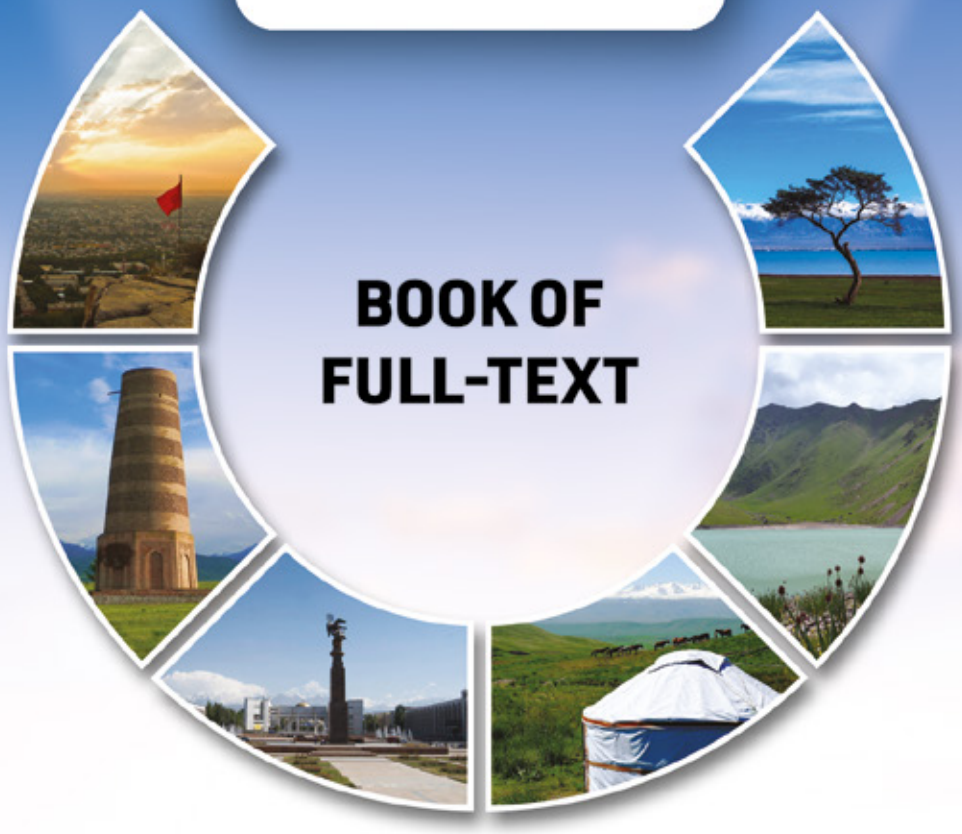
THE EURASIAN
AGRICULTURE AND NATURAL
SCIENCES CONGRESS
KYRGYZSTAN - 20 - 23 SEPTEMBER 2017



# BOOK OF FULL-TEXT

**The Eurasian**
**Agriculture and Natural Sciences Congress,**
Kyrgyzstan September 20-23, 2017

SELÇUK ÜNİVERSİTESİ

KONYA
NECMETTİN ERBAKAN ÜNİVERSİTESİ

agrieurasia.com /agrieurasia /agrieurasia

# THE EURASIAN AGRICULTURE AND NATURAL SCIENCES CONGRESS

KYRGYZSTAN - 20 - 23 SEPTEMBER 2017

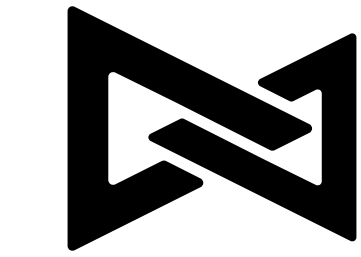
**BOOK OF FULL-TEXT**

**20-23 SEPTEMBER 2017**
Bishkek, KYRGYZSTAN

SELÇUK ÜNİVERSİTESİ

NECMETTİN ERBAKAN ÜNİVERSİTESİ

agrieurasia.com /agrieurasia /agrieurasia



**THE EURASIAN**
AGRICULTURE AND NATURAL
SCIENCES CONGRESS
KYRGYZSTAN - 20 - 23 SEPTEMBER 2017

**IMPRESSUM**
The Eurasian Agriculture and
Natural Sciences Congress,
2017

**EDITOR IN CHIEF**
Prof. Dr. Mustafa PAKSOY

**Website**
www.agrieurasia.com

**PREFACE**

The necessity of increasing agricultural production due to the rapid growth of the world population, increasing the importance of the solution of environmental problems caused by extreme chemical applications and the importance of new agricultural techniques development is increasing day by day. When increasing of the population and agricultural production need are considered together, the most intensive use of agricultural inputs is seen in underdeveloped or developing countries. Chemical fertilizers, pesticides and other technological developments are at the forefront of agricultural chemicals. This has created hesitations in humans, and people have begun to become conscious, eventually demanding healthy herbal and animal products. Scientists working on agriculture are working hard to overcome these concerns. Sustainable studies about agriculture and livestock and new methods developed from seed to table together with shows that healthy products can be grown. The fact that the farmers who make agricultural production cannot have the right information is also one of the important problems. In this context, the producers should be fully informed of the active participation of the producers and their individual experiences, and the producers should be made aware of the new techniques. As yield increases in plant and animal production, there is a decline in quality. The works about increasing plant and animal production in the coming years is likely to increase again. In addition, improvement of organic agriculture, sustainable agriculture and traditional agriculture practices, increase of environmental sensitivity and achievement of quality besides yield will be among the priority targets. The Eurasian Agriculture and Natural Sciences Congress (20- 23 September 2017) which is organized for discuss current scientific information, share and discuss the results of the completed scientific works, held in Bishkek where is the capital city of Kyrgyzstan hosted by Kyrgyzstan-Turkey Manas University and under the auspices of the Rector of Kyrgyzstan-Turkey Manas University Prof. Dr. Sebahattin BALCI, Deputy of Rector of Kyrgyzstan-Turkey Manas University Prof. Dr. Asılbek KURMIZAYEV, Rector of Selçuk University Prof. Dr. Mustafa ŞAHİN, Rector of Yüzüncü yıl University Prof. Dr. Peyami BATTAL and Rector of Necmettin Erbakan University Prof. Dr. Muzaffer ŞEKER

We wish to be a useful resource for everyone who loves agriculture and nature

Best regards
Prof. Dr. Mustafa PAKSOY
President of Organization Committee

## HONORARY COMMITTEE

**Prof. Dr. Sebahattin Balcı**
The Rector of Kyrgyz-Turkish Manas University, Bishkek-Kyrgyzstan

**Prof. Dr. Asılbek Kulmirzayev**
The Rector's deputy, of Kyrgyz-Turkish Manas University, Bishkek-Kyrgyzstan

**Prof. Dr. Mustafa Şahin**
The Rector of Selçuk University, Konya-Turkey

**Prof. Dr. Peyami Battal**
The Rector of Yüzüncü Yıl University, Van-Turkey

**Prof. Dr. Muzaffer Şeker**
The Rector of Necmettin Erbakan University, Konya-Turkey

## ORGANIZATION COMMITTEE

**Prof. Dr. Mustafa PAKSOY** Kyrgyzstan - Turkey Manas University, Bishkek / KYRGYZSTAN

**Prof. Dr. Suat ŞENSOY** Yüzüncü Yıl University, Van / TURKEY

**Prof. Dr. Önder TÜRKMEN** Selcuk University, Konya / TURKEY

**Prof. Dr. Hüseyin ÖĞÜT** Kyrgyzstan - Turkey Manas University, Bishkek / KYRGYZSTAN

**Prof. Dr. Cevat AYDIN** Selcuk University, Konya / TURKEY

**Prof. Dr. Tinatin DÖÖLÖTKELDİYEVA** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Prof. Dr. Canıbek KERİMALİYEV** Vice Minister of Agriculture of the Republic of Kyrgyzstan Bishkek Kyrgyzstan

**Doç. Dr. Kubanıçbek TURGUNBAEV** Kyrgyzstan National Agriculture University Faculty of Agriculture and Forestry Fruit and Forestry Department Bishkek Kyrgyzstan

**Yrd. Doç. Dr. Zeki Severoğlu**
Kyrgyzstan Turkey Manas University Faculty of Science Department of Biology Bishkek KYRGYZSTAN

**Yrd. Doç. Dr. İlhan Doğan** Kyrgyzstan-Turkey Manas University Faculty of Science Department of Biology Bishkek KYRGYZSTAN

**Dr. Nurlan MAMATOV** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Dr. Abdıkerim ABDULLAYEV** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Dr. Mahabat KONURBAYEVA** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Dr. Saykal BOBUŞEVA** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Dr. Muzaffer İPEK** Selcuk University, Konya / TURKEY

**Dr. Fatih ERDOĞAN** Directorate of Fruit Research Institute Eğirdir / ISPARTA / TURKEY

**Research Assist. Aybek KARABAYEV** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Research Assist. Tair ESENALİ UULU** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Salıbay BAYSALBAYEV** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Nazima SULAYMANOVA** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Acar KENEŞBEKOVA** Kyrgyzstan Turkey Manas University, Bishkek / KYRGYZSTAN

**Expert. Musa Seymen** Selcuk University, Konya / TURKEY

**Research Assist. Özlem ÇAKMAKÇI** Yüzüncü Yıl University, Van / TURKEY

## SCIENTIFIC COMMITTEE

Abai Sagitov (Prof. Dr.) Kazakh Research Scientific Institute for Plant Protection, Ministry of Agriculture, Kazakhstan
Abdullah Ünlü (Dr.) Batı Akdeniz Agricultural Research Institute, Turkey
Ahmet Aksoy (Prof. Dr.) Akdeniz University, Department of Biology, Turkey
Ahmet Alçiçek (Prof. Dr.) Ege University, Department of Animal Science, Turkey
Ahmet Kazankaya (Prof. Dr.) Yüzüncü Yıl University, Department of Horticulture, Turkey
Aitbaev Temirzhan Erkasovich (Prof. Dr.) Kazakh Research Institute of Potato and Vegetable Farming, Kazakhstan
Ali İslam (Prof. Dr.) Ordu University, Department of Horticulture, Turkey
Alireza Eivazi (Assoc. Prof. Dr.) Agricultural Research Center, West Azerbaijan Province, Urmia, Iran
Almagül Kakimjanova (Prof. Dr.)National Center for Biotechnology, Kazakhstan
Alovsat Guliyev (Prof. Dr.) Azerbaijan Institute of Soil Science and Agrochemistry, Azerbaijan
Amırov Bakhytbek Mustafauly (Assoc. Prof. Dr.) Kazakh Research Institute of Potato and Vegetable Farming, Kazakhstan
Amin İsmayilov (Prof. Dr.) Azerbaijan Institute of Soil Science and Agrochemistry, Azerbaijan
Andreas Leclerque (Dr.) Geisenheim University, Institute of Microbiology and Biochemistry, Germany
Anatolyi Zaryshnyak (Prof. Dr.) Vice President of the National Academy of Agrarian Sciences of Ukraine, Ukraine
Apostolos G. Papadopoulos (Prof. Dr.) Rural Sociology and Geography, Greece
Atilla Aşkın (Prof. Dr.) Süleyman Demirel University, Department of Horticulture, Turkey
Atilla Dursun (Prof. Dr.) Atatürk University, Department of Horticulture, Turkey
Ayhan Öztürk (Prof. Dr.) Selçuk University, Department of Animal Science, Turkey
Batukaev Abdulmalik (Prof. Dr.) Chechnya State University, Department of Agrotechnology, Russia
Bayan Alimgazinova (Prof. Dr.) Director of Department, KazAgroInnovation, Kazakhstan
Bayram Sade (Prof. Dr.) President of Karatay University, Turkey
Bekir Erol Ak (Prof. Dr.) Harran University, Department of Horticulture, Turkey
Bekmamat Jeenbaev (Prof. Dr.) Southern Federal University, Russia
Biryukova Olga Alexandrovna (Prof. Dr.) Southern Federal University, Russia
Boribay Sariyev (Prof. Dr.) T. Ryskulov New Economic University, Kazakhstan
Boris F. Aparin (Prof. Dr.) Saint Petersburg State University Institute of Earth Sciences, Russia
Burhan Arslan (Prof. Dr.) Namık Kemal University, Department of Crop Science, Turkey
Cengiz Sayın (Prof. Dr.) Akdeniz University, Department of Agricultural Economics, Turkey
Cennet Oğuz (Prof. Dr.) Selçuk University, Department of Agricultural Economics, Turkey
Cevat Aydın (Prof. Dr.) Selçuk University, Agricultural Machineries and Technologies Engineering, Turkey
Christoph Tebbe (Prof. Dr.) Technische Universität Braunschweig, Institute of Geoecology, Germany
Çimen Atak (Prof. Dr.) İstanbul Kültür University, Department of Molecular Biology and Genetics, Turkey
Cumhur Çökmüş (Prof. Dr.) Konya Gıda Tarım University, Turkey
Dietrich Stephan (Dr.) Federal Research Center for Cultivated Plants, Germany
Ernaz Altindağ (Assoc. Prof. Dr.) Düzce University, Department of Biology, Turkey
Ercan Ceyhan (Prof. Dr.) Selçuk University, Department of Crop Science, Turkey
F. Ekmel Tekintaş (Prof. Dr.) Adnan Menderes University, Department of Horticulture, Turkey
Fabio Rezzonico (Dr.) ZHAW School of Life Sciences and Facility Management, Switzerland
Fariz Mikailsoy (Assoc. Prof. Dr.) Iğdır University, Faculty of Agriculture, Turkey
Felix ARİON (Dr.) University of Agricultural Sciences and Veterinary Medicine, Romania
Fikrettin Şahin (Prof. Dr.) Yeditepe University, Department of Genetics and Bioengineering, Turkey
George Bird (Prof. Dr.) University of Michigan State, Department of Entomology, USA
George W. Sundin (Prof. Dr.) University of Michigan State, Department of Plant, Soil and Microbial Sciences, USA
Göksel Demir (Prof. Dr.) Kırklareli University, Faculty of Architecture, Turkey
Gulnara Dzhumaniyazova (Prof. Dr.) Academy of Sciences, Uzbekistan
Gülbübü Kurmanbekova (Assoc. Prof. Dr.) Kyrgyz Turkish Manas University, Department of Biology, Kyrgyzstan
Güldehen Bilgen (Prof. Dr.) Ege University, Department of Animal Science, Turkey
H. Avni Duyar (Prof. Dr.) Sinop University, Faculty of Fisheries, Turkey
Harun Aydın (Assoc. Prof. Dr.) Yüzüncü Yıl University, Faculty of Engineering, Turkey
Hüseyin Basım (Prof. Dr.) Akdeniz University, Department of Plant Protection, Turkey
Hüseyin Göçmen (Prof. Dr.) Akdeniz University, Department of Plant Protection, Turkey
Ilgiz Khabırov (Prof. Dr.) Bashkir State Agrarian University, Russia
İbrahim Işıldak (Prof. Dr.) Yıldız Teknik University, Faculty of Engineering, Turkey
İbrahim İlker Özyiğit (Prof. Dr.) Marmara University, Department of Biology, Turkey
İbrahim Jafarov Hasan (Prof. Dr.) Azerbaijan State Agrarian University, Azerbaijan
İbrahim Ortaş (Prof. Dr.) Çukurova University, Department of Soil Science, Turkey
İlker Kepenekci (Prof. Dr.) Gaziosmanpaşa University, Department of Plant Protection, Turkey
İsa Cavidoğlu (Prof. Dr.) Yüzüncü Yıl University, Department of Food Engineering, Turkey
İsmet Boz (Prof. Dr.) Ondokuz Mayıs University, Department of Agricultural Economics, Turkey
Jesus Santillano Cazares (Dr.) Autonomous University of Baja California, USA
Jumabekov Ermek Zhumabekovich (Prof. Dr.) Institute of General Genetics and Cytology, Kazakhstan
Kabyl Zhambakin (Prof. Dr.) Institute of Plant Biology and Biotechnology, Kazakhstan
Kairova Gulshara Nursapaevna (Prof. Dr.) Kazakh Research Institute of Horticulture and Viticulture, Kazakhstan
Kadirbay Çekirov (Assoc. Prof. Dr.) Kyrgyz Turkish Manas University, Department of Biology, Kyrgyzstan
Kazybaev Saule Zhambulovna (Assist. Prof. Dr.) Kazakh Research Institute of Horticulture and Viticulture, Kazakhstan
Kazım Çarman (Prof. Dr.) Selçuk University, Agricultural Machineries and Technologies Engineering, Turkey
Korobova Nataliya Aleksandrovna (Assoc. Prof. Dr.) Don Zonal Agricultural Research Institute, Russia
Kravtsova Natalia Yevhenivna (Assoc. Prof. Dr.) Southern Federal University, Russia
Lia Matchavariani (Prof. Dr.) Tbilisi State University, Georgia

