesses distinct characteristics compared to other types of tourism. First, it establishes a direct connection between agricultural production and tourism services, where tourists not only visit but also actively participate in activities such as planting, harvesting, or processing agricultural products, thereby preserving and promoting the value of local agroheritage (Knežević et al., 2025). Second, agritourism carries a strong educational dimension, raising visitors' awareness of sustainable production, rural culture, and environmental protection, while encouraging responsible consumption behaviors (Nguyen et al., 2018). Third, it is closely dependent on natural resources and seasonality, which can be both an advantage in offering unique seasonal products and a limitation when adverse weather disrupts experiences (Grillini et al., 2025). Fourth, agritourism is inherently tied to communities and cultural identity, since rural life, cuisine, and local traditions constitute its uniqueness and appeal (Ćirić et al., 2021). Finally, agritourism contributes to sustainable development by diversifying livelihoods, reducing migration pressures, conserving landscapes, and promoting clean production, provided that a balance is maintained between economic benefits and environmental responsibility (Grillini et al., 2023).

3. Research Methodology

This study employed a qualitative approach to capture the multidimensional perspectives of stakeholders on the development of agritourism in An Binh Ward, Can Tho City. Data were collected through semi-structured interviews with three groups of participants: eight tourism experts (including lecturers and researchers), eight travel enterprises, and five households engaged in agritourism activities. The interview protocol was designed around four key themes: (i) the potentials and advantages of the locality, and (ii) the challenges and barriers to agritourism development. Face-to-face interviews lasted approximately 20–30 minutes and were fully documented with the informed consent of the participants. The data were subsequently coded and analyzed using thematic content analysis, which involved three steps: open coding, axial coding, and theme synthesis. To enhance reliability, the analysis was conducted independently by two researchers before cross-validation. This process enabled the construction of a comprehensive picture of the current situation and future prospects of agritourism development in An Binh from a multi-stakeholder perspective.

4. Research Results and Discussion

4.1. Potentials and Advantages of Agritourism Development in An Binh, Can Tho

Findings from the qualitative data reveal that An Binh possesses multiple advantages for agritourism development, including: (i) natural conditions and agricultural resources, (ii) the cultural identity of the riverine garden lifestyle and community way of life, (iii) diversity of agricultural products and local specialties, (iv) geographical location and accessibility, (v)

government–community support and consensus, and (vi) the orientation toward sustainable and green tourism.

4.1.1. Natural conditions and agricultural resources

Stakeholders consistently emphasized that An Binh has significant advantages in terms of landscape and agricultural ecosystems. Expert 1 noted: *"The locality has favorable natural conditions, lush fruit orchards, and seasonal products that visitors can always explore and experience."* Similarly, Travel company 1 added: *"Phong Dien is the green lung of the city, with scenic waterways and diverse orchards, making it ideal for agritourism development."* These observations highlight An Binh's fertile alluvial soil, year-round freshwater resources, and distinctive orchard landscapes. This aligns with Son et al. (2023), who found that natural landscapes are the most influential factor in determining agritourism visitor satisfaction in the Mekong Delta. Thus, An Binh holds strong potential to become a flagship destination in Can Tho, leveraging its sustainable agricultural resources.

4.1.2. Cultural identity of the riverine garden lifestyle and community spirit

Beyond natural advantages, many stakeholders highlighted cultural values. Expert 2 stated: *"The riverine garden space, combined with cultural activities such as Don ca tai tu (traditional music), garden cuisine, and fruit festivals, enhances visitor experiences."* Similarly, Household 1 explained: *"Residents are willing to open their orchards, welcome guests, and demonstrate traditional cultivation and food processing."* These accounts underscore the importance of local cultural identity as a key differentiator in building unique agritourism products. Patterson and Aslam (2024) stressed that sustainable agritourism must be rooted in local cultural identity, as it enriches tourist experiences and strengthens destination competitiveness. In An Binh, the combination of agricultural products and riverine culture offers visitors a holistic experience—from sightseeing and tasting to community interaction.

4.1.3. Diversity of agricultural products and local specialties

Another frequently mentioned advantage is product diversity. Expert 4 observed: *"Each season offers different products: Ha Chau plum, star apple, rambutan, mango… Visitors always find something new to experience."* Travel company 2 further noted: *"This diversity can be integrated into seasonal tours that combine hands-on experiences with on-site consumption of fresh produce."* These findings highlight the potential of developing seasonal agritourism tours, which are being implemented in other regions. Grillini et al. (2023) confirmed that diversifying agricultural products is a key strategy to increase competitiveness and achieve sustainable agritourism development. Compared to other destinations, An Binh's rich variety of fruit specialties is a distinctive strength.

4.1.4. Geographical location and accessibility

Stakeholders also emphasized location. Expert 5 remarked: *"An Binh is located near the city center, with convenient waterway and road connections, making it suitable for day tours."* This advantage facilitates access for domestic markets, particularly corporate groups, students, and short-stay travelers. Pham (2023) argued that agritourism destinations close to urban centers are more attractive to tourists due to lower travel costs and suitability for short visits. This provides An Binh with a clear competitive edge for future development.

4.1.5. Government–community support and consensus

Several stakeholders affirmed that the local government has already provided strategic orientation. Expert 7 shared: *"Local authorities have set a direction for ecotourism development, supporting promotion, investing in infrastructure, and encouraging community participation."* At the same time, Household 2 added: *"Residents are willing to convert part of their orchards to host tourists, provided that supportive policies are in place."* These insights reflect strong consensus among different actors. Nguyen Hoang Thanh and Lee (2025) demonstrated that public–private partnerships (PPP) play a critical role in advancing agritourism in Vietnam, with governments as facilitators and businesses/communities as implementers. The case of An Binh is a typical example of mobilizing multi-stakeholder collaboration for agritourism development.

4.1.6. Sustainable orientation and green tourism

Finally, stakeholders underscored the importance of sustainability. Expert 8 emphasized: *"Developing organic and clean agriculture, combined with environmental education, will create long-term highlights for An Binh tourism."* This reflects the global trend toward green agriculture-based tourism. Barbieri and Mahoney (2009) argued that when linked to sustainability, agritourism can simultaneously deliver economic (income diversification), social (community cohesion), and environmental (resource conservation) benefits. This direction also resonates with the preferences of international tourists and younger generations.

4.2. Challenges for Agritourism Development in An Binh, Can Tho

Synthesizing stakeholders' perspectives, the main challenges of agritourism in An Binh can be grouped into five categories: (i) weak infrastructure, (ii) unprofessional human resources, (iii) lack of multi-stakeholder linkages, (iv) financial and policy constraints, and (v) seasonality and ineffective marketing. These barriers are consistent with both international and domestic studies, suggesting that An Binh is facing typical challenges of agritourism destinations at an early development stage.

4.2.1. Inadequate infrastructure and facilities

Several stakeholders highlighted infrastructure limitations. Expert 3 noted: *"Roads are deteriorated, and many orchards lack parking spaces, making it difficult for large groups."* Travel company 2 added: *"There is a shortage of standard sanitation facilities and limited accommodation, so visitors often come only for day trips."* This is a common challenge in Mekong Delta agritourism. According to Son et al. (2023), inadequate infrastructure is the most significant barrier preventing agritourism from attracting international tourists, especially in areas without professional supporting services. This indicates that stronger investment in transportation, accommodation, and basic amenities is essential for An Binh.

4.2.2. Service quality and human resource issues

Local households also acknowledged service skill limitations. Household 3 shared: *"We are not proficient in foreign languages and do not know how to introduce our products attractively to visitors."* Expert 6 added: *"Most of the workforce are farmers without formal training, so professionalism is limited."* Tew and Barbieri (2012) found that a lack of service skills and training is a common barrier in agritourism, directly affecting visitor experiences.

The An Binh case is no exception, as participants are mostly farmers with limited foreign language ability and marketing skills.

4.2.3. Lack of stakeholder coordination

Another frequently mentioned issue was weak coordination among government, enterprises, and the community. Travel company 1 explained: *"It is difficult for businesses to package tours because each household operates differently, with no consistency in guest reception."* Expert 5 emphasized: *"There needs to be an association or cooperative to coordinate activities; otherwise, agritourism products will remain fragmented and uncompetitive."* Nguyen Hoang Thanh and Lee (2025) argued that public–private partnerships (PPP) and farmer cooperatives are crucial mechanisms to enhance agritourism efficiency in Vietnam. The reality in An Binh highlights the urgent need for multi-stakeholder coordination mechanisms to standardize products and build a common brand.

4.2.4. Financial constraints and limited policy access

Some households identified financial limitations as their greatest difficulty in improving infrastructure and services. Household 2 explained: *"We want to upgrade sanitation facilities and buy more boats for tourists, but loans are difficult to obtain and interest rates are high."* This is consistent with Barbieri and Mahoney (2009), who found that many American farm households engaged in agritourism faced financial challenges and relied on government support to sustain services. In Vietnam, green credit schemes or preferential loans for agritourism households are not yet widespread, limiting investment capacity.

4.2.5. Seasonality and climate risks

Agritourism in An Binh is heavily seasonal, depending on fruit harvests. Expert 4 observed: *"Visitor numbers peak in summer when rambutan and plum ripen, but during the rainy season there are fewer products, and flooded orchards make it difficult to host tourists."* This indicates that agritourism is highly vulnerable to seasonality. Grillini et al. (2023) also confirmed that seasonality and climate-related risks (such as droughts and floods) are major challenges for global agritourism, particularly in tropical regions. This is a pressing concern for An Binh, which is significantly affected by climate change in the Mekong Delta.

4.2.6. Limited promotion and marketing

Some travel companies noted that agritourism products in An Binh have not been widely promoted. Travel company 3 commented: *"Few visitors are aware of An Binh's brand; most come through local guides or by chance."* Nguyen et al. (2018) reported that residents in surveyed regions perceived the positive economic and socio-cultural impacts of agritourism to outweigh its negatives, and such positive attitudes motivated their participation in agritourism development. For An Binh, the lesson is to strengthen digital marketing, expand online visibility, and connect tour itineraries with larger travel companies to build a recognizable brand.

5. Conclusion

This study has demonstrated that An Binh Ward, Can Tho City, possesses significant potential for agritourism development thanks to its favorable natural conditions, orchard landscapes, diverse agricultural products, and convenient geographical location. In addition, local cultural identity, government support, and the global trend toward green tourism provide a solid foundation for developing distinctive agritourism products.

However, the findings also reveal critical challenges, including inadequate infrastructure, unskilled human resources, weak stakeholder linkages, limited financial capacity, and seasonal risks. These are typical barriers for agritourism in its early stage of development and are consistent with international findings on agritourism in rural regions of developing countries (Tew & Barbieri, 2012).

Implications for government: The results suggest that local authorities should continue to act as facilitators by investing in infrastructure, introducing green credit policies, and promoting public–private partnerships (PPP). As Nguyen Hoang Thanh and Lee (2025) emphasized, PPP is a crucial instrument for effective agritourism development, enabling resource mobilization and coordination among government, businesses, and communities.

Implications for travel enterprises: Tourism companies should focus on designing distinctive agritourism tours based on seasonality and the riverine cultural experience. Developing seasonal tour products (e.g., rambutan tours or fruit festival tours) not only enhances the value of agricultural products but also creates novelty for tourists. Furthermore, businesses should support farmers in digital marketing to position "An Binh" as a recognizable agritourism brand.

Implications for local communities: Local residents play a central role in agritourism. They need training in service skills, foreign languages, and tourism safety to enhance professionalism. As Knežević et al. (2025) argued, community empowerment and co-creation are essential for preserving agroheritage and strengthening social sustainability.

Limitations and future research: This study still has several limitations. First, the qualitative method with a relatively small sample (8 experts, 3 enterprises, and 7 households) limits the generalizability of the findings to the entire region. Second, data were collected over a short period and did not fully capture the effects of seasonality and climate change on agritourism activities. Third, the study did not analyze in depth the differences in expectations between domestic and international tourists, which could significantly influence product orientation. Based on these limitations, future studies should expand the sample size and integrate qualitative and quantitative methods. One potential direction is to conduct large-scale tourist surveys to measure satisfaction and revisit intentions, as suggested by Son et al. (2023) in their research on agritourism satisfaction in the Mekong Delta. In addition, further studies could apply PLS-SEM models to examine the relationships among infrastructure, human resources, culture, and tourist satisfaction. Finally, comparative studies across provinces (e.g., Ben Tre, Vinh Long, An Giang) are needed to identify the most suitable agritourism model for the Mekong Delta in the context of rapid urbanization and climate change (Pham et al., 2023).

References

Barbieri, C., & Mahoney, E. (2009). Why is diversification an attractive farm adjustment strategy? Insights from Texas farmers and ranchers. *Journal of rural studies*, *25*(1), 58-66.

Bhatta, K. (2023). Community-based agritourism: A literature review. In *International Workshop on Agritourism* (Vol. 1).

Ćirić, M., Tešanović, D., Kalenjuk Pivarski, B., Ćirić, I., Banjac, M., Radivojević, G., ... & Šmugović, S. (2021). Analyses of the Attitudes of Agricultural Holdings on the Development of Agritourism and the Impacts on the Economy, Society and Environment of Serbia. *Sustainability*, *13*(24), 13729.

Grillini, G., Sacchi, G., Streifeneder, T., & Fischer, C. (2023). Differences in sustainability outcomes between agritourism and non-agritourism farms based on robust empirical evidence from the Tyrol/Trentino mountain region. *Journal of Rural Studies*, *104*, 103152.

Grillini, G., Streifeneder, T., Stotten, R., Schermer, M., & Fischer, C. (2025). How tourists change farms: The impact of agritourism on organic farming adoption and local community interaction in the Tyrol-Trentino mountain region. *Journal of Rural Studies*, *114*, 103531.

Knežević, M., Vujko, A., & Borovčanin, D. (2025). Community-Centered Farm-Based Hospitality in Agriculture: Fostering Rural Tourism, Well-Being, and Sustainability. *Agriculture*, *15*(15), 1613.

Nguyen, N. T. H., Suwanno, S., Thongma, W., & Visuthismajarn, P. (2018). The attitudes of residents towards agro-tourism impacts and its effects on participation in agro-tourism development: The case study of Vietnam. *African Journal of Hospitality, Tourism and Leisure*, *7*(4), 1-18.

Nguyen Hoang Thanh, N., & Lee, L. (2025). The role of public–private partnerships in the development of agritourism: the case of Vinh Long, Vietnam. *Cogent Social Sciences*, *11*(1), 2505123.

Patterson, I., & Aslam, M. U. (2024). Agritourism as an Emerging Sustainable Tourism Industry in Uzbekistan. *Sustainability*, *16*(17), 7519.

Pham, T. T. H., Cao, H. S., & Lapointe, D. (2023). Agrotourism and fast urbanisation: The double pressure of development on peri-urban agriculture in Hôi An, a small city of central Vietnam. *Asia Pacific Viewpoint*, *64*(3), 408-424.

Phan, N. T. (2021). Agritourism-Sustainable Tourism Trend in Ben Tre Province, Vietnam. *Humanities and Social Science Research*, *4*(2), p1-p1.

Roman, M., & Kawęcki, N. (2024). Agritourism in academic research: Literature review and cluster analysis.*Turyzm/Tourism, 34*(1), 45-55.

Son, N. T., Nguyen, Q. N., & Hoang, T. H. L. (2023). Factors influencing tourist satisfaction with agritourism in the Mekong Delta, Vietnam. *GeoJournal of Tourism and Geosites*, *49*(3), 998-1005.

Tew, C., & Barbieri, C. (2012). The perceived benefits of agritourism: The provider's perspective. *Tourism management*, *33*(1), 215-224.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

MOTIVATIONS FOR EXPERIENCING AGRICULTURAL TOURISM IN DA LAT: A PERSPECTIVE FROM GENERATION Z TOURISTS IN THE MEKONG DELTA REGION, VIETNAM

Tri Thong Truong
Faculty of Tourism and Hospitality Management, Nam Can Tho University

Van Do Nguyen
Faculty of Tourism and Hospitality Management, Nam Can Tho University

Thanh Quoc Duong
Faculty of Tourism and Foreign Languages, Kien Giang College

Abstract
Agritourism has recently emerged as a sustainable form of tourism, integrating agricultural production with travel experiences, thereby generating economic benefits for farming households while providing practical learning opportunities for visitors. This study aims to explore the motivations driving Generation Z tourists from the Mekong Delta to engage in agritourism activities in Da Lat, Vietnam. Grounded in the push–pull motivation framework, data were collected from 131 Gen Z respondents using a structured questionnaire with five-point Likert scales. Descriptive statistical analysis revealed that push motivations such as the need for relaxation (Mean = 4.32), escape from daily pressures (Mean = 4.27), novelty seeking (Mean = 4.20), and social bonding (Mean = 4.10) play an important role in shaping travel intentions. Conversely, pull motivations demonstrated a stronger impact, particularly those unique to Da Lat, including strawberry-picking experiences at farms (Mean = 4.46), a temperate climate (Mean = 4.42), and distinctive agricultural landscapes (Mean = 4.34). These findings confirm that the combination of intrinsic needs and destination attributes strongly stimulates Gen Z's participation intentions. The study proposes several managerial implications, including diversifying experiential products, integrating wellness services and farmstay accommodations, strengthening digital communication strategies, and emphasizing environmental sustainability, thereby contributing to positioning Da Lat as a hub for sustainable agritourism in Vietnam.
Keywords: Agirciltural tourism, Da Lat, Experience, Motivation, Gen Z, Vietnam

1. Introduction

In recent decades, agritourism has emerged as a growing trend that connects tourist experiences with on-farm activities, where visitors can engage in cultivation, explore production processes, and enjoy agricultural products directly at the source. Conceptually, an influential typology was introduced to clarify the core characteristics of agritourism and to structure research approaches in this field (Phillip et al., 2010). Agritourism not only generates economic benefits for farm households and rural communities but also serves an educational function by fostering public understanding of agriculture, while simultaneously enhancing the quality of life for farm families engaged in service provision (Tew & Barbieri, 2012).

In the post-COVID-19 era, the demand for nature-based, safe, and experience-rich tourism forms has become increasingly prominent in the recovery strategies of many destinations; in Vietnam, this was also reflected in the sector's reports and policy orientations during 2020–2021 (Vietnam National Administration of Tourism, 2021).

Recent scholarly approaches highlight the nexus between sustainable agricultural positioning and the spatial development of agritourism, framing it as a foundation for designing products and managing destinations in a sustainable manner (Wu et al., 2022). Within the Vietnamese context, Da Lat—the "city of a thousand flowers"—possesses significant comparative advantages, including its temperate climate, high-tech agricultural ecosystems (strawberries, flowers, tea, coffee), and distinctive agricultural landscapes. These assets underpin the development of experiential products such as "a day as a farmer," greenhouse tours, and on-site fruit picking and tasting. Such models have attracted large numbers of visitors interested in learning and experiencing, while also reinforcing Da Lat's image as a green and creative destination.

At the same time, shifts in tourist structures and preferences—particularly among Generation Z (born between 1997 and early 2012)—are reshaping the boundaries of tourism products toward authentic, personalized, and sustainable experiences. Recent cross-national evidence indicates that Gen Z tends to prioritize social interaction, pursue unique and novel experiences, and favor environmentally friendly options; they also construct and share their journeys via social media and are strongly influenced by digital influencers in decision-making (Popşa, 2024). Domestically, recent media and policy reports underscore the pull effect of young travelers in driving demand for innovative cultural–nature-based, experience-rich products (People's Army Newspaper, 2024).

Nevertheless, research gaps remain evident. Most existing studies on agritourism in Vietnam have focused on the supply side (management, policy, providers) or broad performance indicators, with limited inquiry into the motivations of Gen Z tourists—a generation marked by distinct consumption behaviors and strong immersion in the digital environment. Some regional studies on agriculture and tourism in Da Lat have pointed to considerable potential, but they lack demand-side analyses to understand the expectations and experiential desires of young visitors. Moreover, Gen Z tourists from the expansive Mekong Delta region—a demographic yet to be systematically explored—represent an underexamined source market. Consequently, there is an urgent need to address the motivational dynamics of Gen Z in relation to agritourism experiences in Da Lat, a highland agricultural setting (temperate, high-tech) that contrasts with the "riverine garden" environments where they reside.

Against this backdrop, this study pursues two objectives: (1) to assess the primary push and pull motivations driving Generation Z tourists from the Mekong Delta to choose agritourism experiences in Da Lat; and (2) to propose managerial implications based on these findings. Employing a quantitative design with 131 survey respondents, the study aims to provide empirical evidence to support the design and adjustment of Gen Z–oriented products, while offering a conceptual basis for strategies to develop sustainable agritourism in Da Lat.

2. Literature Review

Tourism motivation is defined as the set of factors that drive individuals to engage in a specific trip or travel experience (Van Anh & Hoang, 2023). According to Crompton's (1979) seminal framework, tourism motivation can be divided into two main categories: push factors, which originate from intrinsic needs such as relaxation, exploration, and social connection; and pull factors, which derive from destination attributes such as landscapes, climate, and engaging activities. Subsequent studies have also highlighted the importance of personal experiential motives and novelty-seeking in shaping travel intentions, particularly among younger generations. For Generation Z, tourism motivations are influenced by generational traits closely tied to technology and social media.

For instance, Gen Z travelers often desire to "check in" at unique destinations as a way of self-expression and to share experiences within their online communities. In addition, they value authentic experiences and prefer direct participation in farm activities such as planting, harvesting, and animal care, thereby enjoying the sensation of "a day as a farmer." Recent studies on community-based and sustainable tourism in Vietnam also demonstrate that young people show strong interest in nature- and environment-related aspects of tourism experiences (Van Anh & Hoang, 2023).

Agritourism is regarded as a form of sustainable tourism that contributes to product diversification and income generation for farmers (Nguyen, 2022). For Gen Z travelers, agritourism satisfies multiple motivational dimensions. First, the motivation for relaxation and immersion in nature: many young Gen Z visitors from urban areas in the Mekong Delta seek a change of atmosphere, fresh air, and the distinctive highland landscapes of Da Lat. Second, the motivation for learning and exploration: Gen Z expresses strong interest in high-tech agricultural practices and enjoys participating in activities such as strawberry picking, vegetable cultivation, and livestock care—experiences that are novel compared to their everyday lives. Third, the motivation for social bonding and self-affirmation: agritourism in Da Lat provides opportunities for Gen Z to travel with friends and family, strengthening emotional connections. Simultaneously, engaging in unique activities and sharing "check-in" images on social media enables them to assert their individuality and gain recognition within their communities. Overall, grounded in classical theories of tourism motivation and considering the specific characteristics of Generation Z, the motivational dimensions of agritourism experiences for this group can be conceptualized as a combination of push and pull factors.

3. Research Methodology

This study employed a quantitative approach using a structured questionnaire survey. The target respondents were Generation Z tourists (born between 1997 and 2012, with the majority falling within the 1997–2008 cohort to ensure participants were 18 years or older) residing in the Mekong Delta region, who had either participated in or expressed interest in agritourism experiences in Da Lat in recent years. A sample size of 100–200 respondents was determined, applying a convenient sampling method. The data collection instrument was a questionnaire designed with two main sections: (1) demographic information of respondents; and (2) measurement scales of agritourism motivations, comprising two primary groups—push motivations (10 observed variables) and pull motivations (10 observed variables). Each variable was measured using a five-point Likert scale, ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Data were collected between January and July 2025, yielding 147 responses. After a screening process, 131 valid questionnaires remained and were analyzed using SPSS 26.0 software, applying descriptive statistical techniques in the form of percentages and mean values.

4. Research Results and Discussion

4.1. Push Motivations Influencing the Intention to Participate in Agritourism in Da Lat

The survey results indicate that push motivations were rated highly among Gen Z tourists from the Mekong Delta region (M = 4.08 on a 5-point scale). This suggests that intrinsic needs such as relaxation, exploration, and social bonding strongly drive their intention to participate in agritourism experiences in Da Lat.

Indeed, the two most highly rated push motivations were the desire for mental relaxation and energy restoration (Mean = 4.32) and the wish to escape from the pressures of daily life (Mean = 4.27), both falling under the "strongly agree" category. These findings underscore the primacy of stress relief and leisure as internal drivers for Gen Z's travel intentions, aligning with Crompton's (1979) seminal conclusions and subsequent studies which emphasize escape and relaxation as among the most prevalent travel motivations.

Beyond relaxation, Gen Z also shows a strong appetite for novelty and learning through tourism. High levels of agreement with motivations such as "experiencing something entirely new" (Mean = 4.20) and "exploring and gaining new knowledge about agriculture" (Mean = 4.07) highlight the appeal of unique, educationally rich experiences at the destination. These results reflect the generational characteristic of Gen Z as seekers of "novel and distinctive" experiences to broaden their understanding. Similarly, social bonding motivations were evident, as many respondents expressed that the trip provided opportunities to "strengthen connections with friends and family" (Mean = 4.10) and to "gain interesting stories to share afterward" (Mean = 4.02). These social interaction elements resonate with the broader trend of Gen Z's preference for community-oriented and socially engaging tourism experiences.

The findings also reveal a dimension of self-affirmation and experience-sharing among a segment of young tourists. Although rated slightly lower, many respondents still agreed that they "wanted memorable photos and unique experiences to share on social media" (Mean = 3.96) and sought to "assert themselves through distinctive experiences" (Mean = 3.82). This reflects the self-expression and "check-in" culture of Gen Z, which emphasizes showcasing travel experiences online. Likewise, the motivation to "challenge oneself through agricultural labor activities" (Mean = 3.86), though not among the strongest drivers, was still endorsed by more than half of the respondents, suggesting that some young travelers find appeal in physically demanding, self-challenging experiences.

In summary, the push motivations of Gen Z tourists toward agritourism in Da Lat are centered on stress relief, the pursuit of meaningful and novel experiences, social bonding, and, to some extent, self-affirmation. These intrinsic drivers are consistent with the push motivation categories predicted by classical tourism motivation theories and contemporary studies on Gen Z travel behavior. Such endogenous motivations form the foundation for their intention to participate in agritourism activities.

Table 1. Push Motivations Leading to the Intention to Experience Agritourism in Da Lat

Push motives (M=4,08)	**Mean**	**Conclusion**
I want to escape from the stressful pace of daily life through a trip.	4,27	Strongly agree
I wish to have opportunities for mental relaxation and energy restoration.	4,32	Strongly agree
I want to experience something new that I have never tried before.	4,20	Agree
I want to explore and gain new knowledge about agriculture.	4,07	Agree
I want to improve my health by immersing myself in green spaces.	4,13	Agree
I wish to affirm myself through distinctive and special experiences.	3,82	Agree
I want to capture beautiful photos and unique memories to share on social media.	3,96	Agree
I wish to strengthen emotional bonds with friends/family through the trip.	4,10	Agree
I want to have more interesting stories to share with others after the trip.	4,02	Agree
I want to challenge myself through agricultural labor activities.	3,86	Agree

Source: Survey data, 2025 (n = 131)

4.2. Pull Motivations Influencing the Intention to Participate in Agritourism in Da Lat

The findings on pull motivations reveal that the attractiveness of Da Lat as a destination even surpasses push motivations, with an overall mean score of 4.20. This affirms that destination attributes—such as landscape, climate, and specific activities—play a major role in attracting Gen Z tourists to agritourism in Da Lat. Baniya and Paudel (2016) similarly observed that pull motivations often exert a stronger influence than push motivations in stimulating domestic tourism, and the case of Da Lat is no exception. Among the pull factors, the most prominent were the appealing climate and landscapes of Da Lat, combined with its distinctive agricultural activities. Specifically, respondents expressed strong agreement with being "attracted by the cool and fresh climate of Da Lat" (Mean = 4.42) and "interested in its distinctive agricultural landscapes, including pine hills, flower gardens, and farms" (Mean = 4.34). These findings indicate that the temperate environment and verdant scenery constitute major advantages of Da Lat in the eyes of young travelers, aligning with Gen Z's demand for a refreshing escape into nature.

Particularly noteworthy is the extremely high appeal of Da Lat's signature agritourism activities. The item "experiencing strawberry picking directly at farms" achieved the highest mean score (Mean = 4.46), suggesting that nearly all respondents were highly enthusiastic about this activity. Similarly, activities such as "visiting high-tech vegetable farms and hydroponic models" (Mean = 4.29) and "touring tea plantations and coffee farms to learn about production processes" (Mean = 4.11) also received widespread approval. These results reflect young tourists' learning and exploratory motivations, as they wish to directly engage with both high-tech and traditional agricultural practices to broaden their knowledge. In practice, farm tours in Da Lat have enabled visitors to pick fruits, take photographs in the fields, participate in farming tasks, and observe hydroponic cultivation models—novel "one day as a farmer" experiences that have successfully attracted large numbers of tourists. The very high mean scores of these items underscore the strong appeal of such experiential activities for Gen Z.