## SCIENTIFIC COMMITTEE

M. Ercan Özzambak (Prof. Dr.) Ege University, Department of Horticulture, Turkey
M. Inam-ul-Haq (Prof. Dr.) Pir Mehr Ali Shah Arid Agriculture University, Pakistan
M. Murat Sipahioğlu (Prof. Dr.) İnonü University, Department of Plant Protection, Turkey
Madoka Nakai (Prof. Dr.) Institute of Agriculture, Tokyo University of Agriculture and Technology, Japan
Mahdi Arzanlou (Assoc. Prof. Dr.) University of Tabriz, Department of Plant Protection, Iran
Maher A. Abdel Hamid (Prof. Dr.) Cairo University, Department of Soil Science, Egypt
Mahmut Elp (Prof. Dr.) Kastamonu University, The Faculty of Fisheries, Turkey
Margarita Shternshis (Prof. Dr.) Novosibirsk State University, Russia
Medet Axmatov (Assist. Prof. Dr.) Gareev Botanical Garden of the National Academy of Sciences, Kyrgyzstan
Mehmet Rüştü Karaman (Prof. Dr.) Afyon Kocatepe University, Department of Medical and Aromatic Plants, Turkey
Meryem İpek (Prof. Dr.) Uludağ University, Department of Horticulture, Turkey
Mikhail Mazirov (Prof. Dr.) Russian State Agrarian University, Department of Soil Management and Statistics in Agronomy, Russia
Mohammad Babadoost (Prof. Dr. ) University of Illinois, Department of Crop Science, USA
Mustafa Önder (Prof. Dr.) Selcuk University, Department of Field Crops, Turkey
Murat Demirel (Prof. Dr.) Yüzüncü Yıl University, Department of Animal Science, Turkey
Murat Tunçtürk (Prof. Dr.) Yüzüncü Yıl University, Department of Field Crops, Turkey
Muslimov Nurjan Zhumartovich (Assoc. Prof. Dr.) Agro-Research Institute of Taraz Innovative Humanitarian University, Kazakhstan
Natalia Ryabushkina (Assoc. Prof. Dr.) Institute of Plant Biology and Biotechnology, Kazakhstan
Nazgül İmanberdiyeva (Assoc. Prof. Dr.) Kyrgyz Turkish Manas University, Department of Biology, Kyrgyzstan
Nedim Koşum (Prof. Dr.) Ege University, Department of Animal Science, Turkey
Nihat Akın (Prof. Dr.) Selçuk University, Department of Food Engineering, Turkey
Nikolai Patyka (Prof. Dr.) National University of Lafe and Environmental Science, Ukraine
Nuh Boyraz (Prof. Dr.) Selcuk University, Department of Plant Protection, TURKEY
Nuh Uğurlu (Prof. Dr.) Selçuk University, Department of Farm Buildings and Irrigation, Turkey
Nurbek Aldayarov (Prof. Dr.) Kyrgyz Turkish Manas University, Department of Biology, Kyrgyzstan
Nurbol Galiakparov (Assist. Prof. Dr.) Institute of Plant Biology and Biotechnology, Kazakhstan
Nurlan Balgabaev (Prof. Dr.) Kazakh Research Institute of Water Resources, Kazakhstan
Oh Seok Kwon (Prof. Dr.) Kyungpook National University, Republic of Korea
Olga Yerokhina (Assoc. Prof. Dr.) Kazakh Research Institute of Soil Science and Agrochemistry, Kazakhstan
Osman Gülşen (Prof. Dr.) Erciyes University, Department of Horticulture, Turkey
Ömer Zorba (Prof. Dr.) Abant Izzet Baysal University, Faculty of Engineering, Turkey
Özdemir Adızel (Assoc. Prof. Dr.) Yüzüncü Yıl University, Biology department, Turkey
Rolf O. Kuchenbuch (Prof. Dr.) Kyrgyz Turkish Manas University, Kyrgyzstan
Ruhsar Yanmaz (Prof. Dr.) Ankara University, Department of Horticulture, Turkey
Saglara Mandzhieva (Assoc. Prof. Dr.) Southern Federal University, Russia
Sarbakanova Sholpan Taupikovna, (Dr.) Kazakh Research Veterinary Institute, Food Safety Laboratory, Kazakhstan
Selman Türker (Prof. Dr.) Necmettin Erbakan University, Department of Food Engineering, Turkey
Semra Demir (Prof. Dr.) Yüzüncü Yıl University, Department of Plant Protection, Turkey
Serik Kenenbayev (Prof. Dr.) Kazakh Scientific Research Institute of Agriculture and Plant Growing, Kazakhstan
Serpil Önder (Prof. Dr.) Selçuk University, Department of Landscape Architecture, Turkey
Sinan Sefa Parlat (Prof. Dr.) Selçuk University, Department of Animal Science, Turkey
Sitpaeva Gulnara Tokbergenovna (Dr.) Institute of Botany and Phytointroduction, Kazakhstan
Soner Kazas (Assoc. Prof. Dr.) Ankara University, Department of Horticulture, Turkey
Sultan Çobanoğlu (Prof. Dr.) Ankara University, Department of Plant Protection, Turkey
Süleyman Soylu (Prof. Dr.) Selçuk University, Department of Field Crops, Turkey
Tamer Marakoğlu (Assoc. Prof. Dr.) Selçuk University, Agricultural Machineries and Technologies Engineering, Turkey
Tatiana Minkina (Prof. Dr.) Southern Federal University, Russia
Tatyana Patyka (Prof. Dr.) National University of Lafe and Environmental Science, Ukraine
Tinatin Doolotkedlieva (Prof. Dr.) Kyrgyz Turkish Manas University, Kyrgyzstan
Togzhan Mukasheva (Prof. Dr.) University of KazNU, Department of Biotechnology, Kazakhstan
Tomas Garcia Azcarate (Dr.) Senior Scientist in the Institute of Economics, Geography and Demography, Spain
Turgay Taşkın (Prof. Dr.) Ege University, Department of Animal Science, Turkey
Vahdettin Çiftçi (Prof. Dr.) Abant Izzet Baysal University, Department of Crop Sciences, Turkey
Vedat Türkoğlu (Prof. Dr.) Yüzüncü Yıl University, Department Chemistry, Turkey
Vicente Pallas(Prof. Dr.) Instituto de Biología Molecular y Celular de Plantas, Spain
Vitalij V. Lapa (Prof. Dr.) Institute for Soil Science and Agrochemistry, Belarus
Vladimir Androkhanov (Prof. Dr.) Novosibirsk Soil Research Institute, Russia
Volkan Altay (Assoc. Prof. Dr.) Mustafa Kemal University, The faculty of Science and Literature, Turkey
Yakov Pachepsky (Prof. Dr.) United State Department of Agriculture, USA
Yaroslav Gadzalo (Prof. Dr.) President of the National Academy of Agrarian Sciences of Ukraine of Ukraine, Ukraine
Yusuf Tunçtürk (Prof. Dr.) Yüzüncü Yıl University, Department of Food Engineering, Turkey
Yusuf Uzun (Prof. Dr.) Yüzüncü Yıl University, The Faculty of Pharmacy, Turkey

# CONTENTS

## CONTENTS


PAGE

**ORAL PRESENTATION FULL-TEXT** 17

**O-1 Vegetatıve and Phenologıcal Characterıstıcs of Promısıng Walnut (juglans regıa l.) Genotypes ın Uşak (Turkey) Provınce**
E. Yıldız, V. Okatan, A.M. Çolak, M.U. Türk..... **18-25**

**O-5 Determination of the Effects of Bacterial Fertilizer on Yield and Plant Growth Parameters of Tomato**
Atilla Dursun, Ertan Yıldırım, Metin Turan, Melek Ekinci, Raziye Kul, Fazilet P. Karagöz..... **26-31**

**O-9 Farklı Sıcaklık Uygulamalarının Mantarda ( Agaricus bisporus (Lange) Sing. ) Verim Ve Karpofor Özellikleri Üzerine Etkileri**
Fatih Erdoğan, Mustafa Paksoy, Musa Seymen, Önder Türkmen..... **32-37**

**O-10 Viability and Germination Characteristics of Gypsophila sp. Seeds Naturally Grown in Erzurum**
Hilal Beyza DURSUN, Fazilet P. KARAGÖZ..... **38-43**

**O-11 Solanaceae Familyasındaki Sekonder Metabolitler ve Nikotin Hakkında Bir İnceleme**
Kenan Sönmez, Şeküre Şebnem Ellialtıoğlu..... **44-51**

**O -12 Development of New Cherry Cultivars Using Different Breeding Methods**
Mehmet Baş, Ayşe Fidancı, Selma Özyiğit, Adnan Doğan, Burak Kunter..... **52-59**

**O-13 Comparıson of Usıng Dıfferent Harvestıng Methods on Walnut's (J. Regia L.) Fruıt**
M. Yalçın, K. Alibaş, Ü. Ertürk, Y. Akça..... **60-69**

**O-15 The Morphological and Physiological Response of Garnem Rootstock Against Drought Stress In Vitro Culture Conditions**
Muzaffer İPEK, Lütfi PIRLAK..... **70-75**

**O-16 Assessment Fungal Diseases onTomato Cultivation in Greenhouse and Determining Effectiveness of Some Fungicides Against Powdery Mildew(Leveillula taurica) in Antalya Province**
Özkan KOÇ, Nuh BOYRAZ..... **76-81**

**O-17 Evaluation of Chemical Control Approach, its Applications on Beans by Farmers and its effect on Human Health and Environment**
Seda AYDIN, Nuh BOYRAZ..... **82-85**

**O-18 The Effect of Methyl Jasmonate and Salıcylıc Acıd on Yıeld and Tuber Qualıty of Radısh (Raphanus Satıvus L.)**
O. Zambi, N. Akbudak, S. Özkan, A. Sahiner..... **86-91**

**O-21 Erciş Üzüm Çeşidine Ait Bir Yaşlı Dalların Besin Elementi İçerikleri**
N. Keskin, B. Kunter, S. Keskin, A. Doğan, C. Uyak, B. Arslan, R. İ. Gazioğlu Şensoy..... **92-97**

**O-23 Determination of Oyster mushroom (Pleurotus ostreatus) Postharvest Quality Losses in Modified Atmosphere Storage Conditions**
R. Yanmaz, S.S. Bilgin, S. Akan, N. Halloran..... **98-103**

**O-28 The Response of Sweet Cherry Sapling Applied Plant Growth Promoting Rhizobacteria (PGPR) Against Salinity**
Şeyma ARIKAN, Lütfi PIRLAK..... **104-109**

**O-35 Some Eco-friendly and RNAi-based Biotechnological Applications aganist Phytopathogenic Fungi**
Ö. Salman, N. Boyraz..... **110-117**

**O-36 The Effect of Pre-treating Two Eggplant (Solanum melongena L.) Genotypes with Hydrogen peroxide, Nitric oxide, and Salycilic acid Under Salt Stress Conditions**
G. Baysal Furtana, F. Öcal Özdamar, Ş. Ş. Ellialtıoğlu, R. Tıpırdamaz..... **118-125**

**O-47 Effect of Human Factor To Reallocatıon Phase of Land Consolıdatıon**
T. CAY, E. ERTUNC..... **126-133**

**O-53 Physıcal and Chemıcal Modelıng of Toxıc Electrıcal Insulatıng Lıquıds Decompositıon and Reductıon of Chlorıne-Contaınıng Substances Concentratıon in The Gasphase**
Zarlık MAYMEKOV, Damira SAMBAYEVA, Janarbek İZAKOV, Mirlan MOLDOBAYEV, Kubat KEMELOV..... **134-139**

**O-64 Economic Performance of Robotic Milking**
Aykut ÖRS, Cennet OĞUZ..... **140-147**

**O-67 Sivas Ekolojik Koşullarında Bazı Yem Bezelyesi Genotiplerinin Agro Morfolojik Özellikleri ve Külleme Hastalığına(Erysiphe polygoni) Karşı Reaksiyonları**
V. Yörük, T. Karaköy , A. Demirbaş, Y. Yanar..... **148-163**

**O-68 Analysıs of Fınancıal Performance in Daıry Enterprıses; The Case Study of Konya, Turkey**
C. OGUZ, A. YENER..... **164-171**

## CONTENTS

**O-69 Kırsal Kadınların Gıda Güvenliği Konusundaki Bilinç Düzeyleri: Hüyük İlçesi Örneği Konya, Türkiye**
C. OĞUZ, N. MERAKLI..... **172-177**
**O-70 Confectionary Pumpkin Farming and Economics in Turkey**
Musa Seymen, Hasan Arısoy, Atilla Dursun, Ünal Kal, Önder Türkmen..... **178-183**
Ü**O-77 Determination of the effect of humic acid on growth and development parameters of parsley (Petroselinumsativum Hoffm.) grown in boron soil**
Tuncay TURSUN, Şener AKINCI..... **184-189**
**O-81 Organic Livestock in Turkey**
İbrahim Ak..... **190-193**
**O-82 Effects of Hen Age on Egg Shell Color in Laying hens**
Vahdettin Sarıyel, Ali Aygün, İskender Yıldırım, Doğan Narinç..... **194-197**
**O-84 Ekolojik Açıdan Hz. Peygamber'in Sünnetine Bakış**
Fikret KARAPINAR..... **198-203**
**O-88 Doğacı Kelamcılara Göre Doğa, Bilgi Ve Akıl İlişkisi**
Ramazan ALTINTAŞ..... **204-211**
**O-89 Kırgızistan'ın Tarımsal Mekanizasyon Düzeyinin Coğrafik Bölgeler Açısından Değerlendirilmesi**
Tair ESENALİ UULU, Hüseyin ÖĞÜT, Tamer MARAKOĞLU..... **212-219**
**O-97 Investigation of Rheological Behavior of Kyrgyz Traditional Beverages Bozo and Maksym during Storage Period**
J. Iskakova, A. Deidiev, J. Smanalieva..... **220-225**
**O-98 КОЛИЧЕСТВЕННОЕ ОПРЕДЕЛЕНИЕ ОЧЕНЬ ТОКСИЧНЫХ ТЯЖЕЛЫХ МЕТАЛЛОВ - РТУТИ И МЫШЬЯКА В ВОДАХ РЕКИ НАРЫН.**
Кожобаев К.А., Асанов Б.Д., Исматиллаев С.П..... **226-233**
**O-100 ВЛИЯНИЕ ОТХОДОВ АК-ТЮЗСКОГО ГОРНО-ОБОГАТИТЕЛЬНОГО КОМБИНАТА НА ПОЧВЕННУЮ МИКРОФЛОРУ**
Тотубаева Н., Кожобаев К. , Абдыкадырова Рахат, Токпаева Жийде, Туратова Толгонай, Садыр уулу Эрулан..... **234-239**
**O-101 Micropropagation Studies on Critically Endangered Mediterranean Knapweed (Centaurea tchihatcheffiiFisch Et. Mey)**
Hanife Özler Arpaguş, F. Yeşim Okay, Cevdet Gümüş, Şeküre Şebnem Ellialtıoğlu..... **240-243**
**O-105 Intensification of fodder production through the planting of intermediate triticale**
Aibek Karabaev, Nurlan Mamatov, Mustafa PAKSOY..... **244-247**
**O-106 The Application Of Mathematical Methods In Improving The Quality Of The Lint Of Kyrgyz Breed On The Example Of Open Joint-Stock Company "Mis"**
Nurlan MAMATOV, Aibek KARABAEV, Kadyrbai Chekirov..... **248-253**
**O-118 Safflower (Carthamus Tinctorius L.) As A Food and Energy Plant and Turkey Example**
FikretAKINERDEM..... **254-259**
**O-122 Продуктивность пшеницы озимой в зависимости от обработки почвы в условиях Региона Центральной Анатолии Турции**
Н. Акгюн, Т. Маракоглу, К.Чарман..... **260-265**
**O-123 Determination of Yield and Yield Component of Red Lentil (Lens culinaris Medik.) Varieties Grown Under Harran Plain Condition**
Hasan ASLAN, Mahmut GAYBERİ..... **266-271**

## CONTENTS


PAGE

**POSTER PRESENTATION FULL-TEXT** 273

**P-1 Bazı Bitki Ekstraktlarının Farklı Nem Ve Sıcaklıkta Depolanmış Biber Tohumlarının Fide Gelişimine Etkisi**
B. B. KENANOĞLU, E. S. KOPTUR..... **274-279**

**P-2 MINERAL NUTRIENT STATUS OF ALMOND (PRUNUS AMYGDALUS L.) ORCHARDS GROWING IN THE UŞAK (TURKEY) PROVINCE**
E. Yıldız, V. Uygur..... **280-285**

**P-5 Effects of bacterial fertilizer on yield and yield parameters of cucumber in greenhouse conditions**
Ertan YILDIRIM, Atilla DURSUN, Metin TURAN, Melek EKİNCİ, Fazilet P. KARAGÖZ, Raziye KUL..... **286-291**

**P-13 Molecular Studies In Almond**
Başak ÖZDEMİR, Yeşim OKAY..... **292-299**

**P-14 A Socıal Responsıbılıty Project: Chıldren and Envıronmental Awareness**
Yeşim Okay, Şebnem Ellialtıoğlu..... **300-303**

**P-16 Effect of Dıfferent Nozzle Type on Dıcamba + Trıasulfuron Performance**
Derya ÖĞÜT YAVUZ, Özhan BOZ, M. Nedim DOĞAN..... **304-309**

**P-24 The effect of colchicine application to obtain chromosome duplication on the germination of some forage crops seeds.**
M. Bilgen, Z. Delibalta, A. Adak..... **310-315**

**P-26 Frezya (Freesia sp.) Kesme Çiçeğinin Yaş Depolama Öncesi ve Sonrası Farklı Konsantrasyonda Sakkaroz İçeren Vazo Solüsyonunda Vazo Ömrünün Araştırılması**
Ö. Dündar, H. Demircioğlu O. Özkaya..... **316-319**

**P-32 Determination of Suitable Extraction Method for the Available Iron (Fe) Content of Calcareous Soils**
Mehmet Rüştü Karaman, Aydın Adiloğlu, Ayhan Horuz, M.Şefik Tüfenkçi, Metin Turan, Sevinç Adiloğlu..... **320-325**

**P-33 Compairing of Geostatistical Interpolation Methods in Predicting of Spatial Variability of Available Phosphorus on the Wheat Field**
Mehmet Rüştü KARAMAN, Tekin SUSAM Ayhan HORUZ, M. Şefik TÜFENKÇİ, Aydın ADİLOĞLU..... **326-331**

**P-35 ОЗЕЛЕНЕНИЕ ПРОМЫШЛЕННОЙ ЗОНЫ ТЭЦ Г. БИШКЕК В КОНТЕКСТЕ УСТОЙЧИВОГО РАЗВИТИЯ**
Тотубаева Н. – Кыргызско-Турецкий университет Манас, Талайбекова Гулжан- Кыргызско-Турецкий университет Манас, Раимов Умутбек – Госагентство по охране окружающей среды и лесного хозяйства при ПКР ..... **332-335**

**P-45 İris Kesme Çiçeğinin Sakkaroz İçeren Vazo Solüsyonunda Vazo Ömrünün Araştırılması**
Ö.Dündar, H. Demircioğlu, O. Özkaya..... **336-338**

**THE EURASIAN**
AGRICULTURE AND NATURAL
SCIENCES CONGRESS
KYRGYZSTAN - 20 - 23 SEPTEMBER 2017

**20-23 SEPTEMBER 2017**
Bishkek, KYRGYZSTAN

# ORAL PRESENTATION

# O-1 VEGETATIVE AND PHENOLOGICAL CHARACTERISTICS OF PROMISING WALNUT (JUGLANS REGIA L.) GENOTYPES IN UŞAK (TURKEY) PROVINCE

E. Yıldız[1], V. Okatan[2], A.M. Çolak[1], M.U. Türk[1]

[1]Department of Horticulture, Faculty of Agriculture and Natural Sciences, Uşak University, Uşak, Turkey; [2]Sivaslı Vocational High School, Uşak University, Sivaslı, Uşak, Turkey; corrosponding author email: ercan.yildiz®usak.edu.tr

## Abstract

This study was conducted out to determine genetic variability and select superior walnut types within seedling population between 2015-2017 years in the Uşak province. 53 walnut types were selected according to lateral fruitfulness and late leafing times. The selected 53 genotypes were found to be in the range of 533 m to 1257 m altitude. Estimated ages of genotypes ranged from 15 to 100 years, and trunk diameters ranged from 15 cm to 96 cm. It was determined that the habitats of the trees were Upright (47%) and semi-Upright (38%). In selected walnut types the percentage of lateral bud fruitfulness was determined between 10% and 90%. The time of leafing in selected walnut types was detected between March 30 and April 14.

**Keywords:** Genetic resources, Morphological properties, Selection, Walnut

## INTRODUCTION

*Juglans regia* L. is native to a wide region extending from the Carpathian Mountains across Turkey, Iraq, Iran, Afghanistan and southern Russia, far away to China (Ercisli, 2004). Although 18 species are known where on earth *Juglans regia* L. is cultivated in Turkey. Walnut production in Turkey where inside of orchards and grown in garden borders scattered with walnut trees grown from seed are common practices (Sen, 1980). However, in the last few years there have been positive developments in the cultivation of walnuts. In recent years, walnut orchards established with the grafted nursery plants in the form of the closure is seen that production started to spread (Akca, 2001; Ciftci, 2004).

Continuous seed propagation in Turkey has given rise to a great number of seedling walnut trees, which represent valuable walnut gene resources. The number of native trees is estimated to be over 5 million and they possess large genetic variability in yield, nut and kernel characteristics, late bud breaking, late flowering, winter hardiness, tolerance to disease etc. (Sen and Tekintas, 1992). This high genetic variation of native walnut populations throughout the country represent good opportunities for walnut breeding to obtain new cultivars directly or to use them in cross breeding activity (Ercisli, 2004). These previous studies revealed that Turkish standard walnut cultivars have early leafing and low bud fruitfulness characteristics. Therefore, the obtain late leafing, lateral bud fruitfulness, nut quality and resistance against blight is an important breeding goals and these kind of genotypes could be present in natural walnut populations (Muradoglu, 2005; Akca, 2009).

In this research, within very dense population of the walnut trees grown from seed in Uşak district is intended to reveal the superior quality of genotypes. Therefore, it was aimed to determine lateral fruitfulness, late leaf break, regular yield and high fruit quality of walnut (*Juglans regia L.*) genotypes grown in the central district of Uşak/Turkey. These breeding criteria were previously highlighted by different researchers (Karadag and Akca, 2011; Keles et al., 2014; Beyhan et al., 2016).