Beyond natural and activity-based attractions, service quality and destination reputation also positively influenced intentions to participate. Many young respondents agreed that "agritourism services in Da Lat are diverse and of good quality" (Mean = 4.06), reflecting a favorable evaluation of the destination's resources. Importantly, the item "Da Lat is a famous and popular destination among young people" obtained a mean score of 4.23, underscoring the trend of following "hot spots" within the Gen Z community. The widespread perception of Da Lat as a "must-visit" destination, reinforced by social media exposure and peer influence, motivated many respondents to choose it for agritourism. This corresponds with the characteristics of Generation Z, who are highly susceptible to trends, influencers, and online popularity in shaping their travel decisions. In other words, Da Lat's reputation and social diffusion effects work in synergy with its natural and experiential attractions to strengthen Gen Z's agritourism intentions.

Finally, although rated slightly lower, other factors such as "farmstay accommodation" (Mean = 3.94) and "participation in livestock care activities" (Mean = 3.90) still scored above the agreement threshold. This suggests that most Gen Z travelers remain interested in nearly all forms of agritourism activities in Da Lat, though deeper immersion activities (e.g., overnight stays, labor-intensive farm work) may be less appealing due to differences in personal preferences or comfort expectations. Overall, all proposed pull motivations were positively endorsed, demonstrating the comprehensive appeal of Da Lat as a destination for young tourists. These findings are consistent with recent studies that emphasize youth travelers' strong interest in nature, the environment, and local experiences when selecting destinations.

Put differently, Da Lat's pull motivations—spanning climate, landscape, activities, services, and reputation—constitute a decisive force in shaping the agritourism intentions of Gen Z tourists from the Mekong Delta.

Table 2. Pull Motivations Leading to the Intention to Experience Agritourism in Da Lat

Push motives (M=4,20)	**Mean**	**Conclusion**
I am attracted by the cool and fresh climate of Da Lat.	4,42	Strongly agree
I am interested in Da Lat's distinctive agricultural landscapes (pine hills, flower gardens, farms).	4,34	Strongly agree
I wish to experience strawberry picking directly at the farm.	4,46	Strongly agree
I want to visit and learn about high-tech and hydroponic vegetable farms.	4,29	Strongly agree
I am interested in visiting tea plantations and coffee farms to explore the production process.	4,11	Agree
I want to experience farmstay accommodations to immerse myself in farmers' lifestyles.	3,94	Agree
I am attracted by the fresh and delicious local cuisine made from agricultural products.	4,16	Agree
I wish to participate in livestock care activities.	3,90	Agree
I believe agritourism services in Da Lat are diverse and of good quality.	4,06	Agree
I choose Da Lat because it is a famous and popular destination among young people.	4,23	Strongly agree

Source: Survey data, 2025 (n = 131)

5. Conclusion

This study has clarified the motivations driving Generation Z in the Mekong Delta to participate in agritourism in Da Lat. The findings indicate that both push and pull motivations were highly rated. Among push motivations, the most prominent were the need for mental relaxation (Mean = 4.32), the desire to escape from a busy daily routine (Mean = 4.27), novelty seeking (Mean = 4.20), and social bonding (Mean = 4.10). These results clearly reflect young travelers' intrinsic desire to find rest, explore new knowledge, and strengthen community ties. In terms of pull motivations, Da Lat's distinctive attractions—including its cool climate (Mean = 4.42), unique agricultural landscapes (Mean = 4.34), strawberry-picking experiences (Mean = 4.46), and its reputation as a "hot" youth destination (Mean = 4.23)—played a key role in attracting Gen Z to agritourism. The synergy between endogenous push motivations and exogenous pull attractions strongly shaped young tourists' intention to participate in this form of tourism.

Based on these findings, several important managerial implications are proposed:

First, diversify experiential products with a focus on interaction and learning. Given Gen Z's strong demand for novelty and knowledge, businesses should design multi-level "farm experience" packages. For instance, a "One Day as a Farmer" package may include planting vegetables, harvesting, and preparing dishes from the produce, while seasonal "Farm Tours" can revolve around strawberries, flowers, or coffee. Integrating AR/VR applications into greenhouse visits could increase attractiveness and align with Gen Z's technological habits. Linking education, leisure, and hands-on experience would ensure that each trip provides not only relaxation but also intellectual and emotional value.

Second, enhance elements of relaxation and wellness. Since Gen Z seeks stress relief and energy restoration, enterprises should develop products that combine agritourism with wellness tourism, such as morning yoga classes on tea hills, picnics in flower gardens, or herbal massage sessions at farmstays. Farmstay operators should emphasize quiet spaces and nature-inspired designs to differentiate from traditional hotels and guesthouses. Promoting the concept of "slow tourism" would allow visitors to fully rest and enjoy the climate and scenery.

Third, encourage social bonding and experience-sharing on social media. Because Gen Z values peer connections and self-expression online, destinations should organize group activities such as team-building harvest games, "best check-in photo" contests, or culinary workshops using local produce. Photogenic spots (flower gardens, fields, aesthetically designed homestays) should be created to encourage sharing on TikTok and Instagram. Promotional campaigns with hashtags and online mini-games could further stimulate community engagement.

Fourth, improve service quality, infrastructure, and environmental sustainability. As Gen Z is highly sensitive to environmental issues, green management practices should be implemented, including waste sorting, eco-friendly packaging, and reducing single-use plastics. Staff training should be strengthened in areas such as English communication and digital service applications. Investments in infrastructure (farm access roads, sanitation facilities, Wi-Fi systems) are also necessary to meet Gen Z's "always online" expectations.

Finally, strengthen digital communication and destination branding. Since Gen Z primarily obtains information through digital platforms, marketing strategies should focus on TikTok, Instagram, and YouTube. Short videos, appealing visuals, and catchy music have strong viral potential. Collaborations with KOLs and lifestyle influencers can directly promote agritourism to target audiences. Positioning Da Lat as Vietnam's "capital of creative agritourism experiences," with emphasis on its distinct values—cool climate, iconic products (strawberries, flowers, coffee), and high-tech agricultural experiences—would further enhance its appeal.

However, certain limitations remain. The survey scope was limited to 131 Gen Z tourists from the Mekong Delta, restricting generalization to other age groups or regions. The cross-sectional design did not capture seasonal or temporal variations in motivations. Analyses were limited to descriptive statistics (mean values), without applying advanced modeling to test causal relationships among motivations, attitudes, and intentions. Additionally, intergenerational comparisons with Millennials or Gen X were not included, leaving gaps in understanding generational differences. Future studies should therefore expand sample size and coverage, adopt longitudinal designs, employ structural equation modeling (SEM) for hypothesis testing, and incorporate qualitative methods as well as intergenerational comparisons. These directions will provide a more comprehensive understanding of agritourism motivations and behaviors in Vietnam's contemporary context.

References

Baniya, R., & Paudel, K. (2016). An analysis of push and pull travel motivations of domestic tourists in Nepal. *Journal of Management and Development Studies*, *27*, 16-30.

Crompton, J. L. (1979). Motivations for pleasure vacation. *Annals of tourism research*, *6*(4), 408-424.

Konieczna, P., & Trybuś-Borowiecka, K. (2025). Touristic Behaviors of Generation Z: Reasons Behind the Reduction in Travel Among Young People. *Sustainability*, *17*(17), 7919.

Nguyen, T. (2022). Promoting the potential of agricultural tourism in the Mekong Delta. Truy cập ngày 9/9/2025. Truy cập từ https://en.nhandan.vn/promoting-the-potential-of-agricultural-tourism-in-the-mekong-delta-post118647.html

People's Army Newspaper. (2024). Vietnam's cultural tourism boom: A youth-driven renaissance. Ngày truy cập 9 tháng 9 năm 2025, truy cập từ http://en.qdnd.vn/travel/news/vietnam-s-cultural-tourism-boom-a-youth-driven-renaissance-568642

Phillip, S., Hunter, C., & Blackstock, K. (2010). A typology for defining agritourism. *Tourism management*, *31*(6), 754-758.

Popşa, R. E. (2024). Exploring the generation Z travel trends and behavior. *Studies in Business and Economics*, *19*(1), 189-189.

Tew, C., & Barbieri, C. (2012). The perceived benefits of agritourism: The provider's perspective. *Tourism management*, *33*(1), 215-224.

Van Anh, N. T., & Hoang, P. M. (2023). Motivating Factors and Online Behavior Influencing the Choice of Community-Based Tourism Preferences of Generation Z in Vietnam. *Economics and Business Quarterly Reviews*, 39.

Vietnam National Administration of Tourism. (2021). 2020: Vietnam Tourism strives to revive from global pandemic with unprecedented difficulties. Truy cập ngày 9/9/2025, truy cập từ https://vietnamtourism.gov.vn/en/post/15630?utm_source=chatgpt.com

Wu, C. K., Wang, C. N., Le, T. K. T., & Nhieu, N. L. (2022). Sustainable agritourism location investigation in vietnam by a spherical fuzzy extension of integrated decision-making approach. *Sustainability*, *14*(17), 10555.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

COMBINED EFFECTS OF SUMITHION AND MERCURY ON HEMATOLOGY AND HISTOPATHOLOGY OF NILE TILAPIA WITH IMPLICATION FOR AQUACULTURE, AGRICULTURE AND ANIMAL HEALTH

Research Assistant Tilottama Mondal
Laboratory of Fish Ecophysiology, Department of Fisheries Management, Bangladesh Agricultural University
ORCID: 0009-0007-4931-5651

Professor Shahjahan
Department of Fisheries Management, Bangladesh Agricultural University
ORCID: 0000-0003-1097-8849

ABSTRACT
Aquatic ecosystem has been greatly threatened by the widespread use of pesticides and industrial pollutants from agriculture and surrounding environments. Especially, these contaminants pose serious risks to fish species. Notably, Sumithion (Su), an organophosphate insecticide which is used to remove hazardous insects. However, excessive Su use can harm the ecosystem. Mercury (Hg), a heavy metal, are known for having detrimental affects on fish physiology and overall health. The present study aims to investigate the combined effects of Hg and Su on hematological and also asses the histomorphological alterations after expose to Su, Hg and their combination. A total of 240 fingerlings of Nile tilapia (*Oreochromis niloticus*) was randomly distributed in four experimental tanks, including T1 (Control), T2 (Hg: 0.03mg/L), T3 (Su: 0.6 µg/L), T4 (Su + Hg), with three replicates each. The result showed that single exposure of Su and Hg increase both hemoglobin (Hb) and blood glucose levels but in combined exposure of Su and Hg, the increase is significantly higher compared to the control group (Hb: 12.58 g/dL, glucose: 85.33 mg/dL). Moreover, combined exposure of Su + Hg alters physiological parameters of gill, liver and kidney. The number of cellular (twin, fusion, echinocyte, spindle, teardrop, and elongated shaped) and nuclear (bi-nuclei, nuclear buds, karyopyknosis, and notched nuclei) abnormalities in erythrocytes were higher in the Su and Hg-exposed group. These finding indicate that these contamination not only threatens aquatic biodiversity but also have negative impact on agriculture and animal production The observed alterations suggest that combined exposure to Su and Hg resulted in more severe adverse effects on Nile tilapia compared to individual treatments, and it is vital to implement effective monitoring and management strategies to reduce pollution in agricultural and aquatic habitats.
Keywords: Mercury, Sumithion, Hematology, Histopathology, Nile tilapia

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

BIOREMEDIATION OF MERCURY-INDUCED GROWTH RETARDATION IN NILE TILAPIA (*Oreochromis niloticus*) USING DIETARY VITAMIN E AND SELENIUM

Research Assistant Mir Ashrafia Ananna
Laboratory of Fish Ecophysiology, Department of Fisheries Management, Bangladesh Agricultural University
ORCID: 0009-0009-1265-2982

Professor Shahjahan
Department of Fisheries Management, Bangladesh Agricultural University
ORCID: 0000-0003-1097-8849

ABSTRACT
Globally, aquatic pollution is acknowledged as a major threat to environmental integrity, agricultural sustainability, and rural livelihood development. Heavy metals are one of the major contributors to aquatic pollution. Among these, mercury (Hg) is particularly toxic to fish, even at low concentrations. In addition to disrupting aquatic ecosystems, this kind of contamination poses serious hazards to animal production systems that depend on aquaculture resources. Vitamin E and selenium supplementation with diet may mitigate the toxic effects of mercury; hence, this study was implemented to evaluate the role of dietary Vitamin-E and Se nano particles in mitigating the adverse effects of Hg on Nile tilapia (*Oreochromis niloticus)* a species with significant economic value in animal and agricultural production. This experiment was carried out with a total of 240 fingerlings of Nile tilapia (10.82 ± 1.05 g) with 3 replicates that were distributed in four treatments including control, Hg (0.03 mg/L), Hg + Vit-E (0.03 mg/L + 100 mg/kg feed), and Hg+ Selenium (0.03 mg/L + 3 mg/kg) for six weeks. The results showed that growth performance of fish such as weight gain (WG), and specific growth rate (SGR) were enhanced and feed conversion ratio (FCR) was declined in dietary exposure with Hg, but the opposite results were recorded in Hg treated fish. However, histological examination of the intestinal parameters exhibited significant negative alterations in the Hg-treated group. Whereas Vit-E and selenium-supplemented diet played a fundamental role in counteracting the changes caused by mercury toxicity. Overall, Vit-E and Selenium appear capable of alleviating the adverse physiological impacts of mercury on Nile tilapia.
Keywords: Mercury, Vitamin-E, Selenium, Toxicity, Nile tilapia

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

THE USING OF NON-MEDICAL ANTIFUNGAL ANTIBIOTICS TO PROTECT AGRICULTURAL PLANTS FROM DISEASES CAUSED BY FUNGAL PHYTOPATHOGENS

Dr. Valery V. Belakhov
Technion – Israel Institute of Technology, Schulich Faculty of Chemistry (formerly)
ORCID: 0000-0003-1918-974X

ABSTRACT

The intensive use of chemicals in agriculture has led to environmental disruptions, the emergence of more resistant strains of pathogenic microorganisms that cause plant diseases, and other undesirable consequences. In this regard, in recent decades, the attention of researchers has been drawn to studies on the search for and implementation into practice of antibiotics obtained through microbiological synthesis. Currently, antibiotics are used in various branches of agriculture: 1) in veterinary medicine for the treatment and prevention of infectious diseases of animals; 2) in animal husbandry as a new factor in increasing the production of livestock products as growth stimulants for farm animals; 3) in plant growing as biological preparations for the control and prevention of plant diseases of various etiologies.

One of the essential requirements for antibiotics used for plant protection is that they are prohibited from being used in medical practice to avoid the development of resistance to them in harmful insects and microorganisms. In this regard, the use of non-medical antibiotics for plant protection is highly relevant. Currently, non-medical antibiotics are used in plant growing as fungicides, herbicides, insecticides, and plant growth regulators. The main requirements for antibiotic-based preparations used in the control of agricultural pests are as follows: 1) low toxicity for warm-blooded animals and humans; 2) high biological activity and specificity in the causative agent of the disease; 3) the ability to easily penetrate plant tissue; 4) therapeutic doses should be harmless to the plant; 5) stability on the surface and inside the plant; 6) the ability to easily decompose in the soil; 7) safety for the environment.

Phytopathogenic fungi play a major role in soil-borne plant diseases, as they are able to survive in the most unfavorable conditions and are characterized by a wide range of damage to a wide variety of agricultural crops. Phytopathogenic fungi cause 70% of all plant diseases, and the most terrible epiphytoties (mass plant diseases) are associated with fungal diseases. In view of this, the use of antifungal non-medical antibiotics to protect plants from diseases caused by phytopathogenic fungi and, consequently, to preserve crops is a pressing issue.

The report summarizes the literature data from recent decades regarding the successful use of antifungal non-medical antibiotics belonging to various classes of compounds to protect a wide range of agricultural crops from diseases caused by fungal phytopathogens of various etiologies.

Keywords: Antifungal Antibiotics, Agriculture, Plant Protection, Phytopathogenic Fungi, Plant Diseases, Environmental Protection

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

BIOTECHNOLOGICAL VALORISATION OF SHRIMP WASTE: PHYSICOCHEMICAL AND MICROBIAL QUALITY

Hassna LEKNIZI
Laboratoire de Productions Végétales, Animales et Agro-industrie, Université Ibn Tofail, Faculté des sciences de Kenitra

Elyachioui Mohamed
Laboratoire de Productions Végétales, Animales et Agro-industrie, Université Ibn Tofail, Faculté des sciences de Kenitra

Brahim BOURKHISS
Laboratoire de Productions Végétales, Animales et Agro-industrie, Université Ibn Tofail, Faculté des sciences de Kenitra

ABSTRACT
Of the hundreds of shrimp species known worldwide, just 20 are significant for commercial and transformation activities. However, the production and consumption of shrimp generate enormous amounts of debris, mostly shells, which harm the environment and public health. To determine the value of the by-products made from shrimp shells, this study assessed their chemical makeup and microbiological condition. Therefore, shrimp waste samples were collected from Kenitra (Northwest Morocco). After laboratory treatments, we measured the physicochemical and microbial parameters of wastes and their fermented by-product, including temperature, pH, minerals, and organic compounds, following standard methods. Microbial analysis addressed the identification of bacteria and fungi species and the pathogenic strains. The obtained results showed that the shrimp co-product was rich in dry matter (24.91%), organic matter (16.76%), chitin 16.57%, ashes (8.15%), and total protein (13.54%). In contrast, fat presented only 2.52%. Minerals were dominated by Calcium (5.57 mg/l), iron (0.92 mg/l), and phosphorus (0.72 mg/l). In total, 9 microbial strains were identified in the fermented samples, including *Escherichia coli* (54.73%), *Proteus mirabilis* (9.47%), *Klebsiella pneumoniae* (8.42%), and *Enterobacter* sp. (7.36%). *Salmonella enteritidis* was absent in by-product samples. Lactic acid bacteria and yeasts were significantly superior in fermented by-products, while FMAT, molds, total coliforms, Faecal coliforms, and *Clostridium sulphur* were significantly superior in non-fermented samples. These results demonstrated the richness of shrimp wastes in minerals and organic compounds and the absence of pathogenic strains. These are proposed to encourage the use of shrimp by-products in agronomic, food, and pharmaceutical applications.
Tests on the application of these biostimulants to silage corn crops were conducted in the laboratory as a factor in fertilization and soil and plant amendment in biostimulant formulations, and the results obtained were very satisfactory.
Keywords: by-products, shrimp waste, composition, fermentation, biotechnological valorization, microbiology.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

UNLOCKING THE POTENTIAL OF QUINOA: NUTRITIONAL, TECHNOLOGICAL, AND AGRONOMIC INSIGHTS FOR ALGERIA

BENYAHOUB Rabie
Laboratory for the Protection of Ecosystems in Arid and Semi-Arid Zones, Kasdi Merbah University

CHOUANA Toufik
Laboratory for the Protection of Ecosystems in Arid and Semi-Arid Zones, Kasdi Merbah University

AZIB Salim
Bioresources Laboratory, Kasdi Merbah University

Abstract
Quinoa (Chenopodium quinoa Willd.), often referred to as the “mother of all grains,” has attracted growing global attention due to its exceptional nutritional profile, functional versatility, and remarkable adaptability to harsh environmental conditions. Originally cultivated in the Andean region, quinoa has recently expanded to new agroecological zones, including North Africa, where it offers promising prospects for food and nutritional security. This review provides a comprehensive overview of quinoa from a global perspective, highlighting its nutritional and functional attributes, technological treatments, and diverse food applications. Special emphasis is given to the current status and agronomic potential of quinoa cultivation in Algeria, where efforts to introduce and adapt this pseudocereal are steadily increasing. The integration of quinoa into the Algerian agrifood sector could stimulate innovation in product development, support sustainable agriculture, and contribute to national strategies addressing malnutrition and food system resilience. Finally, strategic recommendations are proposed to strengthen research, processing technologies, and value chain development, positioning quinoa as a key resource for future agrifood innovation in Algeria.

Keywords: Quinoa -Processing technologies- agrifood innovation - functional properties - climate resilience - circular economy.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

SERUM BIOCHEMICAL RESPONSE OF RABBIT BUCKS ADMINISTERED MACA ROOT EXTRACT AND *MUCUNA PRURIENS* SEED EXTRACT

OBINNA, AL
Laboratory for the Protection of Ecosystems in Arid and Semi-Arid Zones, Kasdi Merbah University

MACHEBE, NS
Laboratory for the Protection of Ecosystems in Arid and Semi-Arid Zones, Kasdi Merbah University

AMAEFULE, BC
Laboratory for the Protection of Ecosystems in Arid and Semi-Arid Zones, Kasdi Merbah University

NWOGA, CC
University of Nigeria, Nsukka, Faculty of Agriculture, Department of Animal Science

Abstract
This study evaluated the serum biochemical response of rabbit bucks fed graded levels of *Maca root extract* (MRE) and *Mucuna pruriens* seed extract (MSE). Thirty-six rabbit bucks aged 9 weeks were arranged in a 3 × 3 factorial design with MRE at 0, 0.25, and 0.50 ml, and MSE at 0, 1.5, and 3 ml. Serum biochemical indices such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), total bilirubin (TB), and total protein (TP) were analyzed to assess liver function and metabolic health. Results revealed that MRE and MSE significantly ($p < 0.05$) influenced most serum parameters. Increasing MRE and MSE levels reduced AST, ALT, and ALP while elevating total protein values, indicating improved hepatic function. The interaction of 3 ml MSE × 0.25 ml MRE resulted in the lowest ALT (4.92 IU/L) and ALP (17.81 IU/L), while 0.50 ml MRE × 3 ml MSE increased total protein (5.57 g/dl). These findings suggest a synergistic hepatoprotective effect of MRE and MSE extracts. In conclusion, administration of 0.25–0.50 ml MRE combined with 1.5–3 ml MSE enhanced liver enzyme balance and protein synthesis in rabbit bucks.
Keywords: Antibiotics, plant extracts, liver enzymes, total protein, rabbit bucks

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

A HYBRID IOT–AI FRAMEWORK FOR REAL-TIME CROP MONITORING AND PRECISION FARMING APPLICATIONS

Associate Professor Dr. Shaik Salma Asiya Begum
Lakireddy Bali Reddy College of Engineering, Department of CSE(AI&ML)
ORCID: 0000-0002-5616-3963

Mr Shaik Tanveer Fathe Ahamed
Northern Tools and Equipment, Senior Front-End Developer
ORCID: 0009-0006-2192-7069

Abstract
The convergence of the Internet of Things (IoT) and Artificial Intelligence (AI) has transformed traditional agricultural practices by enabling real-time crop monitoring, intelligent decision-making, and optimized resource utilization. This paper presents a hybrid IoT–AI framework for real-time crop monitoring and precision farming, aiming to enhance productivity, sustainability, and efficiency in agricultural management. The proposed framework integrates an IoT-based sensor network with AI-driven analytics to acquire, process, and interpret multi-modal agricultural data. IoT devices deployed in the field capture essential parameters such as soil moisture, temperature, humidity, pH, and light intensity. The collected data is transmitted via a cloud-based platform for centralized storage and processing. The AI module incorporates machine learning and deep learning models to perform key tasks such as crop health assessment, anomaly detection, disease recognition, and yield prediction. A decision-support system (DSS) translates these insights into actionable recommendations for irrigation scheduling, nutrient optimization, and pest control. Experimental validation using real-time field data and simulation results demonstrates the framework's superior accuracy, scalability, and responsiveness compared to conventional monitoring approaches. Furthermore, the proposed system supports predictive analytics, ensuring timely interventions that minimize resource wastage and improve yield quality. Overall, this hybrid IoT–AI framework serves as a robust and intelligent platform for promoting sustainable, data-driven, and precision-oriented farming practices, offering a promising direction for the future of smart agriculture.
Keywords: IoT-based Agriculture; Artificial Intelligence; Precision Farming; Real-Time Crop Monitoring; Smart Sensors; Deep Learning; Machine Learning; Cloud Computing.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PREDICTIVE ANALYTICS FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

Astha Bagjilewale
VIT Bhopal Unıversıty

Abstract
Sustainable agriculture and meals security are increasingly more essential within the context of climate variability, resource constraints, and developing worldwide populations. This takes a look at gives a predictive analytics framework designed to help records-pushed decision-making in agriculture through leveraging diverse datasets, which include soil houses, crop health signs, meteorological conditions, and pest dynamics. advanced system learning models are employed to forecast crop yields, discover early-level illnesses, and optimize useful resource usage, thereby enhancing each productiveness and environmental sustainability. The proposed approach demonstrates massive capability to tell precision agriculture practices, lessen waste, and improve resilience towards unfavourable situations. via integrating real-time records from sensors and aerial imaging technology, this system provides actionable insights for farmers, policymakers, and stakeholders, contributing to more efficient and sustainable food manufacturing systems that deal with both present and future meals safety challenges.
Keywords: Predictive Analytics, Sustainable Agriculture, Food Security, Precision Agriculture, Machine Learning, Crop Yield Forecasting, Disease Detection, Resource Optimization, Drone Imaging, Data-Driven Agriculture

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

THE LAND REFORM POLICY OF THE REPUBLIC OF VIETNAM GOVERNMENT IN SOUTH VIETNAM (1955-1963)

Dr. Duong To Quoc Thai
Dong Thap University
ORCID: 0009-0008-1929-3751

Nguyen Thanh Tuan
Vinh Nhuan Middle and High School
ORCID: 0009-0005-1585-4812

ABSTRACT
The post Geneva Accords context of 1954 marked the temporary division of Vietnam at the 17th parallel, leading to the establishment of two opposing political entities. In the South, the Republic of Vietnam was formed under U.S. sponsorship, led by Ngo Dinh Diem. Aiming to consolidate its fragile political foundation, suppress the national liberation movement, and implement its goal of "rural pacification," the RVN government promulgated the Land Reform Policy (1955-1963) as a strategic "national policy."
The official objectives of the policy were to placate the rural masses through "reducing land rent" and "redistributing land," thereby addressing social inequality, increasing agricultural productivity, gaining the hearts and minds of the peasants, and securing rural control. However, the implementation revealed significant limitations. In reality, the amount of land redistributed to poor peasants was negligible, while the policy preserved and even legitimized the status of large landowners and an emerging class of medium landlords. This not only failed to resolve class contradictions but further deepened grievances over land issues, resulting in the erosion of public trust and the policy's inability to win peasant support. Therefore, the study of "The Land Reform Policies of the Republic of Vietnam Government in South Vietnam (1955–1963)" is crucial, offering insights into the model of neocolonial governance and the agrarian economic history of modern Vietnam.
Keywords: land reform, agriculture, Republic of Vietnam, land expropriation, tenant regulations, revolution, peasants, land ownership.

1. INTRODUCTION
The post Geneva Accords context of 1954 marked the end of French colonialism and the temporary division of Vietnam into two opposing political entities at the 17th parallel. In the South, with rapid U.S. intervention, the Republic of Vietnam (RVN) was established under the leadership of Ngo Dinh Diem. This fledgling government faced dual challenges: consolidating its internal authority and curbing the expanding national liberation movement that was gaining strong momentum in rural areas.
In its effort to control the countryside and pursue the strategic objective of "rural pacification," the RVN introduced a series of key economic policies, most notably the Land Reform Policy (1955-1963). This policy was regarded as a "national policy" designed to quell popular unrest through promises of land rent reduction and land redistribution, with the dual aims of mitigating social injustice, boosting agricultural production, and winning peasant support for the Saigon regime.
However, the policy's implementation revealed inherent shortcomings: the amount of land distributed to poor peasants was insignificant, while the policy effectively maintained and legitimized the power of large landowners.

This reality exacerbated social conflicts over land, further deepening class tensions and fueling discontent. Consequently, the erosion of trust contributed to the failure of the Land Reform Policy to rally peasant support.

Thus, this study seeks to deeply analyze the divergence between the official goals and actual outcomes of the *Land Reform Policy (1955-1963)*. The article aims to elucidate the mechanisms of policy failure and its socio political consequences for the stability of the Republic of Vietnam, thereby offering a representative case in the history of land policies within the conflictual context of the Cold War era.

2. RESEARCH METHODS

This study employs a combined methodological approach, primarily based on the Historical Method and the Logical Method, supplemented by the Statistical Method. Specifically:

The Historical Method serves as the core approach to reconstructing and interpreting the events and policies of the "Land Reform" implemented by the Republic of Vietnam (RVN) government in South Vietnam during the period 1955-1963, grounded on synthesized historical data.