## MATERIALS AND METHODS

### Material

This selection study was carried out in Uşak province and villages which are rich in walnut tree population. Pre-selection was done according to leafing time. The genotypes with early leafing were eliminated and late leafing trees were selected the first year. The trees with both late leafing and lateral bud fruitfulness also were selected in 2015-2017. The data on vegetative and phenology characteristics were obtained from 53 trees of *Juglans regia* L.

### Methods

The observations made in the field were: date of budbreak, lateral bud fruitfulness, tree vigour, tree growth habit, altitude of the trees' growing site, and tolerance to anthracnose, and codling moth. In this study, which lasted two years, genotypes were determined first year and samples were taken from these genotypes during the harvest season. After having analysed all these selected genotypes according to their fruit quality factors, 43 genotypes were eliminated first year and samples were taken again from other 53 genotypes for further analysis in harvest season of the second year. In the walnut genotypes included in the experiment, the date of budbreak was regarded as a period when the first leaves from buds started to separate in 80-90% of the branches (Sen, 2011). The shape of the growth of the tree has been evaluated in three forms: upright, semi-upright and broad. In walnut genotypes, fruit ratios in lateral branches were determined in 20 branches. Sensitivity of the trees to anthracnose (*Gnomonia leptosyla*) has been scored in four forms: high, medium, low and absent. The presence of codling moth (*Cydia pomonella*) in fruits was investigated in three forms: medium, low and absent. The altitudes and coordinates of the genotypes were determined by using GPS tool. The selections were named as Uşak.

## RESULTS AND DISCUSSION

As a result of the observations in the selection zone, 53 walnut selections were collected, based on possession of: late leafing, lateral fruitfulness, anthracnose, and codling moth tolerance. Then the selections were further evaluated according to their nut characteristics such as fruit weight, kernel percent, kernel color, shell thickness. The geographical coordinate, and the altitude at which selected trees and two years of observation for date of budbreak are presented in Table 1. The altitude at which selected trees were found varied from 533 m to 1257 m. Coordinates and altitudes of trees can change according to the point in their locations.

In this paper, walnut advence underlined late leafing, lateral bud fruitfulness, and tolerance of anthracnose and codling moth. Late leafing characteristics of walnut cultivars are very important if they cultivated in areas where late frosts are frequent. Late leafing is not common in Turkish walnut cultivars. However, it is a valuable characteristic. Cultivars of walnut that escape blight, insect pests, and early spring frosts are developed by selection for late leafing. In the selections leafing times of selected types are similar to each other. The time of leafing in selected walnut types was detected between March 30 and April 14. Uşak-18, Uşak-20 and Uşak-34 genotypes are a very late leafing type compared with the other selections in their original locations. This selections are 8 and 18 days late leafing compared with 'Chandler' and 'Sebin' in with a single 900 m altitude location, respectively. Leafing time of the all selected trees was later than the 'Sebin' commonly grown in this region. Also, leafing time of total 13 genotypes was 5 to 8 days later than 'Chandler' cv. grown in this region.

The results of some vegetative and phenological characteristics of selected walnut genotypes are given in Table 2. Estimated tree age of selections ranged from 15 to 100 years. The selected walnut trees had 15-90 cm trunk diameters. Akca and Ozongun (2004) found trunk circumferences of the selected types in the middle Black Sea region as 0.80 to 2.80 m. Aslantas (2006) also determined the trunk diameter of the evaluated 528 trees. In these trees, trunk diameter ranged from 0.7 to 4.3 m. In other study, made by Beyhan and Ozatar (2008), trunk circumferences of the selected trees were range from 67 to 150 cm.

**Table 1.** The location information and leafing time of selected walnut genotypes.

| No | Geographical Coordinate | | Altitude (m) | Leafing time | |
|---|---|---|---|---|---|
| | Longitude | Latitude | | 2016 | 2017 |
| UŞAK-1 | 38° 44' 09,23 | 29° 09' 69,68 | 604 | 6 April | 7 April |
| UŞAK-2 | 38° 38' 41,69 | 29° 14' 19,14 | 651 | 6 April | 4 April |
| UŞAK-3 | 38° 38' 95,53 | 29° 09' 83,83 | 577 | 10 April | 8 April |

| | | | | | |
|---|---|---|---|---|---|
| UŞAK-4 | 38° 19' 41,75 | 28° 54' 70,88 | 833 | 7 April | 9 April |
| UŞAK-5 | 38° 15' 48,15 | 28° 54' 37,59 | 995 | 2 April | 31 March |
| UŞAK-6 | 38° 15' 36,48 | 28° 54' 33,24 | 1013 | 10 April | 8 April |
| UŞAK-7 | 38° 16' 86,11 | 28° 58' 08,78 | 804 | 3 April | 1 April |
| UŞAK-8 | 38° 15' 01,97 | 28° 58' 83,59 | 828 | 6 April | 4 April |
| UŞAK-9 | 38° 16' 78,15 | 29° 07' 60,80 | 559 | 11 April | 9 April |
| UŞAK-10 | 38° 40' 28,69 | 29° 22' 06,65 | 885 | 7 April | 8 April |
| UŞAK-11 | 38° 38' 60,06 | 29° 28' 40,62 | 886 | 12 April | 10 April |
| UŞAK-12 | 38° 38' 65,88 | 29° 28' 62,80 | 892 | 3 April | 1 April |
| UŞAK-13 | 38° 37' 31,49 | 29° 22' 74,85 | 909 | 7 April | 5 April |
| UŞAK-14 | 38° 37' 22,16 | 29° 22' 77,49 | 903 | 5 April | 7 April |
| UŞAK-15 | 38° 37' 10,31 | 29° 19' 43,20 | 889 | 7 April | 9 April |
| UŞAK-16 | 38° 35' 47,20 | 29° 18' 49,82 | 1037 | 7 April | 7 April |
| UŞAK-17 | 38° 41' 94,76 | 29° 24' 16,83 | 955 | 12 April | 13 April |
| UŞAK-18 | 38° 42' 25,39 | 29° 24' 12,46 | 954 | 14 April | 14 April |
| UŞAK-19 | 38° 43' 27,30 | 29° 24' 57,18 | 983 | 12 April | 13 April |
| UŞAK-20 | 38° 44' 91,65 | 29° 24' 97,20 | 1038 | 14 April | 14 April |
| UŞAK-21 | 38° 45' 10,55 | 29° 25' 43,68 | 1104 | 10 April | 8 April |
| UŞAK-22 | 38° 48' 96,74 | 29° 26' 12,21 | 1078 | 9 April | 8 April |
| UŞAK-23 | 38° 47' 53,26 | 29° 33' 23,00 | 1257 | 9 April | 7 April |
| UŞAK-24 | 38° 47' 62,39 | 29° 34' 19,21 | 1105 | 12 April | 12 April |
| UŞAK-25 | 38° 42' 61,44 | 29° 31' 15,99 | 935 | 8 April | 10 April |
| UŞAK-26 | 38° 42' 73,20 | 29° 32' 98,67 | 938 | 8 April | 10 April |
| UŞAK-27 | 38° 42' 28,47 | 29° 32' 87,80 | 937 | 7 April | 9 April |
| UŞAK-28 | 38° 50' 3345 | 29° 54' 2301 | 1053 | 8 April | 10 April |
| UŞAK-29 | 38° 47' 5428 | 29° 54' 9221 | 1159 | 10 April | 12 April |
| UŞAK-30 | 38° 47' 6887 | 29° 54' 6730 | 1136 | 13 April | 13 April |
| UŞAK-31 | 38° 49' 2942 | 29° 52' 1020 | 1036 | 8 April | 10 April |
| UŞAK-32 | 38° 39' 5121 | 29° 46' 3349 | 955 | 8 April | 10 April |
| UŞAK-33 | 38° 39' 3501 | 29° 40' 0220 | 944 | 8 April | 10 April |
| UŞAK-34 | 38° 29' 4192 | 29° 39' 4241 | 909 | 14 April | 14 April |
| UŞAK-35 | 38° 28' 0173 | 29° 38' 3816 | 907 | 11 April | 11 April |
| UŞAK-36 | 38° 28' 0963 | 29° 38' 3837 | 905 | 7 April | 7 April |
| UŞAK-37 | 38° 28' 5140 | 29° 39' 0152 | 906 | 9 April | 10 April |
| UŞAK-38 | 38° 28' 6222 | 29° 36' 3339 | 793 | 9 April | 9 April |
| UŞAK-39 | 38° 34' 0445 | 29° 39' 1767 | 801 | 9 April | 9 April |
| UŞAK-40 | 38° 34' 1566 | 29° 39' 5634 | 808 | 11 April | 13 April |
| UŞAK-41 | 38° 34' 1067 | 29° 39' 5175 | 808 | 9 April | 11 April |
| UŞAK-42 | 38° 34' 0348 | 29° 39' 4506 | 805 | 12 April | 12 April |
| UŞAK-43 | 38° 34' 0173 | 29° 39' 4649 | 810 | 8 April | 6 April |
| UŞAK-44 | 38° 34' 0508 | 29° 39' 4106 | 806 | 11 April | 13 April |
| UŞAK-45 | 38° 34' 0770 | 29° 39' 3980 | 805 | 11 April | 11 April |
| UŞAK-46 | 38° 25' 3389 | 29° 12' 4196 | 709 | 30 March | 31 March |
| UŞAK-47 | 38° 25' 3361 | 29° 12' 4339 | 707 | 04 April | 5 April |
| UŞAK-48 | 38° 25' 3396 | 29° 12' 4945 | 704 | 02 April | 1 April |
| UŞAK-49 | 38° 25' 3366 | 29° 12' 5055 | 704 | 31 March | 1 April |
| UŞAK-50 | 38° 24' 2227 | 29° 18' 2151 | 568 | 31 March | 30 March |
| UŞAK-51 | 38° 24' 2416 | 29° 18' 2025 | 572 | 31 March | 31 March |
| UŞAK-52 | 38° 22' 3369 | 29° 18' 3973 | 533 | 02 April | 1 April |
| UŞAK-53 | 38° 22' 2333 | 29° 18' 4285 | 537 | 01 April | 1 April |
| Min | - | - | 533 | 30 March | |
| Max | - | - | 1257 | 14 April | |

It was determined that the habitats of the trees were upright (47%) and semi-upright (38%) in this study. Diferent to

our results, Akca and Ozongun (2004) and Karadag and Akca (2011) reported that the trees of selected walnut grown as spreading, at about 58% and 55% of the trees, respectively.

The ratio of lateral bud fruitfulness of selected types ranged between 10% and 90%. Uşak-4 and Uşak-20 genotypes had the highest rate (90%) of lateral fruits. Also, in Uşak-8, Uşak-17, Uşak-36 and Uşak-37 genotypes the percentage of lateral bud fruitfulness was determined 75% and over (Table 2). The most significant yield factor that can be manipulated through breeding is lateral bud fruitfulness, a bearing habit in which the current season's lateral buds produce flowers. Lateral fruitfulness is also related to precocity (Akca and Ozongun, 2004). Selection for this character is particularly important in Turkey where for most walnut varieties, only terminal and subterminal buds produce shoots which bear pistillate flowers. The genetic factors of yield for an individual tree include bearing habit, the number of flowering shoots, and the number of flowers per shoot. Fruit set, nut and kernel weight, and lateral fruitfulness are important in yield determination for walnut.

A high percentage of fruitful lateral buds is not common in old European and American cultivars, but new walnut cultivars are mostly laterally fruitful. For instance, some of the cultivars which are laterally fruitful include 'Chandler', 'Vina', and 'Sundland' from the UC-Davis (University of California, Davis) breeding programme (Hendricks et al., 1985) and 'Lara' from France, an open pollinated offspring of 'Payne' (Charlot and Germain, 1988). The ratio of lateral bud fruitfulness of 'Payne', 'Sundland', and 'Chandler' ranged from 80% to 87%. 'Chandler', 'Fernor', 'Fernette', 'Vina' and 'Tulare' have late leafing and lateral bud fruitfulness. The ratio of lateral bud fruitfulness of these cultivars ranged from 80 to 90%. Although there is no harmony in some literatures, in general, it is regarded that the percentage of lateral bud fruitfulness should be at 50 to 70% in new promising types that is late leafing. The ratio of lateral bud fruitfulness of 'Sebin' is 40%. The percentage of lateral bud fruitfulness of Turkish walnut cultivars, 'Sebin', 'Bilecik', 'Kaman-1', 'Sen-1', 'Yalova-1', 'Yalova-3' and 'Yalova-4' is 20 to 40% (Akca, 2009). The percentage of lateral fruitfulness ranged between 40 and 63% in the selected types in Çoruh valley (Aslantas, 2006), 10 and 70% in Middle of Karadeniz region (Akca and Ozongun, 2004). Lateral bud fruitfulness was found to be similar to previous studies by Akca and Sen (1994) and, Sutyemez and Caglar (2001).

There is a negative correlation between late leafing and lateral bud fruitfulness. Germain (1989) said that lateral bud fruitfulness was fairly correlated with early leafing. Uşak-17 and Uşak-20 genotypes for this character are particularly important in Turkey where many areas have late spring frost. Breeding of new walnut varieties is characterized by earlier fruiting, higher yield, lateral bearing, good adaptability to different ecological conditions and good fruit quality (Germain, 1988; Akca, 2009). Walnut productivity is highly dependent on the number of pistillate flowers on annual shoots, the number of pistillate flowers per fruit bud, the percent of fruit set, the number of nuts per cluster, nut size and kernel percentage (Serr, 1962; Forde, 1975; Akca, 2009).

The anthracnose (*Gnomonia leptosyla*) damage was seen all selected genotypes, expect Uşak-17, Uşak-20 and Uşak-37 genotypes. The presence of codling moth (*Cydia pomonella*) was found to be absent in about 64% of the genotypes in this study. Also, the codling moth damage was determined as medium in 9 genotypes (Table 2). Most selections had good field resistance against anthrachnosis, and codling moth despite there being many affected trees. In the years and locations that climatic conditions favoured the spread of these diseases. Serr (1964) suggested that the wild walnut forests of northeastern Turkey, which are growing under heavy rainfall, including summer rains, should be evaluated for potential anthracnose and codling moth resistance.

**Table 2.** Some vegetative and phenological characteristics of selected walnut genotypes.

| No | Estimated ages of tree | Trunk daimeter (cm) | Habitats | Lateral fruitfulness (%) | Anthracnose presence | Codling moth presence |
|---|---|---|---|---|---|---|
| UŞAK-1 | 30 | 35 | Semi-Upright | 10 | Low | Absent |
| UŞAK-2 | 50 | 48 | Upright | 15 | Low | Absent |
| UŞAK-3 | 25 | 35 | Upright | 10 | Low | Low |
| UŞAK-4 | 80 | 33 | Broad | 90 | High | Absent |
| UŞAK-5 | 15 | 18 | Upright | 50 | Low | Absent |
| UŞAK-6 | 40 | 38 | Upright | 70 | Low | Absent |
| UŞAK-7 | 20 | 22 | Semi-Upright | 45 | Low | Low |
| UŞAK-8 | 45 | 57 | Broad | 85 | Low | Absent |
| UŞAK-9 | 100 | 91 | Broad | 25 | Medium | Absent |
| UŞAK-10 | 35 | 38 | Semi-Upright | 15 | Low | Absent |
| UŞAK-11 | 30 | 35 | Semi-Upright | 50 | Low | Medium |
| UŞAK-12 | 55 | 48 | Semi-Upright | 15 | High | Absent |
| UŞAK-13 | 30 | 24 | Upright | 55 | Low | Absent |
| UŞAK-14 | 55 | 48 | Upright | 10 | Low | Medium |
| UŞAK-15 | 35 | 29 | Semi-Upright | 15 | Low | Absent |
| UŞAK-16 | 15 | 15 | Semi-Upright | 10 | High | Low |
| UŞAK-17 | 75 | 61 | Upright | 75 | Absent | Absent |
| UŞAK-18 | 25 | 21 | Upright | 70 | High | Absent |
| UŞAK-19 | 45 | 38 | Broad | 50 | Low | Medium |
| UŞAK-20 | 60 | 61 | Broad | 90 | Absent | Absent |
| UŞAK-21 | 90 | 80 | Upright | 50 | High | Absent |
| UŞAK-22 | 60 | 57 | Semi-Upright | 50 | High | Medium |
| UŞAK-23 | 30 | 30 | Semi-Upright | 40 | High | Medium |
| UŞAK-24 | 40 | 35 | Semi-Upright | 45 | High | Absent |
| UŞAK-25 | 35 | 40 | Upright | 20 | Low | Absent |
| UŞAK-26 | 50 | 41 | Semi-Upright | 60 | Medium | Medium |
| UŞAK-27 | 30 | 43 | Semi-Upright | 10 | High | Absent |
| UŞAK-28 | 60 | 54 | Upright | 50 | Low | Absent |
| UŞAK-29 | 100 | 80 | Upright | 25 | High | Absent |
| UŞAK-30 | 35 | 43 | Broad | 25 | High | Absent |
| UŞAK-31 | 100 | 83 | Semi-Upright | 30 | High | Absent |
| UŞAK-32 | 50 | 43 | Upright | 15 | Medium | Low |
| UŞAK-33 | 25 | 29 | Upright | 25 | Low | Absent |
| UŞAK-34 | 25 | 40 | Upright | 15 | Low | Absent |
| UŞAK-35 | 45 | 38 | Upright | 65 | Low | Absent |
| UŞAK-36 | 65 | 56 | Semi-Upright | 80 | Low | Low |
| UŞAK-37 | 65 | 54 | Upright | 75 | Absent | Low |
| UŞAK-38 | 100 | 83 | Semi-Upright | 20 | Low | Absent |
| UŞAK-39 | 55 | 46 | Upright | 10 | High | Absent |
| UŞAK-40 | 50 | 45 | Upright | 15 | High | Low |
| UŞAK-41 | 70 | 57 | Upright | 10 | Low | Medium |
| UŞAK-42 | 70 | 57 | Upright | 10 | Low | Absent |
| UŞAK-43 | 90 | 92 | Upright | 10 | High | Medium |
| UŞAK-44 | 50 | 45 | Semi-Upright | 55 | Low | Medium |
| UŞAK-45 | 65 | 53 | Upright | 15 | High | Low |
| UŞAK-46 | 22 | 27 | Upright | 25 | Medium | Absent |
| UŞAK-47 | 25 | 32 | Semi-Upright | 40 | Medium | Absent |

| | | | | | | |
|---|---|---|---|---|---|---|
| UŞAK-48 | 30 | 37 | Upright | 30 | High | Absent |
| UŞAK-49 | 50 | 49 | Semi-Upright | 45 | Low | Low |
| UŞAK-50 | 60 | 48 | Broad | 35 | Low | Absent |
| UŞAK-51 | 40 | 40 | Semi-Upright | 40 | Medium | Absent |
| UŞAK-52 | 55 | 73 | Semi-Upright | 45 | Medium | Low |
| UŞAK-53 | 60 | 96 | Broad | 55 | Medium | Absent |
| Min | 15 | 15 | - | 10 | - | - |
| Max | 100 | 96 | - | 90 | - | - |

## CONCLUSION

This study is significant because it is the first selection work in Uşak province in Turkey. We found considerable differences most of the vegetative and phenology characteristics. These characteristics of selected types are similar to other promising selection of Turkish. However, selected types with late leafing and lateral bud fruitfulness fulness are suggested for good performance, which may be limiting factors for example late frost damage. To make an objective comparison of fruit quality, precocity, and yield of these selected genotypes, they all need to be grown using the same rootstock, soil, climate, and cultural practices. Adaptation studies will also be required for the selected walnut genotypes. Then, as a result of adaptation, the best walnut types and cultivars can be produce and contribute to the economy of our country. As a result, it is believed that if the production and growing processes of the selected types are controlled scientifically, these results can be much more satisfactory.