The Logical Method functions as an essential analytical bridge for examining various sources (decrees and ordinances of the RVN concerning land tenure) and official reports (including statistics on land distribution and compensation). Document analysis enables the comparison between the government's declared objectives and its actual legal framework, thereby clarifying structural limitations. This process allows the author to scientifically assess the contradiction between the proclaimed goals and the counterproductive outcomes of the RVN's Land Reform Policy (1955-1963).

The Statistical Method provides a quantitative tool for processing and refining key evidence and data related to land rent and agricultural output in the period 1955-1963, illustrating the escalation of "social contradictions" and "peasant dissatisfaction."

In addition to these primary methods, this study also employs comparative, deductive, inductive, and synthetic approaches throughout the research process.

3. RESEARCH CONTENT

3.1. Contents and Implementation of the Land Reform Policy (1955-1963)

Major Legal Documents

After expelling the French, the Republic of Vietnam faced the task of stabilizing the socio economic situation. As the vast majority of the population were peasants and the economy depended heavily on agriculture yet land distribution remained highly unequal the Diệm administration enacted a series of "land reform" laws under particular historical circumstances.

During the resistance war, most large and medium landlords fled to Saigon, Cho Lon, and other urban centers, leaving hundreds of thousands of hectares of land unattended in rural areas. This abandoned land, along with French owned estates, had been temporarily allocated to poor peasants by the revolutionary authorities. By the time peace was restored, 564.547 hectares of land in the South had been distributed to 527.163 individuals (Institute of Economics under the State Science Commission, 1960, p. 305)

After the establishment of the Republic of Vietnam, between 1955 and 1956, the U.S. sent an advisory mission led by Wolf Ladejinsky (chief advisor on land reform) to assist the RVN government in drafting land policies. *Cong Luan* newspaper (7 July 1969) reported that from 1955 to 1960, the U.S. had provided USD 12 million in aid to support the RVN's land reform initiatives.

President Ngo Dinh Diem subsequently issued three decrees regarding the implementation of the "land reform" policy. These decrees primarily regulated the relationship between landlords and tenant farmers and imposed limits on the amount of land that landlords could legally retain.

Decree No. 2 (8 January 1955) amended Decree No. 20, which prescribed the "tenant regulations" (Reform, Ministry of Land and Land, 1960, pp. 91-95). Notably, Decree No. 2 essentially repeated the content of Decree No. 20 signed earlier by Bảo Đại, the former "chief of state," on 4 June 1953.

Under Decree No. 20, the maximum land rent and interest rate negotiated between landlords and tenants was uniformly set at 15% of the harvest. It also prescribed the use of Type A tenancy contracts for actively cultivated land. Decree No. 2 introduced several amendments as follows:

Type A Contract (white colored): Minimum land rent: 15%, maximum: 25% of the harvest. Lease term: 5 years, automatically renewable upon expiration.

Type B Contract (pink colored): Applied to abandoned land.Minimum term: 3 years, xtendable to 5 years if the landlord is absent (same as Type A). Tenant obligations were eased: year 1: exempt from rent, year 2: pay ½ rent, year 3: pay ¾ rent. In return, landlords were exempted from land tax for 3 years.

Type C Contract (blue colored): Applied to abandoned land where the landlord was absent. The Village Council represented the absent landlord in contracting with tenants[1]. Duration: 3 years, extendable to 5 years if the landlord remained absent.

As of December 31, 1968, a total of 662.800 tenancy contracts of types A, B, and C had been signed between landlords and tenant farmers and registered with the Communal Administrative Committees, covering an area of 1.362.832 samples.

Contract type	Contract number	Area (acre)
Type A	494.934	909.077
Type B	77.348	219.151
Type C	90.518	238.604
A+B+C	662.800	1.362.832

Nguồn: (Dang Ngoc Van, 1969, p. 27)

Overall, the Ngo Dinh Diem administration issued Decree No. 2 with several objectives: to regulate the relationship between landlords and tenant farmers; to improve tenants' living conditions; to guarantee the right to cultivate land; to re establish land rent rates based on the principle of shared benefits; to create opportunities for tenants to become landowners of the plots they cultivated; and to facilitate the reclamation of abandoned land.

Decree No. 7 (February 5, 1955), which "prescribed conditions for the reclamation of abandoned and uncultivated land (replacing the annulled Decree No. 22)")" (Reform, Ministry of Land and Land, 1960, pp. 91-95), stipulated that land left uncultivated during the cropping season must be allocated to tenant farmers under the following conditions: exemption from land rent in the first year, payment of half rent in the second year, and three quarters rent in the third year. The duration of the tenancy contracts followed the same provisions as Decree No. 2 and Decree No. 20, with the possibility of renewal. Tenants had the right to return the land, provided that they notified the landlord six months in advance.

[1] A landlord was considered *absent* if he failed to submit the required declaration within the specified period (from January 30, 1955 to March 1, 1955), stating his intention to cultivate or re-cultivate any abandoned land. *Circular No. 10-CN, dated 9 February 1955.*

If the landlord wished to reclaim the land (i.e., not renew the contract), he was required to give the tenant three years' advance notice.

During the resistance war for independence, an estimated 500.000 hectares of rice fields had been abandoned (with no landlords present to assert ownership). Much of this land belonged to medium landlords (owning 5-10 hectares) and large landlords (owning 50 hectares or more), who fled rural areas to avoid intimidation by Viet Minh (Communist) resistance forces. Because these landlords left and were no longer present, ownership of the abandoned land reverted to the state, and local authorities redistributed it freely to tenant farmers. Through these measures, a significant portion of abandoned land was brought back under cultivation. Between 1955 and 1959, the total number of Type B and Type C contracts signed for land reclamation increased to a considerable figure as follows:

Year	Contract type B	Contract type C
1956	27 790	34 438
1957	68 362	76 487
1958	79 549	92 537
1959	90 252	109 939

Nguồn: (Dinh Cong Dắc, 1970, p. 21)

To contribute to the development of agriculture and rural areas, the government also allowed tenant farmers who had previously followed the revolutionary side to continue cultivating the plots of land that the revolution had allocated to them during the war. Rents and tenancy rights were now recognized and guaranteed by the government. Likewise, abandoned public lands were also to be assigned to tenant farmers for cultivation under the same conditions.

One year after the application of the tenancy regulations, President Ngo Dinh Diem promulgated Decree No. 57 on October 22, 1956, "regulating land reform" (Reform, Ministry of Land and Land, 1960, pp. 91-95). According to this decree, landlords were allowed to retain a maximum of 100 sample, of which 30 sample had to be directly cultivated, while the remaining 70 sample had to be leased to tenant farmers under the tenancy regulations. Any area beyond that limit would be subject to expropriation (either by voluntary sale or by selling it to the state, which would then resell it to those in need of land for cultivation). In total, "2.033 landlords owning 425.000 sample were affected. In addition, 245.000 sample belonging to 430 landlords of French nationality also fell into the category of lands that had to be transferred to the government." However, in reality, "by 1959, according to National Revolution, a Southern newspaper published on October 23, 1959, only 627 landlords had actually been expropriated, while the compensation paid had already reached 267,220,705 South Vietnamese đồng. According to *Le Observateur de la France*, published on July 23, 1959, only 40.000 hectares of expropriated land had been sold (just 5.7%) out of the area intended for redistribution to 20.000 farmers" (Institute of Economics, State Committee of Science, 1960, p. 305).

Such figures alone reveal the exaggerated and deceptive nature of the so-called "landlord expropriation" policy of the Ngo Dinh Diem government. Under Decree No. 57, landlords possessing more than 100 sample were legally required to sell the excess to landless individuals. The government set out four priority categories for land recipients in the following order: those who had been tenants for more than two years, war veterans, refugees, and the unemployed. "In addition, they were allowed to retain an extra 15 hectares of ancestral land, and the area retained could be chosen at any location" (Tran Phuong, 1968, pp. 245-259). The surplus land would be purchased by the government at market price, with 10%

paid in cash and the remainder paid in bonds over twelve years at an interest rate of "3% per year" (Le Dinh Trong, 2020, p. 65). The expropriated land was resold to land-poor farmers with a maximum limit of 5 hectares, "except for farmers who had taken advantage of recent circumstances to unlawfully seize landlord property, refused to make contracts, or failed to pay rent or land taxes during the previous year, and did not settle these obligations before March 31, 1957," as stipulated in Article 11. Buyers were allowed to pay in installments over six years, during which time the land remained under government ownership. For ten years, recipients were prohibited from leasing, mortgaging, reselling, or transferring the land.

Under these decrees, all categories of land previously allocated temporarily by the Revolutionary authorities to poor peasants were now required to be formalized through tenancy contracts. In essence, Decrees No. 2 and No. 7 issued by Ngo Dinh Diem simply legalized the reappropriation by landlords and colonial interests of more than 750.000 hectares of land that the Revolution had distributed to peasants during the nine year resistance war against the French, pushing tens of thousands of farming families back into the position of tenant farmers, often with increased rent burdens.

In reality, Decree No. 57 affected only a little more than 2.000 landlords in the South, helping them resolve issues related to possessing land beyond the legally prescribed limits. The efforts of the Ngo Dinh Diem government aimed at alleviating the hardships of tenant farmers were divided into two closely related components. The first was to reduhce rents and ensure tenancy rights. The second was to redistribute land to those who had none. Decree No. 57 served mainly to placate the rising peasant movements and to cosmetically modernize the landlord system, while simultaneously preserving the landlord class as the socio political foundation of the U.S.supported neo colonial regime in South Vietnam.

As shown above, aside from the basic provisions, the U.S.-Ngo Dinh Diem decrees merely added or modified a few specific details. Compared with the decrees issued under the French-Bảo Đại government, they did not demonstrate any real progress or improvement. In other words, "the land reform program of the Ngo Dinh Diem administration failed to produce results particularly political results, which were its fundamental objective. Until the assassination of Ngo Dinh Diem, land reform still did not resolve the essential issues of peasants and rural society" (Dang Phong, 2005, p. 833)

Strategic Objectives of the Policy

Political Objectives

The Land Reform Policy (LRP), implemented by the Saigon regime amidst escalating ideological and military conflict, transcended conventional economic concerns and was framed as a core political strategy and an instrument for regime preservation. It was explicitly designed to achieve three interrelated objectives: neutralize Communist insurgency leverage, cultivate a loyal and conservative social base, and establish a stable socio material foundation for local democratic governance.

Primarily, LRP functioned as a strategic counterinsurgency measure, predicated on the understanding that peasants comprising approximately 80% of the population holds a decisive role in this existential, life-and-death conflict. particularly as rural areas constituted the "springboard of revolution" in Communist guerrilla doctrine. The Communists had effectively mobilized peasant support by exploiting structural land inequalities, eliciting latent resentment, and propagating the slogan "the tiller shall have land," coupled with policies of property redistribution. In this context, the Nationalist land reform was introduced as a mechanism to contest ideological hegemony.

By operationalizing the principle of "propertizing the peasantry" converting tenant farmers and landless peasants into legally recognized landowners the regime sought to mitigate class antagonisms and replace previous "inhumane" practices with tangible support mechanisms, including equitable taxation, agricultural credit, and technical assistance. The immediate political objective was to instill a sense of "confidence in a brighter future" among rural populations, thereby integrating them into the nationalist fold, while simultaneously eliminating structural drivers of social conflict. If widely publicized, LRP was expected to induce defections from insurgent-aligned peasant combatants, undermining Communist manpower and morale, and contributing to enhanced rural security and political stability.

Beyond short term wartime exigencies, LRP constituted a long-term strategy for the consolidation of a socially and politically stable base. Historical evidence indicates that once the material and socio-psychological needs of the peasantry were met, they were likely to evolve into "a politically conservative constituency." Land ownership provided a strong incentive to protect accumulated labor and personal assets, fostering a class of "land-owning peasants" predisposed to oppose revolutionary disruption. Comparative historical examples including Japanese tenant farmers post 1946 reforms and Turkish peasants under Kemalist policies demonstrate that beneficiaries of land reform frequently adopted conservative political orientations to maintain acquired advantages. The Saigon regime envisaged LRP as a vehicle to transform the rural majority into a landed middle class, capable of resisting Communist infiltration while simultaneously reinforcing loyalty and legitimacy within the Nationalist political framework.

Finally, LRP was conceived as an essential material prerequisite for the development of democratic governance, ideologically positioned against Communism. The underlying premise was that "freedom and democracy are meaningful only when individuals possess fundamental property rights," which, in an agrarian context, are embodied in land ownership. Propertization of the peasantry constituted the foundational step for establishing economic security and enabling participatory democracy at the village and commune levels. Once peasants were "liberated from deprivation, hunger, and ignorance" through secure land tenure, they could engage more meaningfully in local electoral processes. By addressing individual and familial insecurities, LRP transformed rural political behavior from passivity to active civic participation. Accordingly, LRP represented not merely a redistribution policy, but a comprehensive strategy to consolidate nationalist ideology, aligning the economic interests of the rural majority with the survival of the anti-Communist state, thereby providing a durable foundation for a stable, equitable, and democratic society.

Economic Objectives

The Land Reform Policy (LRP), implemented by the Saigon regime, constituted a strategic macroeconomic intervention, aimed at addressing rural economic stagnation, boosting agricultural productivity, and establishing a material foundation for national industrialization. The policy's core economic objectives were pursued through two principal mechanisms: restructuring property relations to maximize agricultural output, and reallocating capital to stimulate domestic markets.

Firstly, LRP sought to dismantle the feudal agrarian structures that constrained productivity. Historical evidence indicates that under the ancien régime, peasant aspirations for smallholder status were systematically suppressed by excessive rent extraction sometimes up to 60% of crop yields and usurious lending practices. The absence of secure land tenure and cultivation rights produced widespread demotivation among tenant farmers, undermining care for farmland and agricultural investment.

By implementing the principle of "propertizing the peasantry," LRP transformed tenants into legitimate landowners, creating new economic incentives. This fundamental shift encouraged peasants to engage in intensive land management, adopt improved seed varieties, and apply fertilizers, resulting in increased yields and overall productivity. Furthermore, the abolition of land rents and reduction of financial burdens directly improved the living standards of millions of tenant households, effecting a redistribution of welfare from the landlord class to the productive rural population.