## ACKNOWLEDGEMENTS

This study was funded by Usak University, Scientific Research Project # 2015-MF-014

## LITERATURE CITED

Akca, Y. and Sen, S.M. 1994. Studies on selection of walnut (Juglans regia L.) in Gürün. In: Progress in temperature fruit breeding, Schmidt H., Kellerhals M. (eds), 179–181.

Akca Y. 2001. Breeding of walnut varieties by cross breeding, In: National Walnut Symposium, 5–8 September, Tokat-Turkey, 53–63.

Akca Y. and Ozongun, S. 2004. Selection of late leafing, late flowering, laterally fruitful walnut (Juglans regia L.) types in turkey. New Zealand J. Crop Hort. Sci. 32, 337–342.

Akca, Y. 2009. Walnut. AnÕt Publ., Ankara

Aslantas, R. 2006. Identification of superior Walnut (Juglans regia) genotypes in North-eastern Anotolia, Turkey. New Zealand J. Crop Hort. Sci. 34, 231–237.

Beyhan, O. and Ozatar, H.O. 2007. Breeding by selection of walnuts (Juglans regia L.) in Kahramanmaras. Intl. J. Nat. Eng. Sci., 2(3): 93-97: ISSN, 1307-1149.

Beyhan, O., Gozlekci, S., Gundogdu, M. and Ercisli, S. 2016. Physico-Chemical and Antioxidant Characteristics in Fruits of Walnut (*Juglans regia L.*) Genotypes from Inner Anatolia. Not. Bot. Horti. Agrobo., 44(2): 586-592.

Charlot, G. and Germain, E. 1988. Le noyer-nouvelles techniques. Paris, Centre Techniques Interprofessionnel des Fruits et Legumes.

Ciftci, K. 2004. A Research on the Socio-Economical Aspects and Problems of Walnut Production in İzmir and Manisa. Ege University, Institute of Science, Mater Thesis, p. 89.

Ercisli, S. 2004. A short review of the fruit germplasm resources of Turkey. Genet. Res. Crop Evol. 51, 419–435.

Forde, H.I. 1975. Walnut In: Advances in Fruit Breeding, Janick J., Moore J.N. (eds). West Lafayette, Indiana, Purdue University Press.

Germain, E. 1988. Main characteristics of the populations and varieties of French walnut ( Juglans regia L. ). International Conference on Walnuts . Ataturk Central Horticultural Research Institute, pp 89-94, Yalova.

Germain, E. 1989. Inheritance of late leafing and lateral bud fruitfulness in walnut (J. regia), phenotypic correlations among some traits of the trees. Acta Hort. 125–143.

Hendricks, L.C., McGranahan, G.H., Ramos, D.E., Iwarkiri, B. and Forde, H.I. 1985: Walnut orchard management. In: Ramos, D. E. ed. Establishing the walnut orchard. Oaklanda, California, Division of Agricultural National Research. University of California, Publication 21410. Pp. 46-51.

Karadag, H. and Akca, Y. 2011. Phenological and pomological properties of promising walnut (*Juglans regia* L.) genotypes from selected native population in Amasya Province. African Journal of Biotechnology, 10(74): 16763-16768.

Keles, H., Akca, Y. and Ercisli, S. 2014. Selection of Promising Walnut Genotypes (*Juglans regia* L.) from Inner Anatolia. Acta Sci. Pol., Hortorum Cultus, 13(3): 167-175.

Muradoglu, F. 2005. Selection of Promising Genotypes in Native Walnut (*Juglans regia* L.) Populations of Hakkari Central. Yüzüncüyıl University, Institute of Science, phD. Thesis, p. 154.

Sen, S.M. 1980. Studies on Breeding by Selection of Walnuts of North Eastern Anatolia and Eastern Black Sea Reg. Agric Faculty. Atatürk Univ. Erzurum. Turkish.

Sen, S.M. and Tekintas, E. 1992. A study on the selection of Adilcevaz walnuts. Acta Hort. 317, 171–174.

Şen, S.M. ۲۰۱۱. Ceviz Yetiştiriciliği. ۲۲۰ s., Başak Matbaacılık, Ankara.

Serr, E.F. 1962. Selecting Suitable Walnut Varieties . California Agricultural Experiment Station, 144 p, Davis, California.

Serr, E.F. 1964. The nut crops of Turkey. Proceedings of the Nut Growers Society Oregon. Washington 50, 11–22.

Sutyemez, M. and Caglar, S. 2001. Distribution of some morphological traits in walnut seed trees. Nucis Newsletter 10, 20–21.

# O-5 Determination of the Effects of Bacterial Fertilizer on Yield and Plant Growth Parameters of Tomato

Atilla DURSUN[1], Ertan YILDIRIM[1], Metin TURAN[2], Melek EKİNCİ[1], Raziye KUL[1], Fazilet P. KARAGÖZ [1]

[1] Atatürk University, Agriculture Faculty, Department of Horticulture, Erzurum, Turkey

[2] Yeditepe University, Engineering Faculty, Genetic and Bioengineering, Istanbul, Turkey

e-mail: atilladursun@atauni.edu.tr

## Abstract

The use of fertilizers is important in agricultural production. In particular, it is more focus on organic fertilizer that increases in yield and quality of crops and is not harmful to environment at the same time. In this study, the effect of bacterial fertilizer on yield and some quality parameters were investigated in two tomato cultivars (*Solanum lycopersicum L.*, cv. Cevahir F1 and Pala F1) in greenhouse conditions. Three different concentrations (1, 3, and 5 $gL^{-1}$ and control (no application)) of two different (Azotobacter spp. ($1x10^9$): A, mixed of *Bacillus subtilis* and *Bacillus megatarium* ($1x10^9$): B) bacterial fertilizer were evaluated in a completely randomized design with 3 replications. The applications were treated after a week of planting of the seedlings. The solutions were given to the root zone of the plant and repeated 3 times at intervals of 10 days. Average fruit weight, fruit number per plant, fruit weight per plant, plant height, fruit width and length, total soluble solid, pH, ascorbic acid, chlorophyll content, dry matter yield and mineral content were evaluated on tomato. The effects of applications were found significant on plant growth parameters. Bacterial fertilization demonstrated that it increased in yields and other parameters in all the applications. Besides, the effects of applications were significant on mineral content of tomato fruits.

**Keywords:** Macro and micro elements, Nutrition, Plant development, *Solanum lycopersicum* Yield

## 1.Introduction

By the producers and consumers having high education and income levels especially in the developed countries have organized, produced clean products that do not harm the natural balance, do not pollute the environment, do not toxic to humans and other living things especially in the production of horticultural crops in agriculture. This production system is called biological, ecological or organic agriculture (Er and Başalma, 2008; Ozyazıcı et al., 2010; Kodaş, 2011).

Organic fertilizer and plant wastes are used in organic farming, in this way, by improving the physical, biological and chemical properties of the soil; the continuity of soil fertility is provided. In this agricultural system, crop rotations, organic wastes, animal fertilizers, green fertilizers and mineral rocks are used for feeding the soil and provide the plant nutrients. In addition, bacterial fertilizers also are used as soil improvers. Bacterial fertilizers refers to containing active strains of micro-organisms mainly plant growth-promoting rhizobacteria (PGPR) in sufficient numbers. They are used either to fix aunospheric nitrogen or to solubilize plant nutrients like phosphates, stimulate plant growth through synthesis of growth-promoting substances (Tilak, 1991). Moreover, it makes possible to use in agricultural fields due to plant nutrients content, low toxic element content and high humic acid content in bacterial fertilizers.

Almost all of the vegetables, due to substances they contain, as well as to protect and improve human health, to increase in their effects, are depend on grown by organic means (Özer, 2012). Tomato is one of the most produced vegetable grown worldwide. Aim of the study was carried out to determine the effects of two different certifiable organic bacterial fertilizer on growth and yield in tomato under greenhouse conditions.

# 2.Materials and Methods

### 2.1. Growth conditions and plant materials

This study was conducted under greenhouse conditions at Atatürk University, Turkey, in 2016. Two tomato cultivars (*Solanum lycopersicum L*., cv. Cevahir F1 and Pala F1) were cultivated under natural light conditions. Tomato seedlings were planted in the second week of May in 2016. The experiment was ended on 15 October in the same year.

### 2.2. Bacterial Fertilizers

Three different concentrations (1, 3, and 5 $gL^{-1}$ and control (no application)) of two different (Azotobacter spp. ($1x10^9$): A, mixed of *Bacillus subtilis* and *Bacillus megatarium* ($1x10^9$): B) certifiable organic bacterial fertilizer were used in this study and bacterial fertilizers were obtained from Professor Dr. Metin TURAN (Yeditepe University, Department of Genetics and Bioengineering, İstanbul, Turkey). These bacterial fertilizers contain also 15% organic matter, 6% organic C, 13% humic + fulvic acid and enzyme, acid phosphatase, urease, denitrogenase, protease, (30 U / ml from each) besides the PGPR used in the present study.

### 2.3. The application procedure

The applications were made three different dosses of bacterial fertilizers (1, 3 and 5 $gL^{-1}$) and control (no application). This experiment was consisted in a completely randomized design with 3 replications and each replication has 10 plants. The applications were treated after a week of planting of the seedlings. The solutions were given to the root zone of the plant and repeated 3 times at intervals of 10 days.

### 2.4. Data collection and statistical analysis

The measurements taken included average fruit weight (g) (Biçer, 2011), fruit number per plant, fruit weight per plant, plant length (cm), fruit width and length (cm), total soluble solid ($^o$Brix), pH, ascorbic acid (mg/100 g), chlorophyll content, dry matter yield (%) and mineral content in tomato fruit. Macro and micro nutrient (N, K, P, Mg, S, Ca, Na, Fe, Mn, Zn, Cu, Pb, B and Cd) contents of fruits were also determined. Plant samples were oven-dried at 68 °C for 48 h and were then ground. Potassium (K), Ca and Mg were determined after wet digestion of dried and ground sub-samples in a H2 SO4 -Se-Salicylic acid mixture. Phosphorus (P) was determined spectrophotometrically by the vanadomolybdophosphoric-yellow method (Lott et al., 1956). Potassium (K) and Ca were determined by flame photometry, and Mg, Cu, Fe, Mn, Na, Zn, Pb, B and Cd were determined by atomic absorption spectrometry using the methods of AOAC (1990). Boron was determined, after dry-ashing of plant samples, spectrophotometrically at 550 nm by the curcumin method (Odom, 1992). All data in the present study were processed by SPSS and the means were separated by Duncan's multiple range tests.

# 3.Results and Discussion

**Plant growth:** Significant difference was observed among Pala F1 and Cevahir F1 cultivars in terms of the evaluated parameters, except for plant height, fruit length and chlorophyll content. Application of B-5 significantly increased in fruit number per plant (6,83), fruit weight per plant (2,16 kg), total soluble solid (6,23 ($^o$Brix) ), ascorbic acid (mg/100 g), chlorophyll content and dry matter yield (%) when compared to control plants (Table 1). Similar results have been reported by Jackson et al. (1964) and Tilak (1991) in tomato. They found that inoculation Azotobacter has quickened the stem and leaf growth of tomato.

Table 1. Effect of different bacterial fertilizers on plant growth, yield and quality of fruit

| Treatments/Cultivars | Fruit number per plant | | | Fruit weight per plant (kg) | | | Average fruit weight (kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 4,24 c* | 19,57 $^{ns}$ | 11,90 $^{NS}$ | 1,23 e** | 3,50 $^{ns}$ | 2,37 $^{NS}$ | 0,29 $^{ns}$ | 0,18 $^{ns}$ | 0,23 $^{NS}$ |
| A-1 | 5,89 ab | 19,72 | 12,8 | 1,96 abc | 3,4 | 2,68 | 0,33 | 0,17 | 0,25 |
| B-1 | 4,49 bc | 20 | 12,24 | 1,36 de | 3,37 | 2,36 | 0,3 | 0,17 | 0,24 |
| A-3 | 5,67 abc | 19,81 | 12,74 | 1,73 bcd | 3,1 | 2,41 | 0,31 | 0,16 | 0,23 |
| B-3 | 5,50 abc | 20,52 | 13,01 | 1,67 cd | 3,28 | 2,48 | 0,3 | 0,16 | 0,23 |
| A-5 | 5,76 abc | 18,05 | 11,9 | 2,12 ab | 3,21 | 2,66 | 0,38 | 0,18 | 0,28 |
| B-5 | 6,83 a | 20,79 | 13,81 | 2,16 a | 3,19 | 2,68 | 0,32 | 0,15 | 0,24 |
| **Mean** | 5,48 *** | 19,78 | 12,63 | 1,75 *** | 3,29 | 2,52 | 0,32 *** | 0,17 | 0,24 |

| Treatments/Cultivars | Fruit length (mm) | | | Fruit width (mm) | | | Plant length (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 57,57 $^{ns}$ | 64,58 $^{ns}$ | 61,07 $^{NS}$ | 87,71 $^{ns}$ | 77,88 $^{ns}$ | 82,79 $^{NS}$ | 316,33 $^{ns}$ | 307,56 $^{ns}$ | 311,95 $^{NS}$ |
| A-1 | 66,07 | 61,47 | 63,77 | 85,89 | 74,82 | 80,36 | 342 | 320,67 | 331,33 |
| B-1 | 62,07 | 59,49 | 60,78 | 88,55 | 74,3 | 81,43 | 315 | 316,67 | 315,83 |
| A-3 | 57,12 | 61,16 | 59,14 | 86,45 | 78,92 | 82,69 | 337,67 | 314,22 | 325,95 |
| B-3 | 60,98 | 61,42 | 61,2 | 83,75 | 75,81 | 79,78 | 296 | 318,67 | 307,33 |
| A-5 | 63,84 | 61,49 | 62,67 | 85,39 | 76,19 | 80,79 | 321,17 | 328,22 | 324,7 |
| B-5 | 60,14 | 59,02 | 59,58 | 84,74 | 73,64 | 79,19 | 289,67 | 321,67 | 305,67 |
| **Mean** | 61,11 $^{NS}$ | 61,23 | | 86,07 *** | 75,94 | | 316,83 $^{NS}$ | 318,24 | |

| Treatments/Cultivars | Ascorbic acid | | | pH | | | Total soluble solid ($^{o}$Brix) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 152,00 ab*** | 89,00 b*** | 120,50 BC*** | 4,46 $^{ns}$ | 5,71 $^{ns}$ | 5,08 $^{NS}$ | 5,93 a** | 4,45 $^{ns}$ | 5,19 A** |
| A-1 | 83,50 c | 165,00 a | 124,25 BC | 4,43 | 4,69 | 4,56 | 4,47 c | 4,55 | 4,51 C |
| B-1 | 46,00 d | 89,50 b | 67,75 D | 4,41 | 5,05 | 4,73 | 5,40 ab | 4,48 | 4,94 ABC |
| A-3 | 94,65 c | 47,50 c | 71,08 D | 4,52 | 4,31 | 4,42 | 4,90 bc | 4,44 | 4,67 BC |
| B-3 | 131,50 b | 85,50 b | 108,50 C | 4,44 | 4,69 | 4,56 | 4,83 bc | 4,4 | 4,62 BC |
| A-5 | 172,00 a | 170,00 a | 171,00 A | 4,49 | 4,48 | 4,48 | 5,67 ab | 4,44 | 5,06 AB |
| B-5 | 173,50 a | 99,00 b | 136,25 B | 4,52 | 4,91 | 4,72 | 6,23 a | 4,43 | 5,33 A |
| **Mean** | 121,88 ** | 106,5 | | 4,46 * | 4,83 | | 5,35 *** | 4,45 | |

| Treatments/Cultivars | Dry matter yield % | | | Chlorophyll content | | |
|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 4,43 b* | 5,23 $^{ns}$ | 4,83 $^{NS}$ | 55,93 a* | 57,00 a** | 56,47 AB*** |
| A-1 | 4,14 b | 5,33 | 4,74 | 53,37 a | 54,27 a | 53,82 B |
| B-1 | 4,24 b | 5,15 | 4,7 | 47,95 b | 47,95 b | 47,95 C |
| A-3 | 4,09 b | 5 | 4,55 | 56,60 a | 56,63 a | 56,62 AB |
| B-3 | 4,75 b | 5,37 | 5,06 | 58,00 a | 57,50 a | 57,75 A |
| A-5 | 4,03 b | 4,93 | 4,48 | 56,70 a | 59,87 a | 58,28 A |
| B-5 | 5,87 a | 5,03 | 5,45 | 56,23 a | 57,93 a | 57,08 AB |
| **Mean** | 4,51 * | 5,15 | | 54,97 $^{NS}$ | 55,88 | |

A: Bacterial fertilizer of Azotobacter spp.( ($1x10^9$); B: Bacterial fertilizer mixed of *Bacillus subtilis* and *Bacillus megatarium* ($1x10^9$); Control: 0; A/B-1: 1 $gL^{-1}$;A/B-3: 3 $gL^{-1}$; A/B-5: 5 $gL^{-1}$. * P < 0.05, ** P < 0.01, *** P < 0.001means sharing similar letter are statistically not different.

Both bacterial fertilizers were found statistically significant in terms of ascorbic acid and chlorophyll content between cultivars and applications. The higher ascorbic acid and chlorophyll content were found in B-5. Bacterial fertilizers were

found as increasing in ascorbic acid (Aiyer et al., 1964; Bangerth, 1976) and chlorophyll content (Zodape et al., 2011) in tomatoes.

**Fruit nutrient contents:** The effects of bacterial fertilizer applications on mineral (N, P, Mg, Ca, Na, K, Cu, Mn, Fe and Zn) contents of tomato were significant at $p<0.05$, 0.01 and 0.001 (Table 2). All bacterial fertilizer applications particularly affected on increasing in N, P, K, Mn, Zn, Pb, B and Cd contents of the fruit. The highest average K (23767,50 mg/kg) and B (26,01 mg/kg) contents were obtained from A-5 application in the both tomato cultivars. B-3 and A-5 applications were increased in N, P, and Mn contents of the fruit Pala F1 cultivar. In addition, certifiable organic bacterial fertilizer of Azotobacter spp.( ($1x10^9$) (A) increased in Pb, B and Cd contents of the fruit Cevahir F1 cultivar. N, P, K, Ca and Mn contents of fruits increased in reduction in the concentration. Kalantari et al., (2010) reported that the application of compost and vermicompost increased in the concentrations of P, K, Ca, Mg in the shoot. However, Mg, Pb and Zn declined with increase in the concentration. Yıldırım et al., (2010) reported that the yield, growth and nutrition of broccoli plant under organic growing conditions significantly increased (Turan et al., 2004).

Table 2. Effect of different bacterial fertilizers on fruit chemical contents of tomato cultivars

| Treatments/Cultivars | N (%) | | | P (mg kg $^{-1}$) | | | K (mg kg $^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 2,36 b*** | 3,35 $^{ns}$ | 2,85 C** | 3444,00 c** | 3800,33 $^{ns}$ | 3622,17 C** | 22303,33 $^{ns}$ | 19646,67 $^{ns}$ | 20975,00 C* |
| A-1 | 2,95 a | 3,53 | 3,24 AB | 3518,33 c | 4249 | 3883,67 BC | 20645 | 22258 | 21451,50 BC |
| B-1 | 2,85 a | 3,46 | 3,16 B | 3522,33 c | 4089,67 | 3806,00 BC | 21435,33 | 22343 | 21889,17 ABC |
| A-3 | 3,13 a | 3,7 | 3,42 AB | 3899,67 ab | 4311,67 | 4105,67 AB | 23749,67 | 22953,67 | 23351,67 AB |
| B-3 | 3,13 a | 3,84 | 3,49 A | 4014,67 a | 4446 | 4230,33 A | 23439,33 | 23266 | 23352,67 AB |
| A-5 | 3,09 a | 3,8 | 3,45 AB | 3996,67 a | 4434,33 | 4215,50 A | 23548,33 | 23986,67 | 23767,50 A |
| B-5 | 3,07 a | 3,64 | 3,36 AB | 3688,00 bc | 4392 | 4040,00 AB | 22541,67 | 23621 | 23081,33 AB |
| Mean | 2,94 *** | 3,62 | | 3726,24 *** | 4246,14 | | 22523,24 $^{NS}$ | 22582,14 | |

| Treatments/Cultivars | Ca (mg kg $^{-1}$) | | | Mg (mg kg $^{-1}$) | | | Fe (mg kg $^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 8561,33 $^{ns}$ | 8185,33 $^{ns}$ | 8373,33 $^{NS}$ | 4444,67 a** | 4919,33 $^{ns}$ | 4682,00 $^{NS}$ | 172,33 $^{ns}$ | 223,00 $^{ns}$ | 197,67 $^{NS}$ |
| A-1 | 7793,67 | 9149 | 8471,33 | 3714,00 b | 4617,33 | 4165,67 | 128 | 214 | 171 |
| B-1 | 7880 | 8851 | 8365,5 | 3692,33 b | 5055,67 | 4374 | 144 | 226 | 185 |
| A-3 | 8629 | 9256,67 | 8942,83 | 3748,67 b | 4792 | 4270,33 | 157,67 | 230 | 193,83 |
| B-3 | 8465,67 | 9131,33 | 8798,5 | 3853,33 b | 4966 | 4409,67 | 152,67 | 239,33 | 196 |
| A-5 | 8378,33 | 9002,33 | 8690,33 | 3581,00 b | 4874 | 4227,5 | 151,33 | 237 | 194,17 |
| B-5 | 8181,33 | 8943 | 8562,17 | 3846,67 b | 4902,67 | 4374,67 | 162 | 251,33 | 206,67 |
| Mean | 8269,90 *** | 8931,24 | | 3840,10 *** | 4875,29 | | 152,57 *** | 231,52 | |

| Treatments/Cultivars | Mn (mg kg $^{-1}$) | | | Zn (mg kg $^{-1}$) | | | Cu (mg kg $^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 26,33 b* | 25,20 $^{ns}$ | 25,76 B** | 48,40 a*** | 40,16 $^{ns}$ | 44,28 A*** | 7,26 $^{ns}$ | 7,58 $^{ns}$ | 7,42 $^{NS}$ |
| A-1 | 31,78 a | 28,37 | 30,07 A | 39,26 b | 43,38 | 41,32 AB | 7,96 | 8,01 | 7,98 |
| B-1 | 34,12 a | 26,83 | 30,48 A | 34,89 d | 36,71 | 35,80 D | 7,71 | 7,09 | 7,4 |
| A-3 | 35,83 a | 30,33 | 33,08 A | 38,25 bc | 38,07 | 38,16 BCD | 8,13 | 8,75 | 8,44 |
| B-3 | 33,83 a | 29,04 | 31,44 A | 39,40 b | 43,19 | 41,29 AB | 7,43 | 8,02 | 7,72 |
| A-5 | 34,45 a | 28,55 | 31,50 A | 36,15 cd | 37,91 | 37,03 CD | 7,95 | 7,22 | 7,59 |
| B-5 | 36,79 a | 29,32 | 33,06 A | 36,85 bcd | 41,22 | 39,04 BC | 8,06 | 7,58 | 7,82 |
| Mean | 33,30 *** | 28,23 | | 39,03 $^{NS}$ | 40,09 | | 7,78 $^{NS}$ | 7,75 | |

| Treatments/Cultivars | Pb (mg kg $^{-1}$) | | | B (mg kg $^{-1}$) | | | Cd (mg kg $^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** | Pala F1 | Cevahir F1 | **Mean** |
| Control | 0,30 b*** | 0,30 ab* | 0,30 AB*** | 21,80 ab* | 21,29 d** | 21,54 D*** | 1,10 bc*** | 1,08 c*** | 1,09 C*** |
| A-1 | 0,35 a | 0,28 abc | 0,32 A | 20,13 b | 24,57 bc | 22,35 CD | 1,69 a | 1,78 a | 1,74 A |
| B-1 | 0,30 b | 0,25 bc | 0,27 B | 20,08 b | 23,49 cd | 21,79 D | 0,85 d | 0,77 d | 0,81 D |
| A-3 | 0,33 ab | 0,32 a | 0,33 A | 22,75 ab | 25,17 abc | 23,96 BC | 1,17 b | 1,19 c | 1,18 C |
| B-3 | 0,22 c | 0,23 c | 0,23 C | 22,75 ab | 26,44 ab | 24,60 AB | 0,84 d | 0,91 d | 0,88 D |
| A-5 | 0,29 b | 0,26 abc | 0,28 B | 24,28 a | 27,73 a | 26,01 A | 1,31 b | 1,38 b | 1,34 B |
| B-5 | 0,23 c | 0,23 c | 0,23 C | 20,22 b | 22,74 cd | 21,48 D | 0,94 cd | 0,90 d | 0,92 D |
| Mean | 0,29 * | 0,27 | | 21,72 *** | 24,49 | | 1,13 $^{NS}$ | 1,15 | |

A: Bacterial fertilizer of Azotobacter spp.( (1x10$^{9}$); B: Bacterial fertilizer mixed of *Bacillus subtilis* and *Bacillus megatarium* (1x10$^{9}$); Control: 0; A/B-1: 1 gL$^{-1}$;A/B-3: 3 gL$^{-1}$; A/B-5: 5 gL$^{-1}$. * P < 0.05, ** P < 0.01, *** P < 0.001means sharing similar letter are statistically not different.

## 4. Conclusion

In conclusion, bacterial fertilizers that containing strains of micro-organisms mainly plant growth-promoting rhizobacteria in sufficient numbers, is an environmentally safe means of converting into an acceptable source of organic matter. Bacterial fertilizer is an excellent material for use in intensive vegetable production, as it improves yield and nutritional of the tomato. The results of our experiment may lead to increase in organic and high quality tomato production grown in the greenhouse conditions.

# References


Aiyer, R. S., Venkataraman, G. S., & Sundara Rao, W. V. B. (1964). Effect of *Azotobacter* inoculation on vitamin C content of tomato. ScienceandCu-JtllTe 30: 556, 57.

AOAC (1990). Official methods of Analysis of the AOAC. Volume 2 (No. Ed. 15). Association of Official Analytical Chemists Inc

Bangerth, F. (1976). Beziehungen zwischen dem Ca-Gehalt bzw. der Ca Versorgung von Apfel-, Birnen-und Tomatenfrüchten und ihrem Ascorbinsäuregehalt. Plant Foods for Human Nutrition (Formerly Qualitas Plantarum), 26(4), 341-348.

Biçer, Ş. (2011). Arbusküler mikorhizal fungus (AMF), peyniraltı suyu ve hümik asit uygulamalarının kavunda fide yetiştiriciliği ve Fusarium solgunluğuna etkileri. MSc, Yüzüncü Yıl University, Van, Turkey (in Turkish).

Er, C., & Başalma, D. (2008). Organik tarımdaki gelişmeler. Nobel Yayın Dağıtım, (1354).

Jackson, R. M., Brown, M. E., & Burlingham, S. K. (1964). Similar effects on tomato plants of *Azotobacter* inoculation and application of gibberellins. Nature, 203(4947), 851-852.

Kodaş, R. (2011). Tahıllarda Organik Yetiştiricilik, Ankara Üniversitesi Fen Bilimleri Enstitüsü, Tarla Bitkileri Anabilim Dalı, Tezsiz Yüksek Lisans Dönem Projesi.

Lott, W. L., Nery, J. P., Gallo, J. R., & Metcalf, J. C. (1956). Leaf analysis technique in coffee research. IBEC Research Institute.

Odom, J. W. (1992). Determination of Total Boron in Plants by the Curcumin Method. Plant Analysıs Reference Procedures For The Southern Regıon Of The Unıted States, 54.

Ozyazıcı, G., Ozdemir, O., Ozyazıcı, M. A., & Ustun, G. Y. (2010). Bazı Organik Materyallerin ve Toprak Düzenleyicilerin Organik Fındık Yetiştiriciliğinde Verim ve Toprak Özellikleri Üzerine Etkileri. Türkiye IV. Organik Tarım Sempozyumu, 28 Haziran-1 Temmuz 2010, Erzurum, (Poster Bildiri)

Özer, H. (2012). Organik domates (*Solanum lycopersicum* L.) yetiştiriciliğinde değişik masura, malç tipi ve organik gübrelerin büyüme, gelişme, verim ve kalite üzerine etkileri. Doktora Tezi, Ondokuz Mayıs Üniversitesi Fen Bilimleri Enstitüsü, Samsun.

Tilak, K. V. B. R. (1991). Bacterial fertilizers. Indian Council of Agricultural Research; New Delhi.

Turan, M., Ataoglu, N., & Sezen, Y. (2004, October). Effects of phosphorus solubilizing bacteria (*Bacillus megaterium*) on yield and phosphorus contents of tomato plant (*Lycopersicon esculentum* L.) III. *In Proceedings of third national fertilizer congress. Farming-Industry-Environment (in Turkish)* (pp. 939-945).

Yıldırım, E., Karlidag, H., Turan, M., & Donmez, M. (2010). Potential use of plant growth promoting rhizobacteria in organic broccoli (*Brassica oleracea L.,* var. italica) production. In Ecofruit 14th International Conference on Organic Fruit-Growing. Proceedings for the Conference, Hohenheim, Germany (pp. 227-235).

Zodape, S. T., Gupta, A., Bhandari, S. C., Rawat, U. S., Chaudhary, D. R., Eswaran, K., & Chikara, J. (2011). Foliar application of seaweed sap as biostimulant for enhancement of yieldand quality of tomato (*Lycopersicon esculentum* Mill.).

Kalantari, S., Hatami, S., Ardalan, M. M., Alikhani, H. A., & Shorafa, M. (2010). The effect of compost and vermicompost of yard leaf manure on growth of corn. *African Journal of Agricultural Research*, *5*(11), 1317-1323.

## O-9 Farklı Sıcaklık Uygulamalarının Mantarda ( *Agaricus bisporus (Lange) Sing.* ) Verim Ve Karpofor Özellikleri Üzerine Etkileri

**Fatih Erdoğan[1], Mustafa Paksoy[2], Musa Seymen[2], Önder Türkmen[2]**

[1]Gıda Tarım ve Hayvancılık Bakanlığı Meyvecilik Araştırma Enstitü Müdürlüğü, 32500 Eğirdir/Isparta
[2]Selçuk Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü, Konya
Sorumlu yazar: E-mail: ferdoganx@hotmail.com:

**Özet**

Bu çalışma üç farklı üretim odasında ve her odada misel ön gelişme devresinde nem değerleri %85-90, sıcaklık değerleri ise 22, 24 ve 26 °C', karpofor oluşum devresindeki nem değerleri ise %80-85, sıcaklık değerleri de 16, 18 ve 20 °C'ler uygulanmıştır. Her uygulama 4 tekerrür ve her tekerrürde 3 torba olacak şekilde planlanan denemede, torba kompost yüksekliği 8 cm olarak gerçekleşmiştir.

Çalışmada toplam verim (g), toplam mantar sayısı (adet), ortalama karpofor ağırlığı (g), ortalama şapka ağırlığı (g), ortalama sap ağırlığı (g), ortalama şapka çapı (mm), ortalama sap yüksekliği (mm) parametreleri incelenmiştir.

Bu parametrelerin istatistik analiz sonucunda misel ön gelişme safhasında en yüksek değerler 26 °C uygulamasında elde edilmiştir. Karpofor oluşum safhasında ise en yüksek değerler mantar verimi (g), mantar sayısı (adet) ve mantar sap yüksekliğinde (mm) 20 °C uygulamasından, karpofor ağırlığı (g), sap ağırlığı (g), şapka kalınlığı (mm) ve sap çapı (mm) da 18 °C uygulamasından ve son olarak da şapka ağırlığı (g) ve şapka çapı (mm) 16 °C'de olduğu görülmüştür. Misel ön gelişme ve karpofor oluşum dönemindeki sıcaklıkların interaksiyonunda ise mantar verimi ve mantar sayısı 26:20 °C, karpofor ağırlığı ve şapka ağırlığı 24:18 °C, sap ağırlığı, şapka kalınlığı ve sap çapı 22:18 °C, şapka çapında 26:16 °C ve sap yüksekliğinde ise 22:20 °C uygulamasından en yüksek değerler aldığı görülmüştür.
**Anahtar kelimeler:** *Agaricus bisporus,* mantar, misel, karpafor

## Applications for different temperatures mushroom (Agaricus bisporus (Lange) Sing.) yield and its effects on properties karpofor

**Abstract**

This work is the production of three different pre-chamber, and the mycelial growth stages in each room, 85-90% moisture content, temperature values, 22, 24 and 26 ° C, karpofor circuit formation of the 80-85% moisture content, temperature values, 16, 18 and performed at 20 ° Cs. Each application is planned to be four replications and each replicate experiment three bags, compost bags was 8 cm in height.

A total yield (g), the total number of mushrooms (pieces), the average karpofor weight (g), the average weight of a cap (g), average stalk weight (g), the average cap size (mm), average stalk height (mm) parameters were studied .

As a result of statistical analysis of these parameters micellar pre-development stage, the highest values at 26 °C was obtained. The highest values of the initial stage Karpofor mushroom yield (g), the number of mushrooms (pieces) and mushroom stalk height (mm) 20 °C application, karpofor weight (g), stalk weight (g), cap thickness (mm) and stem diameter (mm) and 18 °C, and finally the application of the cap weight (g) and the cap diameter (mm) is 16 °C was observed. Temperatures during the pre-development and the formation of micelle interactions karpofor the number of mushrooms and mushroom yield of 26:20 °C, karpofor weight and the weight of a cap 24:18 °C, stalk weight, stalk diameter and thickness of a cap 22:18 °C, a cap diameter 26:16, stalk height 22:20 °C was observed that the application of the highest values.
**Key words:** *Agaricus bisporus mushroom, mycelium, karpafor*

### Giriş

Dünyada yenilebilen ve kültürü yapılan mantarların yaklaşık %37,8'ini beyaz şapkalı mantar olan *Agaricus bisporus* türü oluşturmaktadır (Işık ve ark., 2004).

Mantarların insan beslenmesinde önemli katkı sağlayan bir besin kaynağıdır. Bazı mantarlar da tıbbi olarak kullanılarak insanlara doğrudan faydası olmaktadır. Mantarın önemi son yıllarda daha da artmaktadır. İnsan nüfusunun hızla artması ve tüketim isteklerin artması mantar yetiştiriciliğin önemini arttırmıştır. Bünyesinde yer alan protein, karbonhidrat, yağ, Ca, P, K, Fe, vitamin B1, B2, B3, B5, B7 ve C gibi besleyici özellikleri barındırması önemli bir besin kaynağı olduğu göstermektedir. Ayrıca mantar önemli bir diyet sebzesidir. İstatistik verilerine göre ülkemizde mantar üretimi 40.272 ton'dur. İller bazında en fazla mantar üretimi ilk sırada 21.533 ton ile Antalya, 5.822 ton ile Burdur, 4.519 ton ile Konya ve 3.142 ile Kocaeli de yetiştirilmiştir (Tuik, 2017).

Türkiye mantar yetiştiriciliğinde birim alandan elde edilen verimin düşük, girdi maliyetlerinin yüksek olması mantar fiyatlarının da yüksek olmasına dolayısıyla mantarın soframızda lüks yemek sınıfında yer almasına sebep olmaktadır. Bu nedenle Türkiye'de mantar üretimi daha çok gelir düzeyi yüksek olan ailelere hitap etmektedir (Özer ve ark., 2000).

Mantar yetiştiriciliğin önemi hızlı bir şekilde artması bazı yetiştirme tekniklerin de geliştirilerek birim alandan elde edilecek ürün miktarının arttırılmasına yönelik çalışmalar yapılmaktadır. Bu çalışmada da misel ve karpofor gelişim aşamasında sıcaklık değerlerinin mantar gelişmesindeki etkileri belirlenmesi amaçlanmıştır.

## Materyal ve Yöntem

Bu çalışma 6.11.2010 - 10.01.2011 tarihleri arasında Selçuk Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümünün mantar üretim odalarında yapılmıştır. Denemede kullanılan kompost ve örtü toprağı Mega Tesnim Ltd. Şti'den temin edilmiştir. Örtü toprağı serilmeden önce %2'lik formaldehit ve %0.1'lik DDVP karışımından oluşan çözelti ile ilaçlanmıştır. Misel gelişmesini tamamlayan kompostların üzerine serilmiştir.

Deneme tesadüf parseller deneme desenine göre 4 tekerrürlü ve her tekerrür de 3 torba olacak şekilde kurulmuştur. Torbalar 3 farklı sıcaklık değeri ayarlanmış odalara yerleştirilmiştir. Bu sıcaklık değerleri misel ön gelişme devresinde (MG) 22, 24 ve 26 °C ile nem deri %85-90 olacak şekilde, karpofor oluşum devresinde (KG) ise sırasıyla 16, 18 ve 20 °C'ye nem değeri ise %80-85 olacak şekilde ayarlanmıştır. Torbalar 2 kg ağırlığında ve yaklaşık 8 cm kalınlığında ayarlanarak torbalara doldurulmuştur. Bu şekilde her oda da 36 adet torba olmak üzere toplamda 108 adet torba olacak şekilde deneme kurulmuştur. Denemede yetiştiricilik, bakım ve hasat işlemleri Günay (2005), Boztok (1994) ve Aksu (1995)'ya göre yapılmıştır. Denemde verim (g/100kg kompost), mantar sayısı (adet/100kg kompost), ortalama karpofor ağırlığı (g/adet), ortalama şapka ağırlığına (g/adet), ortalama sap ağırlığına (g/adet), ortalama şapka çapına (mm), ortalama şapka kalınlığına (mm), ortalama sap çapı (mm) ve ortalama sap yükseklikleri ölçülmüştür.

Denemede elde edilen veriler JMP istatistik programından yararlanılarak varyans analizi yapılmıştır. Verilere ait tüm ortalamalar LSD testine göre gruplandırılmıştır.

## Tartışma ve Bulgular

Yapılan çalışmada torbalarda yetiştirilen mantarlara farklı sıcaklıklar uygulanmasıyla üretilen mantarların verim ve bazı kalite parametreleri incelenmiştir. Parametreler çizelgede verilmiştir. Bu çizelgeler incelenecek olursa;

**1. Toplam Verim:** Misel ön gelişme safhasında 21109 g/100kg kompost ile 26°C sıcaklıkta elde edilmiştir. Karpofor oluşum aşamasında ise en iyi sonuç 20702 g/100kg kompost ile 20°C sıcaklıkta elde edilmiştir. Misel ön gelişme safhası x karpofor oluşum aşaması sıcaklıkları interaksiyonu incelendiğinde en iyi sonuç 26-20°C de 25758 g/100kg kompost olarak elde edilmiştir (Çizelge 1). Paksoy ve ark., (2010) 8 cm kompost uygulamasında 17263 g/100 kg kompost mantar verimi almışlardır. Diğer çalışmalarda ise 100 kg kompost da verimin 15-25 kg arasında olduğu bildirilmektedir (Padem ve ark., 2003; Pardo ve ark., 2004; Özdemir, 2007; Paksoy ve ark., 2008; Pekşen ve Günay, 2009; Seymen ve ark., 2012). Bizim elde ettiğimiz sonuçlar ile örtüşmektedir.