Secondly, LRP was positioned as a prerequisite for industrial development, operating through a dual mechanism that impacted both supply and demand within the evolving economy. On the demand side, increased income and crop yields enhanced peasant purchasing power, enabling investment in clothing, tools, and modern agricultural techniques, thereby generating a broad and stable domestic market for the nascent industrial sector. On the supply side, the policy strategically redirected the investment orientation of former landlords. Capital that had previously been confined to speculative landholding was compelled to enter commercial ventures and establish new industries. This not only liberated liquidity, promoting more dynamic capital flows, but also contributed to a more equitable distribution of income across social strata, enhancing overall economic capacity. The structural shift from an agriculture-centric economy to a diversified economic model where former landlords concentrated on business and industrial establishment was essential for national development. In this regard, LRP created an enabling economic environment, consistent with the United Nations Economic and Social Council's recognition of land reform as "an instrument for promoting economic development" and modernizing national production structures.

Social Objectives

The Saigon regime framed LRP as a strategic social intervention, aimed at realizing rural social justice while effecting a non violent social revolution, in stark contrast to the class-based struggle pursued by Communist insurgents. The policy's primary social objective was to eliminate entrenched inequalities in land and resources, thereby creating a more equitable, stable, and harmonious rural society. Achieving general prosperity required certain individuals to curtail property rights and "renounce privileges" derived from social status a fundamental principle observed in non Communist states to regulate property relations.

LRP operationalized social justice through state-mediated propertization, rather than expropriation or coercion. The government purchased surplus land beyond statutory limits from landlords and redistributed it to tenants aspiring to ownership, accompanied by financial assistance. This approach enabled the regime to redress social inequities without compromising the rights of either party, protecting both former landlords and tenants. The result was a "promising new breeze" that alleviated social grievances, fostering mutual understanding and social cohesion among rural populations.

A higher social objective was to enhance human dignity and eradicate social vices through land ownership. Secure tenure improved social relations, mitigated poverty and deprivation, and curtailed predatory behaviors of local elites. By creating conditions for peasants to become genuine landowners, LRP transformed passive rural communities into active participants in civic and communal life, consolidating social unity and order. Consequently, LRP functioned not merely as a redistributive measure, but as a comprehensive social restructuring policy, establishing a moderate, just society where the rights of all citizens were protected, social inequities were reduced, and Communist exploitation of rural grievances was curtailed thereby reinforcing the stability and legitimacy of the Nationalist regime.

Implementation Status and Limitations of the Land Reform Policy

The Land Reform Policy (LRP), implemented by the Republic of Vietnam under President Ngo Dinh Diem, represented a pivotal program aimed at addressing complex land tenure issues and entrenched class conflicts in Southern Vietnam after 1954. The strategy was structured around four fundamental objectives, encompassing not only economic aims but also significant social and political dimensions.

Firstly, the policy prioritized improving the livelihoods and legal status of tenant farmers through the introduction of a new tenancy framework. This framework guaranteed land use rights for a minimum of five years and capped rent at 25% of crop yields, thereby mitigating financial burdens and enhancing tenure security for cultivators. Secondly, the program sought to reclaim and cultivate land that had been abandoned or left uncultivated during the protracted wartime period.

The third, and central, objective was the limitation of private landownership and the propertization of the peasantry. A key mechanism involved compelling large landowners to sell excess holdings beyond 100 sample (approximately 16 hectares) to the government. These lands, once acquired, were redistributed and sold in smaller plots typically 3 to 5 sample to tenants and landless peasants, thereby transforming them from renters into bona fide landowners. This measure not only addressed the issue of property rights but also aimed to cultivate a stable rural middle class, serving as a social foundation for the regime. Finally, the policy sought to redirect capital investment by encouraging landlords to accept compensation in bonds, which were then intended for reinvestment in industrial ventures. This measure aimed to mobilize previously dormant financial resources tied up in landholdings, thereby facilitating industrialization and economic diversification.

The implementation of LRP unfolded in two distinct phases. The first phase, executed through key legal instruments such as Decrees No. 2 and No. 7 of 1955, focused on establishing and consolidating the tenancy framework. This framework clarified the legal relationship between landlords and tenants, protecting the latter from exploitative practices such as forced gifts or services, while also allowing exemptions from rent during crop failures. The second phase was marked by Decree No. 57, issued on October 22, 1956, which emphasized land redistribution through compulsory purchase of large estates and subsequent allocation to peasants.

In terms of outcomes, the policy achieved notable improvements. The tenancy framework contributed to enhanced living and working conditions for tenant farmers, providing a measure of economic security and stability. However, the overall impact remained modest relative to the scale and political ambitions of the program. The policy failed to fully satisfy the legitimate demands of the majority of rural populations and exhibited significant implementation gaps. These limitations arose not only from procedural weaknesses but also from broader political and macroeconomic pressures, which necessitated a critical reassessment. Policymakers recognized the need for a review and refinement of the policy framework, aimed at addressing these shortcomings and establishing a more effective legal and strategic foundation aligned with the country's social realities and developmental needs.

3.2. Impacts and Consequences of the Land Reform Policy

The Land Reform Policy (LRP), implemented by the Republic of Vietnam, particularly during the Diệm administration (1955-1956), through key legal instruments such as Decrees No. 2 and No. 7 (1955) and Decree No. 57 (1956), represented a significant effort to address the prolonged land crisis and consolidate political foundations in Southern Vietnam.

The policy was designed around four strategic objectives: improving the livelihoods and tenure security of tenant farmers; reclaiming and cultivating abandoned lands; propertizing the peasantry by expropriating estates exceeding 100 sample from large landowners; and redirecting landed capital toward industrial development to stimulate multi-sector economic growth.

Quantitative and Qualitative Impacts

Quantitatively, the program achieved modest but tangible results. The redistribution process involved 452.001 sample of land from 1,972 large landowners, converting 122.741 tenant farmers into smallholder proprietors (Dang Ngoc Van, 1969, p. 100) Tenure security was extended to 601.037 tenants, contributing to increased agricultural output and improved rural livelihoods.

Qualitatively, the establishment of the new tenancy framework stabilized production relations by capping rents at 25% of crop yields and guaranteeing a five year lease, thus shielding tenants from exploitative practices such as forced gifts or compulsory services. Furthermore, the policy introduced mechanisms to redirect capital by allowing large landowners to invest reform bonds in government established enterprises, providing an incentive to stimulate the national economy.

However, analyses indicate that the outcomes were limited and insufficient relative to the scale and political ambitions of the policy. Criticism arose that the government had been overly cautious in demanding greater sacrifices from the landed elite, which undermined the program's potential effectiveness.

Consequences and Limitations

The efficacy of LRP was significantly constrained by structural flaws and implementation limitations, resulting in negative socio political consequences and a failure to fully meet the expectations of the majority of landless peasants.

A major strategic shortcoming was the restricted scope of beneficiaries. The policy prioritized only contractually recognized tenants, thereby excluding a significant portion of truly landless laborers and those managing land under pre existing usufruct arrangements groups that were most in need of land. This exclusion generated perceived injustices within the peasant class, inadvertently providing the Communists with propaganda opportunities to undermine rural support for the regime. Additionally, uneven regional land allocation (e.g, 0.5 sample in the Central Region versus 1.5 sample in the South) exacerbated disparities; small plots in the Central Region were insufficient for subsistence, limiting the policy’s practical benefits.

The decision to expropriate only lands not directly cultivated by landlords created a significant legal loophole. Landowners circumvented the law by hiring labor while claiming direct cultivation, retaining substantial holdings. The absence of clear limits on retained land (e.g, suggested maximum of 10 sample) reduced the law’s rigor, maintaining large estates and diverting the policy from its redistributive goals.

Moreover, proposals to compensate displaced smallholders with land in other regions were largely impractical, as peasants were unwilling to relocate away from family and community networks, leaving local disputes unresolved and perpetuating instability.

The policy also exempted lands owned by religious organizations, notably 33.726 sample under Catholic possession (Stanford Research Institute, 1968, pp. 92-93)), which had sensitive political and social repercussions. This implicit preferential treatment was perceived as unjust, generating misunderstandings and threatening national cohesion during a period demanding unity.

In summary, the Land Reform Policy of the Republic of Vietnam reflected a strong commitment to addressing land issues, including provisions for compensation and installment payments to landlords. Nevertheless, due to government timidity, weak enforcement, and numerous legal and strategic loopholes, the program failed to fully satisfy the aspirations of the majority of landless peasants. The policy lacked the decisiveness and comprehensiveness required, necessitating a full reassessment to address deficiencies, restore prosperous rural livelihoods, and strengthen the foundations for a stable and productive national economy.

4. CONCLUSION

The land reform program implemented by the Republic of Vietnam, through Decrees No. 2 and No. 7 (1955) and Decree No. 57 (1956), represented a strategic intervention aimed at stabilizing rural areas, neutralizing the leverage of Communist resistance, and constructing a social base supportive of the National regime. The program extended beyond purely economic objectives, serving as a material foundation for democratic development and a mechanism to transform tenant farmers into a politically conservative class aligned with the regime. The government demonstrated a strong commitment to resolving the land crisis by expropriating estates exceeding 100 sample and converting distribution methods from installment-based sales to outright transfers.

However, a comprehensive analysis indicates that LRP failed to achieve the thoroughness and completeness necessary, resulting in profound structural limitations and consequences that significantly undermined its core strategic objectives:

First, social exclusion and strategic misjudgments regarding beneficiary selection represented the program's greatest limitation. The "land to the tiller" policy primarily targeted contractually recognized tenants while excluding a substantial population of truly landless laborers and those managing land under usufruct arrangements. This exclusion created inequities within the poorest strata, which has been characterized as a "major blunder," inadvertently providing Communists with propaganda opportunities to mobilize rural support. Consequently, the government was unable to cultivate a sufficiently broad socially conservative base to serve as a solid foundation for the regime.

Second, legal loopholes and lack of enforcement undermined the effectiveness of expropriation. The provision to expropriate only land not directly cultivated by landlords opened avenues for circumvention, as landowners could employ laborers while claiming direct cultivation to retain large estates. Ambiguities regarding the maximum allowable retained holdings further diluted legal rigor, resulting in expropriation outcomes that were disproportionate to the scale of the problem. In addition, impractical measures to address "indirect cultivation" and the unequal regional distribution of land (notably 0.5 sample in the Central Region, insufficient for subsistence) exacerbated local grievances and instability.

Third, the policy generated religious and social tensions. The failure to expropriate substantial lands held by religious organizations, particularly the Catholic Church, was perceived as inequitable, producing "harmful misunderstandings" and threatening national cohesion, directly conflicting with the policy's objective of consolidating societal unity.

In conclusion, although LRP achieved certain successes, such as stabilizing tenancy relations and propertizing segments of the peasantry, its design flaws and unintended consequences substantially weakened its overall effectiveness. The policy failed to address the fundamental problems of rural land tenure and peasant welfare, leading contemporary and later critics to conclude that it "yielded limited political results."

This necessitated a comprehensive reassessment of the existing land reform strategy to identify more effective and equitable solutions for stabilizing rural society and fostering sustainable economic and social development.

REFERENCES

Dang Ngoc Van. (1969). *Land reform issue in the Republic of Vietnam.* National Academy of Public Administration.

Dang Phong. (2005). *Vietnam's economy during the period1945-2000 tập II (1955-1975).* HA NOI: Social Sciences Publishing House.

Dinh Cong Dắc. (1970). *The issue of land reform and rural lifestyle.* National Academy of Public Administration.

Institute of Economics under the State Science Commission. (1960). *Vietnam Economy 1945-1960.* HA NOI: Truth Publishing House.

Institute of Economics, State Committee of Science. (1960). *Vietnam Economy 1945-1960.* HA NOI: Truth Publishing House.

Le Đinh Trong. (2020). *Agricultural economy of the Republic of Vietnam 1955-1975.* Social Sciences Publishing House.

Reform, Ministry of Land and Land. (1960). *Land Reform Law.* National Archives Center II documents.

Stanford Research Institute. (1968). California.

Tran Phuong. (1968). *Land Revolution in Vietnam.* HA NOI: Social Sciences Publishing House 1968, pp. 245-259.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

FORMULATION AND EVALUATION OF AN ANTIOXIDANT CLAY MASK CONTAINING AVOCADO LEAF *(PERSEA AMERICANA MILL.)* AND LEMON *(CITRUS LIMON L.)* EXTRACTS"

Arie Febrianto Mulyadi
Department of Agroindustrial Technology, Faculty of Agricultural Technology, Universitas of Brawijaya

Novia Trisna Rahmayanti
Department of Agroindustrial Technology, Faculty of Agricultural Technology, Universitas of Brawijaya

Sukardi
Department of Agroindustrial Technology, Faculty of Agricultural Technology, Universitas of Brawijaya

Abstract
Indonesia possesses a diverse range of medicinal plants, among which the avocado (*Persea americana* Mill.) is notable for its bioactive potential. Avocado leaves contain various phytochemical compounds, including saponins, alkaloids, tannins, flavonoids, polyphenols, and quercetin, exhibiting strong antioxidant activity with an IC_{50} value of 54.69 µg/mL. Lemon (*Citrus limon* L.) juice, rich in citric acid and vitamin C, also demonstrates significant antioxidant activity (49.593 µg/mL). Market evaluations have revealed that several commercial facial masks contain potentially harmful ingredients, emphasizing the need for safer natural alternatives.
This study aimed to determine the effect of different formulation ratios of avocado leaf extract and lemon juice on the physicochemical properties and antioxidant activity of clay mask formulations, and to identify the optimal formulation. Avocado leaves were extracted using the maceration method with 90% ethanol, and the obtained extract was combined with lemon juice in varying ratios (5:0 g, 4.5:0.5 g, 4:1 g, 3.5:1.5 g, 3:2 g, and 2.5:2.5 g) using a Completely Randomized Design (CRD). The formulations were evaluated for yield, moisture content, pH, antioxidant activity (DPPH assay), drying time, and specific gravity. The results indicated that the optimal clay mask formulation was obtained from the ratio of 4 g avocado leaf extract to 0 g lemon juice, which produced a yield of 91.88%, moisture content of 45.60%, pH of 6.57, IC_{50} value of 153.02 ppm (classified as weak antioxidant activity), drying time of 17 minutes, and specific gravity of 1.05 g/mL. The findings suggest that avocado leaf extract can be effectively utilized in natural clay mask formulations with favorable physicochemical characteristics and moderate antioxidant properties.
Keywords: clay mask, *Persea americana*, maceration, *Citrus limon*, antioxidant activity

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

PHOSPHORUS IN SOIL, CHALLENGES AND MANAGEMENT SOLUTIONS FOR ITS CONSUMPTION

Mohamad Jafari
Soil and Water Research Department, Hormozgan Agricultural and Natural Resources Research and Education Center

Abstract
Phosphorus is an essential macronutrient that plays a crucial role in various physiological and biochemical functions in plants. However, its availability in soils is often limited due to its low solubility and strong fixation. To mitigate these challenges, substantial amounts of phosphate fertilizers are applied annually, leading to environmental and health concerns. Surplus phosphorus can be washed away, leading to eutrophication of water bodies and adversely affecting aquatic organisms. Furthermore, phosphate fertilizers may contain harmful trace elements such as cadmium, arsenic, and lead, which can accumulate in the soil and enter the food chain, resulting in potential long-term health risks. The production of fertilizers also releases pollutants such as ammonia, nitrogen oxides, and fluorides, which can negatively impact air quality and public health. To address these challenges, innovative strategies have been developed. One effective approach involves using concentrated phosphorus solutions combined with organic acids, which can be diluted for use in foliar sprays or fertigation. These solutions ensure optimal pH levels, enhance the availability of phosphorus, and help prevent sediment accumulation. Liquid phosphorus fertilizers have demonstrated greater effectiveness compared to granular types, particularly in calcareous soils where calcium-phosphate precipitation limits availability. Controlled-release phosphorus fertilizers, designed to synchronize nutrient release with plant requirements, represent a significant advancement. Formulations that incorporate biopolymers show great promise for enhancing nutrient efficiency while minimizing environmental losses. Furthermore, converting industrial by-products into phosphorus fertilizers contributes to waste recycling and reduces reliance on mined phosphate. Precision agriculture technologies, such as satellite imagery and variable rate application, further improve phosphorus use efficiency by tailoring fertilizer application to specific soil and crop data. Together, these strategies foster more sustainable phosphorus management, balancing agricultural productivity with environmental stewardship.