**2. Toplam Mantar Sayısı:** Misel ön gelişme safhasında 776 adet/100 kg kompost ile 26°C de görülmüştür. Karpofor oluşum aşamasında ise en iyi sonuç 781 adet/100 kg kompost ile 20°C de elde edilmiştir. Misel ön gelişme safhası x karpofor oluşum aşaması sıcaklık interaksiyonlarının adet sayısına etkileri arasında istatistikî anlamda önemli farklılıklar bulunmuş ve en iyi sonuç 983 adet/100kg kompost ile 26-20°C de elde edilmiştir (Çizelge 2). Demirer ve ark., (2005) yapmış oldukları çalışmada 100kg torbalardan 610-830 adet mantar hasat etmişlerdir. Bizim elde ettiğimiz değerler ile örtüşmektedir. Seymen ve ark., (2012) yapmış oldukları çalışmada elde edilen verilerin yüksek olduğu ve bununda hasat zamanı ve farklı boyutlarda hasat edilmesinden kaynaklandığı düşünülmektedir.

**3. Ortalama Karpofor Ağırlığı:** Misel ön gelişme safhasındaki sıcaklıklar arasındaki fark istatistik olarak önemsizdir. Karpofor gelişme aşamasında ise en iyi sonuç 34.27 g/adet ile 18°C' de elde edilmiştir. İnteraksiyonlar incelendiğin de ise 34.94 g/adet ile 24-18°C en yüksek değer elde edilmiştir (Çizelge 3).

**4. Ortalama Şapka Ağırlığı:** Misel ön gelişme safhasındaki sıcaklıklardan 24°C 22,06 g/adet ile en iyi sonucu vermiştir, karpofor gelişme aşamasında ise 22.56 g/adet ile 16°C en iyi sonucu vermiştir. İnteraksiyonlar incelendiğinde 24-18°C sıcaklık 23.50 g/adet ile en yüksek değere sahiptir (Çizelge 4). Elde ettiğimiz verilerde şapka ağırlığının Seymen ve ark., (2012) ve Paksoy ve ark., (2010) elde ettikleri verilere göre daha yüksek değerler almıştır. Pekşen ve Günay (2009)'ın çalışmasında elde edilen değerler ile elde ettiğimiz değerlerde paralellik görülmektedir.

**5. Ortalama Sap Ağırlığı:** Misel ön gelişme safhasında sıcaklıklar arasındaki fark istatistik olarak önemsiz bulunmuştur. Karpofor oluşturma aşamasında ise 18°C sıcaklıkta 12.22 g/100kg kompost ile en iyi değeri vermiştir. Misel ön gelişme safhası x karpofor oluşum aşaması sıcaklık interaksiyonlarının ortalama şapka ağırlığı üzerine etkisi incelendiğinde ise en iyi sonuç 26-20°C' de 12.11 g/100kg kompost ile elde edilmiştir (Çizelge 5). Paksoy ve ark., (2010), Seymen ve ark., (2012) yaptıkları çalışmalara göre elde ettiğimiz değerler yüksek çıkmıştır. Pekşen ve Günay (2009)'ın çalışmasıyla paralel değerler aldığı görülmüştür.

**6. Ortalama Şapka Çapı:** Misel ön gelişme safhasında ve karpofor oluşum aşaması sıcaklıkları arasındaki

fark istatistik olarak önemli bulunmuştur. Misel ön gelişme safhasında 54.18 mm ile 26°C'de, karpofor gelişme aşamasında ise 52.37 mm ile 16°C'de en iyi gelişmeyi göstermiştir. İnteraksiyonlar incelendiğinde ise en iyi sonuç 54.18 mm ile 26-16°C' de elde edilmiştir (Çizelge 6). Bizim elde ettiğimiz değerlerin yapılan diğer çalışmalara göre (33-52 mm) yüksek değer aldıkları tespit edilmiştir (Padem ve ark., 2003; Derier ve ark., 2005; Özdemir, 2007; Paksoy ve ark., 2008; Paksoy ve ark., 2010; Seymen ve ark., 2012).

**7. Ortalama Şapka Kalınlığı:** Misel ön gelişme safhasında uygulanan sıcaklıklar arasındaki fark istatistik olarak önemsiz bulunmuştur. Karpofor gelişme aşamasında ise 18°C sıcaklık 24.31 mm ile en iyi sonucu vermiştir. Misel ön gelişme safhası x karpofor oluşum aşaması sıcaklık interaksiyonları incelendiğinde ise istatistikî açıdan önemli bir fark bulunmamıştır; fakat en yüksek değer 24-18°C' de 24.97 mm ile elde edilmiştir (Çizelge 7).

**8. Ortalama Sap Çapı:** Misel ön gelişme safhasındaki sıcaklıklar arasındaki fark istatistik olarak önemsizdir, karpofor gelişme aşamasındaki sıcaklıklar arasındaki fark ise istatistik olarak önemli bulunmuştur. Karpofor gelişme aşamasındaki sıcaklıklardan 18°C, 21.19 mm ile en iyi değeri vermiştir. İnteraksiyonlar incelendiğinde ise 22-18°C de 21.56 mm en yüksek değerdir (Çizelge 8). Yapılan çalışmalara bakıldığında ortalama sap çapının 16-20 mm arasında değer aldıkları görülmüştür (Padem ve ark., 2003; Özdemir, 2007; Paksoy ve ark., 2008; Paksoy ve ark., 2010; Seymen ve ark., 2012).

**9. Ortalama Sap Yüksekliği:** Misel ön gelişme safhasındaki sıcaklıklardan 22°C sıcaklık 46.32 mm ile en yüksek değeri vermiştir. Karpofor gelişme aşamasında ise en iyi sonuç 20°C sıcaklıkta 46.10 mm değeri ile elde edilmiştir. İnteraksiyonlar ele alındığında ise 22-20°C sıcaklıkta 48.54 mm değeri ile en iyi sonuç elde edilmiştir (Çizelge 9). Bizim elde ettiğimiz verilerin diğer çalışmalara (28-37 mm) göre yüksek değer aldığı görülmüştür (Padem ve ark., 2003; Özdemir, 2007; Paksoy ve ark., 2008; Paksoy ve ark., 2010; Seymen ve ark., 2012).

## Sonuç

Araştırmada pazarlamaya alternatif yöntemlerin geliştirilmesi için yaklaşık 2 kg kompostta, misel gelişim ve karpofor oluşum aşamasında farklı sıcaklıklarda mantar verimi ve gelişimine etkileri araştırılmıştır. Mantar verimi, mantar sayısı ve sap yüksekliğinde en yüksek değerlerin 26/20 °C uygulamalarından elde edildiği tespit edilmiştir. Diğer parametrelerde de 24/18 °C uygulamalarından en yüksek değerler aldıkları görülmüştür. Bu sıcaklık değerlerin uygulanabilir oldukları bulunmuştur.

## Kaynaklar


Aksu, Ş., 1995. Perlit, Tüf, Torf, Kepek, ve Bunlara Karıştırılan Çeşitli Maddelerin Mantar Misel Gelişmesine Etkisi ve Bu Ortamlar Üzerinde Mantar Üretme Olanaklarının Araştırılması. Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Bahçe Bitkileri Anabilim Dalı, Doktora Tezi, Ankara.

Boztok, K., 1994. Mantar Üretim Tekniği E.Ü. Ziraat Fak. Ofset Basımevi. İzmir.

Demirer, T., BR. Okuyucu., İ. Özer, 2005. Effect of different types and doses of nitrogen fertilizers on yield and quality characteristics of mushrooms (*Agaricus bisporus* (Lange) Sing) cultivated on wheat straw compost. Journal of Agriculture and Rural Development in the Tropics and Subtropics Volume 106, No.1, 2005, pages 71-77.

Günay, A., 2005. Özel Sebze Yetiştiriciliği, Cilt 2, ISBN 975-00725-2-9. İzmir.

Işık, S. E., Aksu, Ş., Damgacı, E., Ergun, C., Erkal, S., 2004. Mantar Yetiştiriciliği. Genişletilmiş 2. Baskı, Yalova.

Padem, H., H. Ünlü., HI. Takka, 2003. *Agaricus bisporus* üretiminde ağaç işleme sanayi atık maddeleri ve humik asit uygulamalarının verim ve kaliteye etkisi. Ekoloji Çevre Dergisi, Cilt: 12, Sayı:46, Syf:409-415.

Paksoy, M., Ö. Türkmen, M. Seymen, 2008. Değişen humik asit dozlarının kültür mantarlarında (*Agaricus bisporus* (Lange) Sing.) verim ve bazı karpofor özelliklerine etkileri. VIII Yemeklik Mantar Kongresi, 15-17 Ekim, Kocaeli, Syf: 28-40.

Pardo A., AJ. De Juan., J. Pardo., JE. Pardo. 2004. Assesment of different casing materials for use as peat alternatives in mushroom cultivation. Evaluation of quantitative and qualitative production parameters. Spanish Journal of Agricultural Research 2 (2), 267-272.

Pekşen, A. Ve A. Günay, 2009. Kültür mantarı (*Agaricus bisporus* (Lange.) Sing.) yetiştiriciliğinde çay atığı ve buğday sapı karışımından hazırlanan kompostların kullanımı. Ekoloji Çevre Dergisi. Cilt:19, Sayı:73, Syf:48-54.

Özdemir, M. 2007. Farklı yetiştirme sistemleri ve humik asit dozlarının kültür mantarında (*Agaricus bisporus* (Lange.) Sing.) verim ve bazı kalite özelliklerine etkisi. SÜ Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi.

Özer, İ., Demirer, T., Kaynaş, K., 2000. Değişik dozdaki tavuk gübresi kompostun ve örtü toprağı kalınlığının yemeklik mantar (*Agaricus bisporus*)'da verim ve kaliteye etkisi.

Seymen, M., M. Paksoy., R. Eyice., Ö. Türkmen., 2012. Kültür mantarında (*Agaricus bisporus* (Lange.) Sing.) farklı kompost miktarı ile örtü toprağı kalınlığının verim ve kaliteye etkisi. IX Ulusal Sebze Tarımı Sempozyumu. Syf: 603-608.

Tuik, 2012. www.tuik.gov.tr. Erişim Tarihi: 22.11.2017.

**Çizelge 1.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların toplam verime etkisi (g/100kg kompost).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 12741.5 d | 20258.5 b | 21716.8 b | 18238.9 b |
| | 24 | 7316.8 e | 17808.3 bc | 14633.5 cd | 13252.8 c |
| | 26 | 15887.3 cd | 21683.3 b | 25758.3 a | 21109.6 a |
| *ORTALAMA* | | 11981.8 b | 19916.7 a | 20702.8 a | |

$LSD_{0.05\ (MG)}$ = 320.2, $LSD_{0.05\ (KG)}$ =2320.2, $LSD_{0.05\ (MGxKG)}$ =4018.8

**Çizelge 2.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların toplam mantar sayısı üzerine etkisi(adet/100kg kompost).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 425 ef | 729.3 bc | 812.5 ab | 655.6 b |
| | 24 | 258.3 f | 683.3 bcd | 550 de | 497.2 c |
| | 26 | 591.5 cde | 754.3 bc | 983.3 a | 776.3 a |
| *ORTALAMA* | | 424.9 b | 722.3 a | 781.9 a | |

$LSD_{0.05(MG)}$ =103.2, $LSD_{0,05\ (KG)}$ =103.2, $LSD_{0,05\ (MGxKG)}$ =178.8

**Çizelge 3.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama karpofor ağırlığı üzerine etkisi (g/adet).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 30.86 ab | 34.61 a | 25.72 c | 30.40 a |
| | 24 | 31.86 ab | 34.94 a | 30.97 ab | 32.59 a |
| | 26 | 32.56 ab | 33.25 a | 28.06 bc | 31.29 b |
| *ORTALAMA* | | 31.76 a | 34.27 a | 28.25 b | |

$LSD_{0.05\ (MG)}$=2.77, $LSD_{0,05\ (KG)}$ =2.77, $LSD_{0,05\ (MGxKG)}$ =2.79

**Çizelge 4.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama şapka ağırlığı üzerine etkisi (g/adet).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 22.08 ab | 21.72 ab | 14.56 c | 19.45 b |
| | 24 | 22.75 ab | 23.50 a | 19.92 b | 22.06 a |
| | 26 | 22.86 ab | 21.20 ab | 16.00 c | 20.02 b |
| ORTALAMA | | 22.57 a | 22.14 a | 16.82 b | |

$LSD_{0.05\ (MG)}$ =2.03, $LSD_{0.05\ (KG)}$ =2.03, $LSD_{0.05\ (MGxKG)}$ =3.51

**Çizelge 5.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama sap ağırlığı üzerine etkisi (g/adet).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 8.5 d | 12.95 a | 11.50 ab | 10.98 a |
| | 24 | 9.11 cd | 11.72 a | 11.06 abc | 10.63 a |
| | 26 | 9.72 bcd | 12.00 a | 12.11 a | 11.28 a |
| *ORTALAMA* | | 9.11 a | 12.22 a | 11.56 a | |

$LSD_{0,05\ (MG)}$ =1.14, $LSD_{0,05\ (KG)}$ =1.14, $LSD_{0,05\ (MGxKG)}$ =1.97

**Çizelge 6.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama şapka çapı üzerine etkisi (mm).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 51.29 abc | 50.26 bc | 48.43 c | 49.99 b |
| | 24 | 51.64 ab | 51.03 bc | 48.77 bc | 50.48 ab |
| | 26 | 54.18 a | 50.68 bc | 50.53 bc | 51.80 a |
| *ORTALAMA* | | 52.37 a | 50.656 ab | 49.25 b | |

$LSD_{0,05\ (MG)}$ =1.76, $LSD_{0,05\ (KG)}$ =1.76, $LSD_{0,05\ (MGxKG)}$ =3.04

**Çizelge 7.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama şapka kalınlığı üzerine etkisi (mm).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 23.63 a | 24.85 a | 19.74 b | 22.74 a |
| | 24 | 23.25 a | 24.50 a | 22.66 a | 23.47 a |
| | 26 | 23.05 a | 23.60 a | 20.24 b | 22.30 a |
| *ORTALAMA* | | 23.31a | 24.31 a | 20.88 b | |

$LSD_{0.05\ (MG)}$ =1.27, $LSD_{0.05\ (KG)}$ =1.27, $LSD_{0.05\ (MGxKG)}$ =2.20

**Çizelge 8.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama sap çapı üzerine etkisi (mm).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 18.90 bc | 21.56 a | 18.97 bc | 19.81 a |
| | 24 | 18.52 c | 20.55 ab | 20.39 ab | 19.82 a |
| | 26 | 19.22 bc | 21.48 a | 19.29 bc | 20.00 a |
| *ORTALAMA* | | 18.88 b | 21.19 a | 19.55 b | |

$LSD_{0,05\ (MG)}$ =1.07, $LSD_{0,05\ (KG)}$ =1.07, $LSD_{0,05\ (MGxKG)}$ =1.85

**Çizelge 9.** Misel ön gelişme safhasındaki ve karpofor oluşum aşamasındaki sıcaklıkların ortalama sap yüksekliği üzerine etkisi (mm).

| | | Karpofor gelişme aşamasındaki sıcaklık (°C) | | | |
|---|---|---|---|---|---|
| | | 16 | 18 | 20 | *ORTALAMA* |
| Misel ön gelişme safhasındaki sıcaklık (°C) | 22 | 42.46 c | 47.96 ab | 48.54 a | 46.32 a |
| | 24 | 42.09 c | 42.47 c | 42.05 c | 42.21 b |
| | 26 | 43.88 abc | 43.55 bc | 47.72 ab | 45.05 a |
| *ORTALAMA* | | 42,81 b | 44.66 ab | 46.10 a | |

$LSD_{0,05\ (MG)}$ =2.79, $LSD_{0,05\ (KG)}$ =2.79, $LSD_{0,05\ (MGxKG)}$ =4.83

# O-10 Viability and Germination Characteristics of *Gypsophila* sp. Seeds Naturally Grown in Erzurum

Hilal Beyza DURSUN, Fazilet P. KARAGÖZ

Atatürk University, Agriculture Faculty, Department of Horticulture, Erzurum, Turkey

e-mail: f.parlakova@atauni.edu.tr

## Abstract

Gypsophila species are considered to be one of the most important alternatives to diversification of products in the cut flower sector. Despite the rich plant diversity in Turkey flora, the studies on taxonomic and plant characteristics of naturally grown Gypsophila species are insufficient. The study was planned to reveal the viability and germination characteristics of the seeds obtained from the genotypes selected from the natural Gypsophila population in Erzurum-center. According to the results obtained, the average 72.56 % seed viability and germination rate of 46.99 % were determined. The average germination speed, germination index and germination energy of vernalized Gypsophila seeds were determined as 2.09 day, 42 day and 53.15 % at the optimum temperature conditions, respectively. 53.15 % of the seeds germinated in the 7th day. These results and germination rate results were parallel to each other. Significant differences in seed viability and germination characteristics were observed among the collected natural populations. It may be possible to use the specie in the ornamental plant industry through the application of breeding and improved growing techniques with the results of our study had the characteristics of pre-study.

**Keywords:** Germination energy, Germination index, Gypsophila, Natural population

## 1.Introduction

Gypsophila species are considered to be one of the most important alternatives to diversification of products in the cut flower sector. Davis (1974) and Gürtanin (1975) reported that Gypsophila, having about 50 species and varieties in our country is common in the arid regions of Internal Anatolia region and in neighboring regions, especially in Eastern Anatolia, and grows up to 2000 m altitude. Used as cut flowers fresh and dry of *G. paniculata* species, it is noted as one of the indispensable elements of the arrangement and bouquet in the domestic market (Karagüzel and Altan, 1999; Karagüzel and Ortaçeşme, 2000).

Gypsophila cultivars are used both as a cut flower sector and as a design plant in landscape studies in Turkey, but a large number of naturally grown Gypsophila species have not yet used as ornamental plants (Huber-Morath, 1967; Karagüzel et al., 1992).

It is becoming increasingly important evaluating of plants in many countries own flora, to expand their production areas by cultivated the new species and use them in landscaping studies. Despite the rich plant diversity in Turkey flora, the studies on taxonomic and plant characteristics of naturally grown *Gypsophila* species are insufficient (Özçelik et al., 2008).

In this study, the viability and germination characteristics of the seed samples taken from the genotypes selected from the natural Gypsophila population in Erzurum-center were determined. It may be possible to use the specie in the ornamental plant industry through the application of breeding and improved growing techniques with the results of our study.

# 2.Materials And Methods

### 2.1. Plant materials

In this study, seeds obtained from genotypes selected from natural Gypsophila population in Erzurum-Center were used as plant material. During the flowering periods of the plants, the places where the Gypsophila genotypes grown in the center of Erzurum were determined and then the seeds matured from the 30 genotypes in the populations in these areas were collected. These seeds were allowed to dry at ambient conditions until the appropriate moisture and then cleaned. The seeds were waited at 4 $^0$C in 1 month for vernalization need (Moruno et al., 2011).

### 2.2. Methods

**Tetrazolium test:** The dyeing solution used for the tetrazolium chloride (TTC) test was prepared according to the method of Patil and Dadlani, (2009). As 3 replications, 50 seeds were kept in water at 20-25 ° C for 24 hours, and then prepared for dyeing. At the end of 24 hours, seed coats of the seeds were removed and the seeds were kept in 1.0 % TZ solution for 4 hours. After these treatments, the seeds were taken from the TZ solution, rinsed in cold water and examined. The seeds were determined to be live or non-live depending on the dyeing situations (Akbudak and Başay, 2009; Santos et al., 2007). Seeds are called live if the embryo is all stained equally, if there is slight damage to the radicle tip (up to 2/3 of the radicle tip), or if the cotyledons are 50% or more stained (ISTA, 2003, 2007).

**Germination studies:** Surface sterilization of the seeds was provided with 1% sodium hypochlorite prior to the germination tests. Germination tests were carried out in the dark using an drying oven which can be adjusted to the planned temperature values with a sensitivity of ± 1 ° C in the Horticulture Department laboratories. 11 cm polystyrene petri dishes were used and 50 seeds were placed on two sheets of filter paper in each petri dish. The experiment was made based on a completely randomized design. The number of seeds germinated each day during the germination experiment was taken. Germination study was carried out 14 days (ISTA, 1996). The average seed viability, germination rate, the average germination speed, germination index ((Alvarado et al., 1987; Ruan et al., 2002; Atik et al., 2007; Carpýcý et al., 2009). and germination energy (Karagüzel, 2003) were determined. All data in the present study were processed by SPSS and the means were separated by Duncan's multiple range tests. The data of percentage were transformed using by arcsine values prior to statistical analysis.

# 3. Results and Discussion

An average of 72.56 % viability was detected in the TTC test performed when Table 1 was examined. This study includes procedures for increasing in the accuracy rate and clarifying the details of the method by determining the viability rates of the seeds obtained from the genotypes selected from the natural Gypsophila populations of Erzurum-center in order to estimate the seed viability quickly and accurately. In various studies, researchers used tetrazolium method to determine seed viability (Santos et al., 2007; Nery et al., 2007; Chamma and Novembre 2007).

Table 1. Viability rates (%) determined by TTC test seeds of collected from the natural Gypsophila (Gypsophila sp.) population in Erzurum

| Genotype no | Seed viability rate (%) | Genotype no | Seed viability rate (%) |
|---|---|---|---|
| Genotype 1 | 76.67 $^{abcdefg}$ | Genotype 21 | 73.33 $^{abcdefg}$ |
| Genotype 10 | 56.67 $^{cdefg}$ | Genotype 22 | 70.00 $^{bcdefg}$ |
| Genotype 11 | 36.67 $^{g}$ | Genotype 23 | 86.67 $^{abcd}$ |
| Genotype 12 | 93.33 $^{ab}$ | Genotype 24 | 73.33 $^{abcdefg}$ |
| Genotype 13 | 83.33 $^{abcdef}$ | Genotype 25 | 66.67 $^{bcdefg}$ |
| Genotype 14 | 53.33 $^{defg}$ | Genotype 26 | 63.33 b$^{cdefg}$ |
| Genotype 15 | 83.33 $^{abcdef}$ | Genotype 27 | 83.33 $^{abcde}$ |

| | | | |
|---|---|---|---|
| Genotype 16 | 96.67 a | Genotype 28 | 43.33 fg |
| Genotype 17 | 83.33 abcdef | Genotype 29 | 53.33 defg |
| Genotype 18 | 73.33 abcdefg | Genotype 3 | 50.00 efg |
| Genotype 19 | 96.67 a | Genotype 30 | 53.33 defg |
| Genotype 2 | 80.00 abcdef | Genotype 4 | 90.00 abcd |
| Genotype 20 | 86.67 abcde | Genotype 5 | 56.67 cdefg |
| Genotype 6 | 80.00 abcdef | Genotype 8 | 90.00 abc |
| Genotype 7 | 66.67 bcdefg | Genotype 9 | 76.67 abcdef |
| Mean | 72.56 *** | | |

* P < 0.05, ** P < 0.01, *** P < 0.001 means sharing similar letter are statistically not different.

Germination rate of the seeds obtained from the genotypes selected from the natural Gypsophila population in Erzurum-center was found statistically (p<0,001) significant. Average germination rate was reported as 29.04%. Mean germination speed was not statistically significant (p> 0.05). The germination index (GI) was statistically significant (p <0.001) while the mean GI was 22.42. The germination energy of collected seeds (p <0.001) was found statistically significant while the mean germination energy was determined as 53.15% (Table 2).

Table 2. Germination characteristics of the seeds obtained from the genotypes selected from the natural Gypsophila (Gypsophila) population in Erzurum

| Genotype no | Germination rate (% ) | The average germination speed (day) | Germination ındex (GI) | Germination energy (GE) (%) |
|---|---|---|---|---|
| Genotype 1 | 37.20 ghi | 1.65 | 12.00 ghij | 36.67 fgh |
| Genotype 2 | 39.15 fghi | 2.20 | 16.33 efghij | 40.00 fgh |
| Genotype 3 | 63.55 ab | 1.83 | 29.33 bcde | 80.00 ab |
| Genotype 4 | 58.26 bcd | 2.30 | 80.67 a | 72.00 bc |
| Genotype 5 | 46.92 defg | 2.85 | 29.67 bcde | 51.67 def |
| Genotype 6 | 56.92 bcd | 2.17 | 30.00 bcde | 70.00 bc |
| Genotype 7 | 59.71 bc | 1.70 | 24.67 bcdefg | 73.33 bc |
| Genotype 8 | 77.72 a | 1.61 | 28.00 bcdef | 93.04 a |
| Genotype 9 | 64.70 ab | 1.74 | 28.33 bcde | 81.67 ab |
| Genotype 10 | 42.12 efgh | 2.04 | 18.33 cdefghi | 45.00 efg |
| Genotype 11 | 53.22 bcde | 1.91 | 22.33 bcdefgh | 63.82 bcd |
| Genotype 12 | 32.14 hi | 2.99 | 16.67 defghij | 28.33 gh |
| Genotype 13 | 59.51 bc | 1.63 | 24.00 bcdefgh | 73.33 bc |
| Genotype 14 | 58.93 bcd | 1.66 | 24.33 bcdefg | 73.33 bc |
| Genotype 15 | 65.00 ab | 1.76 | 29.00 bcde | 80.00 ab |
| Genotype 16 | 61.22 abc | 2.11 | 33.67 b | 76.67 abc |
| Genotype 17 | 58.93 bc | 2.16 | 31.67 bc | 73.33 bc |
| Genotype 18 | 37.45 ghi | 2.27 | 16.67 defghij | 37.28 fgh |
| Genotype 19 | 49.92 cdef | 1.85 | 21.67 bcdefgh | 58.33 cde |
| Genotype 20 | 35.50 ghi | 1.87 | 11.33 ghij | 34.21 fgh |
| Genotype 21 | 42.09 efgh | 1.85 | 18.33 cdefghi | 45.00 efg |
| Genotype 22 | 34.75 ghi | 2.39 | 13.33 fghij | 32.50 gh |
| Genotype 23 | 28.11 ij | 2.09 | 15.33 efghij | 22.50 hi |
| Genotype 24 | 38.91fghi | 2.33 | 17.00 cdefghij | 39.60 fgh |
| Genotype 25 | 37.75 fghi | 2.10 | 9.33 hij | 37.50 fgh |
| Genotype 26 | 55.28 bcd | 2.81 | 31.33 bcd | 66.67 bcd |

| | | | | |
|---|---|---|---|---|
| Genotype 27 | 55.82 bcd | 1.97 | 29.33 bcde | 68.33 bcd |
| Genotype 28 | 19.32 jk | 2.39 | 4.00 ij | 11.11 ij |
| Genotype 29 | 10.45 k | 2.17 | 3.33 j | 5.00 j |
| Genotype 30 | 29.04 ij | 2.33 | 10.00 ghij | 24.17 hi |
| **Mean** | 46.99 *** | 2.09 ns | 22.42 *** | 53.15 *** |

* P < 0.05, ** P < 0.01, *** P < 0.001means sharing similar letter are statistically not different.

Sivritepe (2011) reported that any seed can include live and dead tissue may or may not be the germination ability. The findings of our study were compatible with these results. In addition, Schmidt (2000) reported that the TTZ test gave a higher percentage of seed viability than the percentage of germination in general.

## 4. Conclusion

In conclusion, significant differences in seed viability and germination characteristics were observed among the collected natural populations. In the ornamental plants sector, the use of natural species is of great importance in ensuring plant adaptation and environmental quality. It may be possible to use the specie in the ornamental plant industry through the application of breeding and improved growing techniques with the results of our study. For this reason, in the light of the results obtained in the research, more extensive studies can be made for this species.

## Acknowledgements

We thank to TUBİTAK because this work has been financially supported by TUBITAK (Program code: 2209, Applıcatıon Number: 1919B011500744).

## References

Akbudak, N., & Başay, S. (2009). Biber Tohumlarında Canlılık Tespitine Yönelik Kullanılan Tetrazolium Test Metodunun Modifikasyonu. Uludağ Üniversitesi Ziraat Fakültesi Dergisi, 23(1).

Alvarado, A. D., Bradford, K. J., & Hewitt, J. D. (1987). Osmotic priming of tomato seeds: effects on germination, field emergence, seedling growth, and fruit yield (No. REP-4221. CIMMYT.).

Atik M, Karagüzel O, Ersoy S (2007). Effect Of Temperature On Germination Characteristics Of Dalbergia Sissoo Seeds. Journal of the faculty of Agriculture, Akdenız Unıversıty, 20(2): 203-210.

Carpýcý, E. B., Celýk, N., & Bayram, G. (2009). Effects of salt stress on germination of some maize (*Zea mays* L.) cultivars. African Journal of Biotechnology, 8(19).

Chamma, H. M. C. P., & Novembre, A. D. D. L. C. (2007). Tetrazolium test for corn seeds: preconditioning and staining periods. *Revista Brasileira de Sementes*, *29*(2), 125-129.

Davis, P.H., (1974). Flora of Turkey and east Aegean Islands, Vol. 2, Edinburg, England.

Gürtanin, N., (1975). Çeşitli Kullanım Alanları Olan Bir Bitki, G. Arrostii guss. Var. Nebulosa, Peyzaj Mimarlığı Derneği Yayınları 1975 (2), Ankara.

Huber-Morath, A. (1967). (Ed.) Davis. P.H., Flora of Turkey and The East Agean Islands. 2, Edinburgh, Univ. Press.

ISTA, (1996). ISTA Germination methods. p.176-197. International Seed Testing Association. Bassersdorf, Switzerland.

ISTA, (2003). ISTA Working Sheets on Tetrazolium Testing. Volumes 1 and 2. International Seed Testing Association. Bassersdorf, Switzerland.

ISTA, (2007). International Rules for Seed Testing. Edition 2007. International Seed Testing Association. Bassersdorf, Switzerland.

Karagüzel, O., (2003). Farklı Tuz Kaynak, ve Konsantrasyonlarının Güney Anadolu Doğal *Lupinus varius*'larının Çimlenme Özelliklerine Etkisi. Akdeniz Üniversitesi Ziraat Fakültesi Dergisi 16(2): 211-220.

Karagüzel, O., Altan, S. (1999). *Gypsophila paniculata* L. "Perfecta"nın Büyüme ve Çiçeklenmesi Üzerine Dikim Zamanı ve Gün Uzunluğunun Etkileri. Turkish Journal of Agriculture and Forestry, 23, Ek Sayı 2: 257- 280.

Karagüzel, O., Ortaçesme, V. (2000). G*ypsophila* Yetiştiriciliğinde Dikim Sıklığının Verim, Kalite ve Aydınlatma Enerjisinin Verimli Kullanımına

Etkisi. Turkish Journal of Agriculture and Forestry, 24:691-697.

Karagüzel, O., Uzun, G., Altan, S., Söğüt, Z., & Ortaçeşme, V. (1992). *Gypsophila paniculata* L.'de Anaçlık Tesisi ve Çelikten Fide Üretimi Üzerinde Araştırmalar. Türkiye I. Ulusal Bahçe Bitkileri Kongresi, 2, 641-646.

Moruno, F., Soriano, P., Vicente, O., Boscaiu, M., Estrelles, E., (2011). Opportunistic Germination Behaviour of *Gypsophila (Caryophyllaceae*) in Two Priority Habitats from Semi-arid Mediterranean Steppes. Not Bot Hort Agrobot Cluj, 2011, 39(1):18-23.

Nery M.C., Carvalho M. L. M. and Oliveira L.M., (2007). Tetrazolium test in the evaluation of watermelon physiological seed quality. Semına-Ciencias Agrarias 28 (3): 365-372.

Özçelik, A., Arı, E., Karagüzel, Ö., Kaya, A. S., Aydınşakir, K., Karagüzel, O., Özçelik H., Kazaz, S., (2008). Kesme Çiçek Çeşit Geliştirme Projesi, Karanfil ve Gypsophilada Gen Havuzlarının Oluşturulması. Proje No: 104 O 364. s.90. Antalya.

Patil, V. N., and Dadlani M., (2009). "Tetrazolium test for seed viability and vigour."Handbook of Seed Testing. 209-241.

Ruan, S., Xue, Q., & Tylkowska, K. (2002). The influence of priming on germination of rice (*Oryza sativa* L.) seeds and seedling emergence and performance in flooded soil. Seed Science and Technology, *30*(1), 61-67.

Santos, M.A.O., Novembre A.D.L.C., and Marcos-Filho J., (2007). Tetrazolium test to assess viability and vigour of tomato seeds. Seed Science and Technology, 35, 213-223.

Schmidt, L., (2000). Guide To Handling of Tropical and Subtropical Forest Seed, Danida Forest Seed Centre, Denmark, 87-982428-6-5, 511p.

Sivritepe, H. Ö., (2011). Tohum Canlılığının Değerlendirilmesi. Alatarım *2011, 10 (2): 94-105.*

# O-11 *Solanaceae* Familyasındaki Sekonder Metabolitler ve Nikotin Hakkında Bir İnceleme

Kenan Sönmez[1], Şeküre Şebnem Ellialtıoğlu[2]

[1] Eskişehir Osmangazi Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü, Eskişehir, Türkiye

[2] Ankara Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü, Ankara, Türkiye

İnsan nüfusu hızla artarken yeterli ve kaliteli beslenme için gerekli olan gıda talebi de artmaktadır. Meyve ve sebzeler yüksek besin değerine sahip, vitamin, mineral madde, lif ve fitokimyasalların iyi bir kaynağı olup dışarıdan ilave alınan vitamin ve antioksidanlardan ziyade doğal olarak tüketmek daha önemlidir. Toplum bilincinin gelişmesine bağlı olarak "Fonksiyonel Gıda" kavramı hayatımıza girmiştir. Sebze ve meyveler içerdikleri sekonder metabolitlere ve bu metabolitlerin oranlarına göre fonksiyonel gıda değeri kazanmaktadır. Sekonder metabolitler türlerine ve bitkilerde bulunan miktarlarına göre anti kanserojen, kanserojen, mutagen veya toksik olabilmektedir. Sekonder metabolitler bitkilerde, patojen, virüs ve böceklere karşı savunma mekanizması oluşturmada önemli görev üstlenmektedirler. Ayrıca çiçek tozlarının veya tohumların taşınması için böcekleri çeken özellikte de olabilmektedir. Dünyada ve ülkemizde sebze olarak en çok üretim ve tüketimi yapılan sebzelerden domates, patates, biber ve patlıcan *Solanaceae* familyasına aittir. *Solanaceae* familyası tarım, ekonomi ve farmakolojik açıdan önemli bir familya olup, yapısında bulundurduğu sekonder metabolitler nedeniyle sağlık bakımından yararlı olabilirken, bazen de nikotin gibi toksik olabilecek bileşiklere sahiptir.

Nikotin, *Solanaceae* familyası bitki türlerinde farklı miktarlarda olmakla birlikte var olduğu bilinen bir sekonder metabolittir. Alkaloidler sınıfında yer alan ve toksik bir madde olan nikotin, organik tarımda insektisit olarak da kullanılmaktadır. Nikotin içeriği, en fazla tütünde bulunmakta olup çok daha düşük konsantrasyonlarda çayda ve *Solanaceae* familyasına ait diğer bitki türlerinde de mevcuttur. *Solanaceae* familyası içinde yaygın olarak tüketilen sebzeler nikotin içerikleri bakımından patlıcan, patates, domates ve tatlı biber şeklinde sıralanmaktadır. Taze patates, domates ve tatlı biberde 10 µg/kg'ın altında nikotin tespit edildiği halde, bu miktar patlıcanda 100 µg/kg olarak belirlenmiştir. Gıdalarla alınan nikotin miktarının ortalama 1.1-1.3 µg/gün olduğu kayıtlarda yer almaktadır. Sindirim yolu ile alınan nikotinin yaklaşık %60-70 oranında karaciğerde parçalandığı bilinmektedir. Bu nedenle solunum yolu ile alınan nikotinin etkisinden farklı olarak, sindirim yolu ile alınan nikotinin insan sağlığı için olumsuz etki yapmayacağı ifade edilmektedir.

**Anahtar Kelimeler:** Nikotin, Sekonder Metabolit, *Solanaceae*, Tütün, Patlıcan

## A Study on Secondary Metabolites and Nicotine in the Family of *Solanaceae*

Kenan Sönmez[1], Ş. Şebnem Ellialtıoğlu[2]

[1]Eskişehir Osmangazi University, Faculty of Agriculture, Department of Horticulture, Eskişehir

[2]Ankara University, Faculty of Agriculture, Department of Horticulture, Ankara

Rapid population growth is accompanied by increasing food demand to ensure adequate and balanced nutrition. Fruits and vegetables have high nutritional value and are good sources of vitamins, minerals, fiber and phytochemicals. A healthy diet high in fruits and vegetables is superior to taking vitamin and antioxidant supplements. The concept of "functional food" has been promoted with increasing public awareness. The functional food properties of vegetables and fruits are determined by their content of secondary metabolites and their proportions. Secondary metabolites may act as anti-carcinogenic, carcinogenic, mutagenic or toxic agents depending on their composition and quantity in plants. Tomato, potato, pepper and eggplant which are the mostly produced and consumed vegetables in Turkey and worldwide also belong to *Solanaceae* family. The *Solanaceae* is an agriculturally, economically and pharmalogically important family. While the *Solanaceae* contains health beneficial compounds as secondary metabolites, it also contains potentially toxic compounds like nicotine.

Nicotine is a secondary metabolite that exists in varying quantities in *Solanaceae* family of plants. It is a member of the alkaloid family of compounds and a toxic substance, which is also used as insecticide in organic agriculture. Nicotine is found predominantly in tobacco and in much lower quantities in tea and *Solanaceae* family of plants. In accordance with their nicotine content, commonly consumed *Solanaceae* family vegetables are listed as eggplant, potato, tomato and sweet pepper. The nicotine levels in fresh potato, tomato and sweet pepper are below 10 µg/kg while they can increase up to 100 µg/kg in eggplants. Nicotine intake by food ranges between 1.1-1.3 µg/day. 60-70% of the nicotine in the digestive track is metabolized in the liver. Hence, nicotine intake through digestive track is reported not to have as much harmful effects as those induced by nicotine intake through respiratory track.

**Key Words:** Nicotine, Secondary Metabolite, *Solanaceae*, Tobacco, Eggplant

**Fonksiyonel Gıda ve *Solanaceae* Familyası**

Beslenme ve sağlık arasındaki ilişki eskiden beri bilinmektedir. Yaklaşık 2500 yıl önce Hipokrat "*yiyeceklerinin ilacın olmasına ve ilacının yiyecekler olmasına izin ver*" diyerek bitkilerin sağlık üzerine etkilerine dikkat çekmiştir. Ancak sağlık ile besinler arasındaki ilişki yukarıda belirtilen özlü ifadeyi doğrular nitelikte, günümüzde tekrar önem kazanmaya başlamış ve besin olarak tüketilen yiyeceklerin sağlık üzerine etkileri yeniden ve yoğun bir şekilde araştırma konusu olmuştur. Besin olarak tüketilen bitkiler yaprakları, meyvesi, yumru ve gövdelerinde bulundurdukları birtakım fitokimyasal maddeler ile bu özelliği göstermektedir. Bitkiler içerdikleri biyoaktif maddelerin (karotenoidler, fenolik bileşikler, fitosteroller, fitostanoller, organik sülfürlü bileşikler, sindirilemez karbonhidatların varlığına göre değer (fonksiyonel gıda) kazanmaktadır.