Keywords: Controlled-Release Fertilizer ‹Environmental Impact ‹Nutrient Management ‹Precision Agriculture‹ Phosphorus

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

MICROPLASTIC POLLUTION: ENVIRONMENTAL CONSEQUENCES AND ECOLOGICAL DISRUPTIONS

Salome Bezarashvili
Department of Nutrition, Aging Medicine, Environmental and Occupational Health, Tbilisi State Medical University
ORCID: 0009-0005-1818-4359

Lali Bakradze
Department of Nutrition, Aging Medicine, Environmental and Occupational Health, Tbilisi State Medical University
ORCID: 0000-0003-3780-3416

Ketevan Murjikneli
Department of Nutrition, Aging Medicine, Environmental and Occupational Health, Tbilisi State Medical University
ORCID: 0009-0004-6046-3231

Nato Khunashvili
Department of Nutrition, Aging Medicine, Environmental and Occupational Health, Tbilisi State Medical University
ORCID: 0000-0001-9942-4943

Genadi Kverenchkhiladze
Department of Nutrition, Aging Medicine, Environmental and Occupational Health, Tbilisi State Medical University
ORCID: 0009-0008-7864-6406

SUMMARY
Microplastic pollution has emerged as one of the most significant environmental challenges of the twenty-first century. These minute plastic particles are now pervasive across all components of the biosphere—from marine and freshwater ecosystems to soils and the atmosphere—posing complex risks to ecological integrity and human well-being. This review synthesizes the current understanding of microplastic sources, transport pathways, biological interactions, and ecosystem-level effects, drawing on recent international research. It highlights the complexity of microplastic dynamics within natural systems and the interconnections among environmental contamination, biodiversity loss, and human exposure. The findings underscore the urgent need for coordinated policies, sustainable material innovation, and cross-disciplinary collaboration to mitigate the long-term consequences of microplastic pollution (Tuuri et al., 2023; Illuminati et al., 2024).

INTRODUCTION
Since the 1950s, global plastic production has expanded exponentially, surpassing hundreds of millions of tons each year. While plastics have revolutionized modern life, their durability and resistance to degradation have generated a new class of environmental contaminants: microplastics, defined as synthetic polymer particles smaller than five millimeters.

These particles are categorized as *primary microplastics*, intentionally manufactured for industrial or cosmetic applications, and *secondary microplastics*, derived from the fragmentation of larger plastic debris (Gao et al., 2024).

Due to their small size, microplastics can move easily across air, water, and soil systems and become bioavailable to a wide range of organisms. Once released, they persist for decades or even centuries, fragmenting further but rarely degrading completely. Over time, they accumulate in food webs, interact with co-contaminants, and disrupt essential ecological processes (Adeleye et al., 2024).

Recent studies have revealed the presence of microplastics even in remote environments such as mountain peaks, polar ice, and deep-sea sediments (Illuminati et al., 2024). These findings confirm that microplastic contamination has evolved from a localized issue into a truly global phenomenon. Understanding their origins, movement, and ecological effects is vital for designing effective mitigation and management strategies.

RESEARCH AND FINDINGS

Sources and Environmental Pathways

Microplastics enter the environment through numerous pathways. Major sources include synthetic textiles, tire wear, industrial abrasives, packaging materials, and personal care products. Secondary microplastics form through physical weathering, ultraviolet radiation, and microbial degradation of larger plastic items (Bagheri et al., 2024).

Atmospheric transport has recently been recognized as a major mechanism of global dispersion. Airborne microplastics are carried over long distances and deposited through precipitation or dry fallout, contaminating even pristine regions (Mutshekwa et al., 2025). These particles behave similarly to fine particulate pollutants, enabling transboundary movement beyond geographic or political limits.

In aquatic systems, microplastics are introduced via stormwater runoff, wastewater effluents, maritime traffic, and agricultural drainage. In soils, the application of sewage sludge and compost derived from urban waste contributes substantially to terrestrial contamination. Once deposited, microplastics interact with sediments, organic matter, and biota, influencing their persistence and potential for bioaccumulation (Maialen Palazot et al., 2024).

Environmental Distribution

Recent studies (2023–2025) consistently confirm the presence of microplastics across all major environmental matrices—marine, freshwater, terrestrial, and atmospheric (Tuuri et al., 2023; Marcharla et al., 2024). In aquatic environments, accumulation occurs in surface waters, sediments, and coastal areas, particularly near densely populated or industrial regions. Terrestrial ecosystems, once thought less vulnerable, are now recognized as major reservoirs due to the slow degradation of plastics and continuous anthropogenic inputs.

Soil contamination is especially concerning, as microplastics can alter soil texture, affect water retention, and disturb microbial communities critical for nutrient cycling (Yarahmadi et al., 2024). Such changes can reduce soil fertility and indirectly threaten agricultural productivity and food security. Atmospheric studies have identified microplastic fibers and fragments across continents, suggesting that plastic pollution has become part of a global biogeochemical cycle comparable to carbon or nitrogen (Illuminati et al., 2024).

Biological and Ecotoxicological Effects

An expanding body of research shows that microplastics cause diverse biological impacts across taxa. In aquatic organisms, ingestion of microplastics has been associated with reduced feeding efficiency, impaired growth, oxidative stress, and reproductive disorders (Malinowski et al., 2023). Physical injuries such as intestinal blockage or tissue abrasion often combine with chemical toxicity from plastic additives or adsorbed pollutants.

Microplastics also act as carriers for persistent organic pollutants (POPs), heavy metals, and pathogens. When ingested, these contaminants can be released within the digestive tract, increasing toxic exposure (Bagheri et al., 2024). Combined exposure to microplastics and co-contaminants often leads to synergistic toxicity, exceeding the effects of individual stressors (Li et al., 2025).

Both laboratory and field studies indicate that chronic exposure to environmentally relevant concentrations can disrupt reproduction and reduce population resilience. Although sublethal, such effects may accumulate over time, leading to ecosystem-level consequences.

Food Web and Ecosystem Impacts

The ecological consequences of microplastic pollution extend throughout entire food webs. Microplastics consumed by plankton, invertebrates, and small fish can be transferred to higher trophic levels (Gao et al., 2024). This trophic transfer facilitates not only the movement of particles but also the chemicals associated with them, raising concerns about biomagnification.

Experimental ecosystem studies show that microplastic contamination can alter community composition, favoring tolerant species over sensitive ones and reducing overall biodiversity (Tuuri et al., 2023). In aquatic systems, decreased grazing by zooplankton due to microplastic ingestion may disrupt phytoplankton dynamics, contributing to algal blooms or nutrient imbalances (Malinowski et al., 2023).

Sediment accumulation of microplastics modifies porosity and oxygen diffusion, influencing benthic nutrient cycling and habitat structure. These often-overlooked alterations can undermine key ecosystem services such as water purification and carbon sequestration (Yarahmadi et al., 2024).

Human Exposure and Societal Implications

Microplastics have entered human environments through ingestion, inhalation, and dermal contact. They have been detected in drinking water, seafood, table salt, and airborne dust. Although the full extent of health effects remains under investigation, potential risks include inflammation, oxidative stress, and the internalization of chemical additives or pathogens (Bel Hasssen et al., 2025).

Beyond health concerns, microplastic pollution poses socio-economic challenges. Industries such as fisheries, agriculture, and tourism experience losses linked to environmental degradation. Addressing these challenges demands systemic transformations in waste management, plastic production, and consumer behavior. International initiatives—including negotiations toward a United Nations Global Plastics Treaty—illustrate growing recognition of the issue as both an environmental and developmental priority (Bel Hasssen et al., 2025).

CONCLUSION

Microplastic pollution has become a defining environmental challenge of the Anthropocene, affecting systems from the molecular to the global scale. It undermines biodiversity, ecosystem functioning, and potentially human health.

Although research progress has been substantial, significant knowledge gaps persist—particularly regarding chronic low-dose exposure, interactions with co-contaminants, and long-term ecosystem resilience (Li et al., 2025).

Addressing this pervasive issue requires integrated and coordinated responses: reducing primary plastic inputs through policy reform, enhancing recycling and waste management, and fostering innovation in biodegradable and sustainable materials. Harmonized monitoring protocols and interdisciplinary research are essential for assessing ecological risks and guiding effective interventions.

Ultimately, combating microplastic pollution demands not only scientific and technological advances but also a fundamental societal transition toward sustainable production and consumption within planetary boundaries.

REFERENCES

Adeleye, A. T., et al. (2024). The unseen threat of the synergistic effects of microplastics and heavy metals in aquatic ecosystems. Environmental Science Reviews.

Maialen Palazot et al. (2024). Microplastic pollution in French soils – Summary report.

Bagheri, S., et al. (2024). Microplastics: Microplastics: Challenges and roles as a vector – A literature review. Aquaculture Reports.

Bel Hasssen, M., et al. (2025). Plastics pollution: pathways, impacts, and regulatory challenges in marine environments. Frontiers in Environmental Science.

Gao, S., et al. (2024). Trophic transfer and biomagnification of microplastics: Experimental and modeling perspectives. Marine Pollution Bulletin.

Illuminati, S., et al. (2024). Microplastics in bulk atmospheric deposition along the coastal region of Victoria Land, Antarctica. Science of the Total Environment.

Li, M., et al. (2025). A review on the combined toxicological effects of microplastics and their attached pollutants. Emerging Contaminants.

Malinowski, C. R., et al. (2023). Microplastics impact aquatic food web dynamics through reduced zooplankton feeding. Science of the Total Environment.

Mutshekwa, T., et al. (2025). Atmospheric deposition of microplastics in urban, rural, and forest environments. Environmental Monitoring and Assessment.

Tuuri, E. M., et al. (2023). How plastic debris and associated chemicals impact marine food webs and biota: A review. Science of the Total Environment.

Yarahmadi, A., et al. (2024). Microplastics and environmental effects: investigating the effects of microplastics on aquatic habitats and their impact on human health. Frontiers in Environmental Science.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

EFFICIENCY OF GROWING SWEET SORGHUM (SORGHUM SACCHARATUM PERS.) IN THE TURKESTAN REGION

Zubaidullayeva A.N.
Khoja Akhmet Yassawi International Kazakh-Turkish University
ORCID: 0009-0000-0373-370X

Summary
The article provides information that sugarcane (Sorghum saccharatum Pers.) is one of the crops that is water-efficient and resistant to drought, high temperatures and saline soils. Its deep and well-developed root system allows the plant to utilise water and nutrients in the soil efficiently. Sorghum is easy to propagate and its cultivation technology is not complex, so it can be grown even in adverse climatic conditions.
Sugarcane is used in sugar production and as a raw material for the production of biofuel (bioethanol). For the proper growth and development of sugarcane, it is necessary to correctly organise agronomic measures, such as preparing the field, proper organisation of agronomic measures, such as field preparation, seedling preparation and sowing methods, the application of mineral fertilisers, irrigation techniques, weed control, disease and pest management, harvesting, and so on, are important.
Scientific data show that specially selected varieties of sugar beet yield high crops in the southern regions of the country. By increasing the production of this crop, productivity and profitability in agriculture can be enhanced.
The research was conducted in the field at the Botanical Garden of the Institute of Botany and Phytointrospection, Almaty, Kazakhstan.
In the experimental results, the juice was extracted from the stems of the sugar beet varieties and calculated for each indicator separately. The sugar beet varieties Kazakhstan 20, Alga and Kazakhstan 16 were selected for the study; the weight of the stems per plant, the amount of juice extracted, and their sugar content were determined.
Keywords: drought-resistant, juice from the stems, natural sugar

Introduction

Relevance of the topic.

Sugar's high energy value and digestibility make it possible to replace it with other substances. Using sugar substitutes not only increases the nutritional value of flour products but also boosts the efficiency of the technological process, conserves resources, and allows the product to be marketed as dietary and functional. Therefore, the research of natural and environmentally friendly sugar substitutes is a relevant issue in this field. One of the sugar substitutes could be sugarcane juice, which is absorbed by the body better than regular sugar. Sugar beet syrup is sweet like regular sugar, has a liquid consistency with a viscosity similar to honey, a pleasant yet slightly sour taste reminiscent of vinegar, a rich brown color, and a low glycemic index.

Objective of the work: To study the biology of sugar beet under the climatic conditions of southern Kazakhstan for use in food production and to develop methods for increasing the soluble sugar content in its tuber.

Research objectives:

1. Study of sugar beet seed germination and determination of germination energy under laboratory conditions

2. To study the biology of the growth and development of different sugar beet varieties under the climatic conditions of southern Kazakhstan
3. Determining the dynamics and distribution patterns of soluble sugar concentration in the stems of different sugar beet varieties
4. Extraction and preservation of sap from plant stems

Research Object
The research object was the products of domestic sugar beet breeders.

Research Methods
- Field experiments;
- Phenological observation work;
- Surgical removal of vegetative organs.

Scientific novelty of the study:
For the first time, the yield and growth of various domestic sugar beet varieties under the southern soil-climate conditions of Kazakhstan, grown-growth and the inter-nodal concentration and distribution dynamics of soluble sugar content in the stem were determined. As the sugarcane approached the early flowering phase, the lower, the effect on sugar content was studied by removing the lower leaves, the flag leaf, and the ear.
Sugarcane is a food, fodder, and industrial crop. It is a warm-loving plant that is resistant to heat and drought. Sugar beet's ability to accumulate large amounts of soluble sugars makes it a potential raw material source for food production. Sugar derived from sugar beet is considered a dietary product suitable for patients with diabetes mellitus. The sweet syrup of the honeydew contains easily digestible microelements and vitamins not found in sugar beet or reed cane. These factors make date sugar unique and, in terms of its effects on the human body, resemble biological active supplements or honey.

Research and Findings
As for the research work:
Plant seeds were simultaneously sown in the soil prepared in early spring, and phenological and biometric monitoring was carried out. The obtained results were subjected to statistical analysis.
The important vegetative stages of plant growth and development up to full maturity, which depend on seed germination, were partially monitored in the study. The results of the research showed that, it was determined that some vegetative stages in the experimental varieties undergo slight changes due to differences in the. During the experiment, the mass emergence of the first shoots after seed sowing occurred on the 7th–8th day, although, it was determined that all varieties reached full emergence by the 10th day. According to the research results, the heading stage for all varieties coincided with the first days of July. Considering the obtained results, the varietal characteristics of the plants—namely the difference between early- and late-maturing types—only began to become apparent at the booting stage.

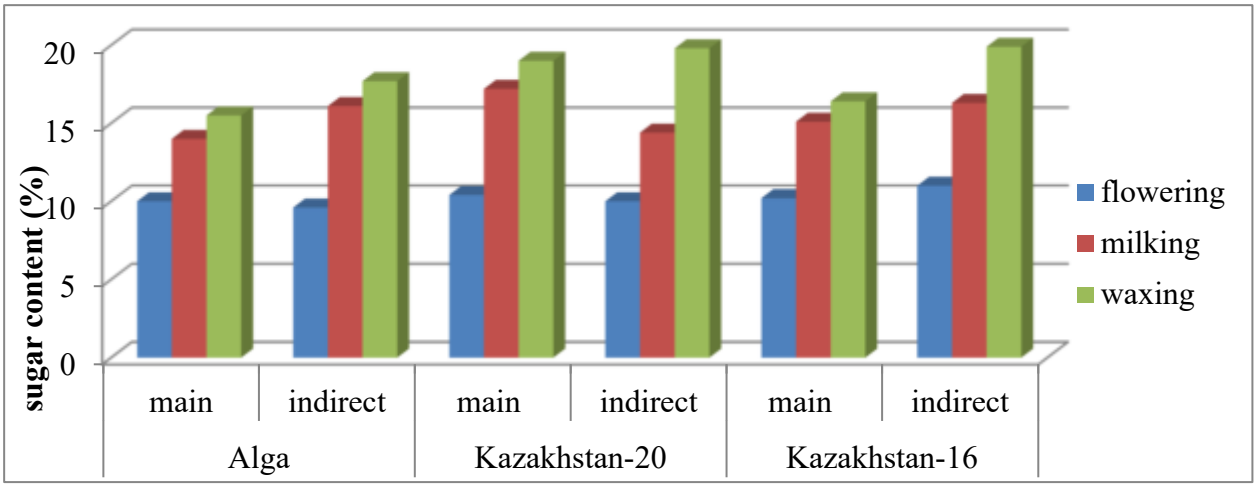


Figure 1- The growing season of sugar sorghum varieties, at each stage the content of soluble sugars in the 8th generation of Main and indirect stems, (%)

Among the varieties tested, the amount of soluble sugar in the internodes of the plant stem increased from the lowest internode, rising according to varietal characteristics up to internodes 6–9, in some varieties it further decreased, while in others it remained stable or fell early. For example, in the Alga variety, the soluble sugar content, although showing a low percentage in the lower internodes of the main and secondary stems, increases up to the 7th–9th internodes and then slightly decreases in the subsequent internodes. However, it was determined that in the Kazakhstan 20 variety, the soluble sugar content in the secondary and primary internodes increases up to the highest nodes. Similarly, the Kazakhstan 16 variety was also found to have its own distinct characteristics. For example, in this variety, the soluble sugar content in the secondary shoots is noticeably higher than in the main stem. This can be considered a biological characteristic of the variety, as this pattern is also maintained through the flowering, milking, and waxy stages. Analyzing the data in the table above, all the varieties tested show uniform growth rates at the 8th node during the milking, flowering, and waxing stages, reaching their highest rate at the waxing stage. Based on these data, it can be seen that the stage of maximum accumulation of soluble sugars in the sugar beet plant's stem is the waxy stage of the vegetative period (Figure 1).

In the next section of the scientific work, we decided to determine what proportion of the total plant biomass the sap in the stems of the aforementioned varieties constitutes. This is because important fructose from plant sap-glucose-rich bioactive substances can be obtained.

The extraction of juice from the stems of sugar beet varieties was carried out as part of the experiment, and the juice was pressed out, it was calculated for each individual indicator, i.e., the weight of the stem per plant, the amount of juice extracted from it, and its sugar content were measured.

Table 1 - The amount of juice output on the stem of sugar sorghum varieties (per plant)

Variety	**Weight of one plant (G)**	**Amount of juice from one plant (ML)**	**Sugar content (%)**
1	2	3	4
Kazakhstan 20	1023,3	578,3	21
Alga	1460	880	13
Kazakhstan 16	873,3	500	18

These figures were the basis for determining the weight of a sugarcane plant per plant, the weight of a plant per square meter (m2) of land, and the biomass it collects from a hectare of land, and calculating how much plant sap comes from the stem of a single plant, how much plant sap can be extracted from a hectare of land. In addition, we found that one plant contains 50-60% plant sap (Table 1).

As the results of the experiment show, the Alga variety accumulates the most biomass, that is, the weight of one plant is 1460 G, the amount of juice released from it is 880 ML. But, the sugar content shows only 13%. The second place is occupied by 20 varieties of Kazakhstan, the weight of one plant is 1023.3 G, the amount of juice from it is 578.3 ML. The sugar content shows 21%. And the amount of juice in the stems of the remaining 16 varieties of Kazakhstan ranged from these varieties.

So, the most profitable varieties for us are the Kazakhstan 20 Variety and the alga variety of domestic selection. After all, biomass shows the best indicators both in terms of storage and in terms of sugar content.

It is known that the juice of the sorghum plant, squeezed out of the STEM, has a very complex composition and is rich in mineral elements, consisting of basic monosaccharides.

Conclusion

Based on the results of the study, the following conclusions were drawn:

1. The experimental sorghum crops showed a high germination rate in laboratory conditions. It also turned out that the germination energy of plants varies between varieties. However, it has been established that the germination energy of all varieties increases over time.
2. All varieties of the sorghum crop in practice have passed all stages of the growing season in field conditions. It was found that among the varieties, their sugar content and maturation periods differ depending on the specifics of the variety.
3. Through the Agrobiological approach, various vegetative organs of high-sugar and productive varieties were surgically cut off. As a result of experiments, it was found that the amount of soluble sugar in the stem of plants directly depends on the destroyed vegetative organ in it. In it, it turned out that while the effect of the destruction of the lower leaves on the sugar content of the plant stem is very weak or unaffected, on the contrary, the destruction of the higher leaves has a somewhat negative effect on the soluble sugar content.
4. At the end of the experiment, it was found that the sugar content in plants with removed spikes increases somewhat, and it turned out that the increase in sugar content varies depending on the variety. Although the sugar content is increased, the amount of juice squeezed out of the stem of the plant is different in each variety. That is, through an agrobiological approach, it is possible to regulate the sugar content throughout the plant.

References

1. Folkertsma R., Frederick H., Raju G., Hash C. The pattern of genetic diversity of Guinea race Sorghum (L.) landraces as revealed with SSR markers. Theoretical and Applied Genetics, 2005, 111: 399–409.

2. Moraru G.A. The prospects for using sweet sorghum to ensure human subsistence. Agrocultura Moldova, No.1, 2000, pp. 16–19.

3. Matyushin B.A., Loktev V.I., Sukhopar A.N. Processing technology and application areas of sweet sorghum. In: Selection, cultivation technology, and application of sorghum and other crops. Saratov, 2006, pp. 124–127.

4. Makarov V.M. Results and prospects of sorghum crops in Kazakhstan. Bulletin of Agricultural Science of Kazakhstan, 2001, No.7, pp. 15–16.

5. Omarova A.Sh., Pryanishnikov S.N., Malinovskaya L.P. Grain sorghum as a promising feed crop for Kazakhstan. Bulletin of Agricultural Science of Kazakhstan, 2004, No.6, pp. 43–44.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS
November 03-05, 2025 / Yumurtalık, Adana, Türkiye
E-MAIL: iksad47@gmail.com
WEB: www.iksad.co.uk/tr/cukurova

CULINARY AND MEDICINAL USES OF WILD TRUFFLES IN THE MAÂMORA FOREST, MOROCCO

Anas Fellaki
Laboratory of Natural Resources and Sustainable Development, Faculty of Sciences, Ibn Tofail University
ORCID: 0009-0009-3191-2970

Mohamed Abourouh
Laboratory of Natural Resources and Sustainable Development, Faculty of Sciences, Ibn Tofail University

Houda ElYacoubi
Laboratory of Natural Resources and Sustainable Development, Faculty of Sciences, Ibn Tofail University

Asmaa ElYamani
Laboratory of Natural Resources and Sustainable Development, Faculty of Sciences, Ibn Tofail University

Atmane Rochdi
Laboratory of Natural Resources and Sustainable Development, Faculty of Sciences, Ibn Tofail University

ABSTRACT
Wild truffles represent an important source of food, medicine, and other biologically active compounds, and they are the subject of intensive study worldwide. The Maâmora Forest remains one of the regions where the traditional use of truffles is still preserved, offering a unique opportunity to investigate these cultural practices. The present research seeks to document the diverse and still insufficiently known traditional uses of wild truffles in this area.
Our ethnomycological survey was conducted through semi-structured questionnaires. The results revealed that two wild edible species are predominantly consumed fresh, often used as a substitute for meat, and incorporated into various traditional Moroccan dishes, such as tagine and *Rfissa*. In addition to their culinary role, both species exhibit significant medicinal applications, including the treatment of eye ailments (juice applied directly to the eyes), enhancement of the immune system, potential anti-cancer properties, anti cold, and use as sexual stimulants.
The quantitative analysis demonstrated that local populations regard wild truffles not only as a valuable source of income but also as important for their nutritional and therapeutic properties. Furthermore, the study documented preservation, preparation, and application practices that had not been recorded in earlier research. These findings contribute to the safeguarding of local traditional knowledge while providing a critical foundation for future studies in nutrition, pharmacology, and biodiversity conservation.
Keywords: Wild truffles, ethnomycology, traditional knowledge, anti-cancer, ethnomedicine.

T.C.
ÇUKUROVA ÜNİVERSİTESİ
Yumurtalık Meslek Yüksekokulu Müdürlüğü

2025 AİLE YILI

Sayı : E-12991152-903.07-1448065 21/10/2025
Konu : INTERNATIONAL ÇUKUROVA AGRICULTURE and TOURISM Kongresi Düzenleme Kurulu

DAĞITIM YERLERİNE

3-5 Kasım 2025 tarihlerinde Yumurtalık, Adana'da düzenlenecek olan " INTERNATIONAL ÇUKUROVA AGRICULTURE and TOURISM I" Kongresi düzenleme kuruluna üniversite akademisyen temsilcisi olarak aşağıda unvan ve isimleri yazılı olan öğretim elemanları görevlendirilmiştir.

GGereğini bilgilerinize arz/rica ederim.

DÜZENLEME KURULU
Lecturer Dr. Uğur KEKEÇ/Çukurova University
Lecturer Dr. Özgür YILMAZ/Çukurova University
Lecturer Dr. Bilge BOZ/Çukurova University
Lecturer Canani YALÇIN/Çukurova University
Lecturer Ayhan SAYĞI/Çukurova University

Dr. Öğr. Üyesi Hülya SAYĞI
Yüksekokul Müdürü

Dağıtım:
Sayın Öğr. Gör. Dr. Uğur KEKEÇ
Sayın Öğr. Gör. Dr. Özgür YILMAZ
Sayın Öğr. Gör. Dr. Bilge BOZ
Sayın Öğr. Gör. Canani YALÇIN
Sayın Öğr. Gör. Ayhan SAYĞI

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Kodu :*BSDP46YR42* Pin Kodu :11352
Belge Takip Adresi : https://turkiye.gov.tr/ebd?eK=5540&eD=BSDP46YR42&eS=1448065

Adres:Çukurova Üniversitesi Yumurtalık Meslek Yüksekokulu 01680 Yumurtalık/Adana
Telefon:0 (322) 671 26 73 Faks:0 (322) 671 26 74
e-Posta:yumurtalikmyo@cu.edu.tr Web:www.cu.edu.tr
Kep Adresi:cukurovauniversitesi@hs01.kep.tr
Bilgi için: Başak YENİDÜNYA
Unvanı: Veri Hazırlama ve Kontrol İşletmeni
Tel No: 0(322) 671 26 73

Bu belge,güvenli elektronik imza ile imzalanmıştır.

ÇUKUROVA INTERNATIONAL AGRICULTURE AND TOURISM CONGRESS

REF : Akademik Teşvik 10/12/2025

İLGİLİ MAKAMA

ULUSLARARASI ÇUKUROVA TARIM VE TURİZM KONGRESİ 03-05 Kasım 2025 tarihleri arasında Adana / Türkiye'de 12 farklı ülkenin (Türkiye-13, Diğer Ülkelerden-25) akademisyen/araştırmacılarının katılımıyla gerçekleşmiştir. Kongre 16 Ocak 2020 Akademik Teşvik Ödeneği Yönetmeliğine getirilen "Tebliğlerin sunulduğu yurt içinde veya yurt dışındaki etkinliğin uluslararası olarak nitelendirilebilmesi için Türkiye dışında en az beş farklı ülkeden sözlü tebliğ sunan konuşmacının katılım sağlaması ve tebliğlerin yarıdan fazlasının Türkiye dışından katılımcılar tarafından sunulması esastır." değişikliğine uygun düzenlenmiştir.

Bilgilerinize arz edilir,
Saygılarımla

Assist. Prof. Dr. Hülya SAYĞI
PRESIDENT OF CONGRESS