Meyve ve sebzeler yüksek besin değerine sahip, vitamin, mineral madde, lif ve fitokimyasalların iyi bir kaynağıdır ve ortalama günde 500 g meyve, sebze tüketimi sağlık açısından gereklidir. Dışarıdan ilave alınan vitamin ve antioksidanlardan ziyade doğal olarak tüketmek daha önemlidir (Asmah et al., 2007). Özellikle de çiğ olarak tüketilen sebzeler, kanser ve kardiyovasküler gibi kronik hastalıkların görülme sıklığını azaltarak gençliği teşvik edebilmekte ve sağlık durumunu iyileştirebildiği bilinmektedir (Bazzano et al., 2002; Riboli and Norat, 2003).

Günümüzde sebze ve meyvelerin hastalıkları önleyici ve tedavi edici özelliklerin daha geri planda kalması, sağlık alanında tedavi edici teknolojilerin daha ön planda olmasından kaynaklanmaktadır (Appendino ve Scalfi 2003).

Solanaceae familyası, dünyanın ılıman ve tropikal bölgelerine yayılmış yaklaşık 1400 türden oluşan glikoalkaloidler formundaki steroidal glikozitlerce zengin çok büyük bir gruptur (Shabana et al., 2013). Aşağıda, bu grup içinde sebze olarak tarımı yapılan, ekonomik önemi olan 4 türe ait fonksiyonel özelliklere kısaca değinilmiştir.

**Patates**

Patates *Solanaceae* familyası içinde 382 milyon ton ile dünyada, üretimi en fazla yapılan sebzedir (Anonymous, 2017). Patates uygun şartlarda uzun süre muhafaza edilebilme imkânı olmasının yanı sıra doyurucu olma özelliğinden dolayı özellikle gelir seviyesi düşük toplumlarda bütün bir yıl boyunca yoğun bir şekilde gıda olarak tüketilmektedir. Yaklaşık bir patates yumrusunun %80'i su, %20'si kuru maddedir, kuru maddenin de %16.9'u karbonhidrat, %2'si protein, %0.1'i lipid, %1'i kül'den oluşmaktadır. Ayrıca vitamin C, $B_1$, $B_2$, $B_6$ vitaminleri, pantotenik ve folik asit bulunmaktadır. Patates (80 kcal) bilinenin aksine pirinç (364 kcal), buğday (332 kcal) ve mısırdan (96 kcal) daha az enerjiye sahiptir. Yüksek oranda lif içermesinden dolayı kalınbağırsak problemleri, kolon kanseri, diyabet, kardiyovasküler hastalıklarda oldukça olumlu etkiye sahip olduğu bilinmektedir. Düzgün bir kalın bağırsak işlevi için içerdiği liflerden dolayı günde 40 g patates tüketilmesi önerilmektedir. Patates suda çözünebilir vitaminler açısından da oldukça zengin bir yapıya sahiptir (Woolfe, 2009).

**Domates**

Domates dünyada (*Solanum lycopersicum* L.) 171 milyon ton üretim ile *Solanaceae* familyası içinde patatesten sonra ikinci sırada yer almaktadır (Anonymous, 2017). Domates, taze tüketimin yanı sıra sos, ketçap, salça ve kurutularak bütün yıl boyunca tüketilmektedir. Ülkemizin sahip olduğu iklimsel özelliklerden dolayı, domatesin 4 mevsim taze olarak tüketilme imkânı da mevcuttur.

Domates meyvesinin içerik olarak yaklaşık %93-95'i su, %5-7'si de inorganik bileşikler, organik asitler (sitrik asit ve malik asit), alkolde çözünemeyen katı maddeler (proteinler, selüloz, pektin, polisakkaritler), karotenoidler ve lipitlerden oluştuğu ifade edilmektedir (Petro-Turza, 1987). Olgun domates meyvesi potasyum bakımından zengin; organik asitler, vitamin A ve C bakımından ise önemli bir besin kaynağıdır (Moreno et al., 2008). Olgun taze domates meyvesinde, yüksek miktarda glukoz ve fruktoz, eser miktarda da sakaroz pektinler, ksilanlar, arabinoksilanlar, selüloz bulunmakta, polisakkaritler açısından zengin bir ürün niteliği kazanırmaktadır. Taze domates meyvesinin suyunda, organik asit olarak en fazla sitrik asit, bir miktar da malik asit bulunurken, oranı en yüksek aminoasit olan glutamik asiti (%45) daha az seviyelerdeki aspartik asit izlemektedir (Gould, 1983; Yılmaz, 2001).

Domatesin rengi veren metebolitlerden likopen kırmızı renkten, ß-karoten sarımsı renkten sorumludur (Dorais et al., 2001). Likopenin antioksidant özelliği oldukça yüksek olup, prostat kanserini önlediği (Gann et al., 1999), kanser çeşitleri gibi dejeneratif bozukluklara karşı koruyucu etki yaptığı, serbest oksijen radikallerini zararsız hale getirdiği, kardiyovasküler hastalıklarda da koruyucu etki yaptığı bilinmektedir (Kök, 2011). Likopenin antioksidant özelliği sayesinde birçok kanser türü ve kalp hastalıklarının önlenmesinde rol oynadığına ilişkin çok sayıda bilimsel çalışmaya rastlanmaktadır (George et al., 2004; Adams et al., 2005; Kuti ve Konuru, 2005; Brandt et al., 2006; Helyes et al., 2006; Rao ve Rao, 2007; Pernice et al., 2010).

β-karoten, vücutta kan ve dokularda bulunan temel karotenoidler arasında yer almakta olup A vitaminine dönüşebilmektedir. Vitamin A eksikliği önemli sağlık sorunlarına yol açan hastalıklara neden olabilmektedir. β-karoten içerikli ilaçlar, A vitamini eksikliğinden kaynaklanan ve ölümcül olabilen bu hastalıkların tedavisinde etkili olmaktadır (West et al., 1999). Sağlık için faydalı olan fitokimyasallardan tokoferol ve flavonoidler domateste bulunduğu için domates ürünleri de fonksiyonel gıda olarak adlandırılmaktadır (Fraser et al., 2009).

**Patlıcan**

Patlıcan (*Solanum melongena* L.) 50 milyon ton üretim kapasitesi ile Solanaceae familyası içinde üçüncü sırada en fazla üretilen sebze konumunda olup (Anonymous, 2017), d**ünya üzerinde '**aubergine' ve 'brinjal' isimleri ile de bilinmektedir (Chen and Li, 2003; Pugalendhi et al., 2010). Patlıcan çok yıllık bir bitki olmasına rağmen, ticari olarak yetiştiricilik bakımından tek yıllık bir bitkidir. İngilizcedeki 'eggplant' ismi, bazı tiplerindeki meyvelerin tavuk yumurtasına benzemesinden kaynaklanmaktadır (Talhouni, 2014). Küçük yuvarlak veya oval meyveler taze olarak içi oyulduktan sonra değişik karışımlarla doldurularak (dolma) tüketildiği gibi kurutularak da tüketilebilmektedir. Uzun silindirik meyveli olan meyveler ise kızartma, közleme için kullanılırken iri oval yapılı meyveler közleme veya kızartma yapımında kullanılmaktadır (Akıncı et al., 2004; Demir et al., 2010; Tümbilen et al., 2011). Patlıcana mor rengini veren antosiyanin yapısındaki 'nasunin' güçlü bir antioksidandır. Nasunin, kötü huylu (LDL) kolesterolün neden olduğu bilinen kalp hastalıkları ve inme riskinin artmasına yol açan serbest radikal oluşumunu bloke etmektedir.

Patlıcanın içermiş olduğu fenolik bileşikler, kafeik asit ve klorojenik asit, serbest radikalleri ortamdan uzaklaştırarak hücrelerin kanserden korunmasına yardımcı olmaktadır (Mars, 2004; Hedges and Lister, 2007; Kades et al., 2013).

Patlıcanın yaprakları ağrı kesici, çiçek sapı antioksidant ve meyvesi ise sakinleştirici, sindirime yardımcı olma özelliğine sahiptir (William, 2012). Hindistan'da şeker hastalığı, kulak iltihabı, diş ağrısı, kolera, bronşit, astım gibi birçok hastalığın tedavisinde patlıcan meyvesinin lapası veya bitkinin birçok kısmından elde edilen suyun kullanıldığı bilinmektedir (Kashyap et al., 2003; Sekera et al., 2007; Demir et al., 2010; Boyacı, 2008).

Patlıcan düşük kalorili, yağ ve sodyum içeriği az, protein ve nişastaca zengin, lif oranı yüksek ve yaklaşık yapısında %90 su içeren bir sebzedir. Bu özellikleri nedeniyle obeziteyle mücadelede kullanılan sebzelerin başında gelmektedir (Mars, 2004; Boyacı, 2008). Patlıcanın içerdiği zengin organik asitler, mineral maddeler, fenolik ve antioksidan bileşikler nedeniyle insan sağlığı bakımından önemi son yıllarda daha da iyi anlaşılan fonksiyonel bir gıda olduğu kabul edilmiştir (Amadi et al., 2013).

**Biber**

Biber (*Capsicum annuum* L.) 463 bin ton üretim miktarı ile Solanaceae familyası içinde üretim bakımından dördüncü sıradadır (Anonymous, 2017). Tatlı ve acı olarak iki grupta toplanan biberin anavatanın Orta Amerika ve Meksika olduğu kabul edilmektedir. Biber besin değeri açısından önemli sebze türlerinden biridir. Yeşil, kırmızı ya da pişmiş olarak tüketildiğinde bu besin içeriklerinde farklılıklar görülebilmektedir. Ancak genellikle kırmızı meyvelerin besin içeriği biraz daha yüksektir. 100 g taze biberde yaklaşık olarak su % 91-93, kuru madde % 7-9, şeker % 3-4, karbonhidrat %4-6, protein % 0.8-1.2, yağ

% 0.2-0.9, vitamin C 120-220 mg'dır. Biber mineral madde içeriği bakımından zengin bir tür değildir, ancak insan beslenmesi açısından önemlidir (Şalk et al., 2008).

Bünyesindeki yağ, pigmentler, resin, protein, selüloz, mineral madde ile insan sağlığı üzerinde önemli etkisi bulunan birçok *Capsicum* türü ayrıca vitamin E ve provitamin A (karoten) kaynağıdır. Biberde acılık veren bir alkaloid olan capsaicin ($C_{18}H_{27}NO_3$) maddesi bulunabilmektedir. Beslenme açısından oldukça önemli olan acı biber, kırmızı renk pigmenti olan capsanthin içerir. Yapılan çalışmalar sonucunda capsaicin maddesinin kanserli hücrelerin gelişimini engellediği, acı biberin yoğun olarak tüketildiği bölgelerde düşük kanser oranının acı biber tüketimine bağlandığı, özellikle kolon, mide, dolaşım sistemi ile ilgili kanser türlerinin biber tüketiminin az olduğu bölgelerde göre daha düşük olduğu belirlenmiştir (Archer and Jones, 2002).

Capsaicin'in kan dolaşımını düzenlediği bu sayede kalp krizi riskini azalttığı ve bu etkinin özellikle kan hücreleri üzerinde meydana getirdiği sıcaklık artışından kaynaklandığı bildirilmiştir. Bu madde ayrıca sinüzit, alerjik belirtileri ve baş ağrısını ıcı etkilere de sahiptir. İlaç sanayinde kullanılan capsaicin farklı amaçlara yönelik sprey üretiminde hammadde olarak değerlendirilmektedir. Biberin yapısında güçlü bir antioksidan olan ve birçok sebzede bulunmayan veya çok az miktarda bulunan selenyum bulunmaktadır. Yapısında bulunan karotenoid pigmentleri (alfa ve betakaroten) biberde sarı, yeşil ve kırmızı rengin oluşmasını sağlar. Biber taze olarak tüketilmesinin yanı sıra, kızartma, közleme, pişirme, içi doldurularak (dolma), salça, turşu, acı sos, ketçap, konserve yapımında, konsantre domates çorbaları ve hazır çorbalar, tarhana, sucuk, pastırma yapımında, çocuk mamaları, yeşil zeytinlerin içinde, bazı peynirlere renk ve tat vermek amacıyla, kurutularak, dondurulmuş gıda, toz ve pul biber, boya ve ilaç sanayi olmak üzere birçok alanda kullanılmaktadır (Bozokalfa, 2002).

**Sekonder Metabolitler ve *Solanaceae* Familyası**

Besin olarak tüketilen sebzelerin içerikleri üzerine yapılan ilk çalışmalar tat ve kalite parametrelerinin belirlenmesinde kullanılan, daha çok protein, şeker, lipid gibi makro besin elementleri ile mineral ve vitamin gibi mikro elementler üzerine olup sekonder metabolitler göz ardı edilmiştir. Yeni teknik ve yöntemlerin geliştirilmesi ile görsel ve duyusal olarak tespit edilemeyen ancak sağlık yönünden de önemli olan sekonder metabolitlerin varlığı tespit edilmiştir. Başlangıçta sekonder metabolitlerin sağlık yönünden önemi ihmal edilmekle birlikte bazı sebze ve meyveler tedavi amaçlı kullanılagelmiştir. Günümüzde Pakistan, Hindistan gibi uzak doğu ülkelerinde bitkilerin hastalıkların tedavisinde etkin bir şekilde kullanıldığı bilinmektedir (Demir et al., 2010; Gul et al., 2011).

Sekonder metabolitler canlı organizmalarda hayati öneme sahiptir (Demain and Fang, 2000). Uzun yıllar önce sekonder metabolitler hücresel atık olarak değerlendirilmekteydi. Ancak son dönemde yapılan çalışmalar sonucunda sekonder metabolitlerin yüksek oranda ATP üretiminde gerekli olduğu, bu metabolitlerin işlevsiz olmadığı görülmüştür (Taiz and Zeiger, 2002; Wink, 1999).

Sekonder metabolitlerin bitkiler âlemindeki dağılışı sınırlı olup bu özellikleri ile primer metabolitlerden ayrılırlar. Sekonder metabolitler aynı familya ya da yakın türlerde, o türe özgü kimyasal bileşikler şeklinde görülürken primer metabolitler bitkiler âleminin tüm bireylerinde bulunur. Sekonder metabolitlerin ilaç hammaddesi, zehir, tatlandırıcı gibi özelliklerinin önem kazanması ile araştırmacılar açısından daha cazip hale gelmiştir (Taiz and Zeiger, 2002).

Sekonder metabolitler bitkilerde, patojenler, virüsler ve böceklere karşı savunmada oldukça önemli görevleri vardır ve aynı zamanda çiçek tozlarının veya tohumların taşınması için böcekleri çeken özellikte de olabilmektedir (Yazaki, 2006; Wink, 1999). Fenolik bileşikler, terpenler ve azotlu bileşikler olarak üç ana grup altında incelenen sekonder metabolitler, abiyotik stres faktörlerine karşı savunmada da etkilidir (Taiz and Zeiger 2002).

*Solanaceae* familyası tarım, ekonomi ve farmakolojik açıdan önemli bir familya olup, yapısında bulundurduğu alkaloidler antienflamatuvar, antihepatotoksit, antialerjik, sakinleştirici, kas gevşetici, idrar söktürücü gibi özellikleriyle yararlı olabilirken, bazen de azotlu bileşikler altında yer alan ve alkaloid sınıfında olan nikotin gibi sekonder metabolitler nedeniyle toksik olabilecek risklere sahiptir (Kırsoy, 2006).

*Solanaceae* familyası içinde yer alan tütünde bulunan nikotin sağlık yönünden birçok araştırmaya konu olurken tütün haricinde yaklaşık 12 değişik familyada da değişik oranlarda nikotin bulunmuş olup bunların çoğu gıda olarak tüketilen bitkilerdir. Bir tek sigarada bulunan nikotin yaklaşık 8-9 mg olup bunun 1 mg'ı sigara içen kişi tarafından alınmaktadır. Oysaki aynı miktarda nikotin, sebzeler içinde 100 µg ile en yüksek oranda içerdiği belirlenen patlıcandan yaklaşık 10 kg, domatesten 20 kg tüketildiği zaman ancak bünyeye alınabilmektedir. Bunun yanı sıra diyet yolu ile sebzelerden alınan nikotinin %70 oranındaki büyük bir kısmı sindirim sisteminde ve karaciğer tarafından etkisiz hale getirilmektedir (Appendino

and Scalfi, 2003).

Nikotin insan vücuduna ağız, deri ve sindirim yolu ile alınmaktadır (Yıldız, 2004; Rang et al., 1999). Nikotin solunum ile %60-80 oranında alınırken, hücre içine girişi pH'nın yüksekliği ile azalmaktadır. Sindirim yolu ile alınan nikotin, en fazla ince bağırsaktan alınmaktadır (Karaconji, 2005). Nikotinin, el ile tütün hasadı yapan tarım işçilerinde de toksisiteye sebep olduğu bildirilmiştir (Furbee and Wermuth, 1997).

Nikotin, *Solanaceae* familyasına ait olan domates, patates, yeşil biber, patlıcan gibi sebzelerde ve ayrıca çayda doğal olarak bulunmaktadır. Yapılan çalışmalar sonucunda İtalya ve Portekiz'de, nikotin miktarı açısından daha yüksek orana sahip olan ve gıda olarak tüketilen patlıcan, domates, patates ve çay ile ortalama alınan nikotin miktarının 2.25 µg/gün olduğu (Sigmund et al., 1999), günlük öğünlerle alınan ortalama nikotin miktarı ise İsveç'te 1.1 µg, Danimarka'da 1.3 µg olarak bildirilmiştir (Wu et al., 1998).

Nikotin toksik bir madde olup yapılan çalışmalar sonucunda yaklaşık 5 mg $kg^{-1}$'lık miktarın öldürücü olduğu bildirilmiştir. Küçük bir çocuk bir sigarayı sindirim yolu ile alması sonucu (yaklaşık 2 mg nikotin) zehirlenme belirtileri gösterebilir (Furbee and Wermuth, 1997). Bu bilgiler çerçevesinde havadaki nikotin yoğunluğu 5 mg $m^{-3}$ olduğunda insanlar ve hayvanlar için tehlikeli sınır olduğu bildirilmiştir. Nikotin zehirlenmesinin belirtileri mide bulantısı, kusma, karın ağrısı, ishal, baş ağrısı, terleme, solgunluk olup, şiddetli zehirlenmelerde, baş dönmesi, halsizlik, bilinç kaybı, kasılma, düşük tansiyon ve koma belirtileri görüldüğü belirtilmiştir (Karaconji, 2005).

Amerika ve Yeni Zelanda'da sigaranın içerdiği nikotin üzerine yapılan anket çalışmalarında %50'nin üzerinde ankete katılanların nikotinin kansere sebep olduğu ile ilgili görüş bildirilmiştir. Oysaki nikotin toksik bir maddedir ve bağımlılık oluşturur. (Wilson, 2011). Bağımlılık oluşturduğu için sigaraya başlayanların bırakmasındaki zorluğun nikotinin etkisinden kaynaklandığını, eksikliğinde iştahsızlık, uykusuzluk, konsantrasyon eksikliği, huzursuzluk belirtileri görüldüğü bildirmiştir (Naff, 2006).

Nikotin tütünden solunum yoluyla alındığında veya ağızdan yüksek dozda sindirim yoluyla alındığında veya temas yoluyla tütün bitkisinden deri yoluyla yoğun olarak alındığında toksik ve zararlı etkileri ortaya çıkabilin bir alkaloiddir. Bununla birlikte Solanaceae bitkilerinde mikrogram düzeylerinde olup pişirildiğinde neredeyse tamamen kaybolmaktadır. Sindirim yoluyla alınan çok düşük dozlardaki nikotin karaciğer ve akciğerler yoluyla parçalanarak atılmaktadır. Aşırı tüketim söz konusu olmadığında, normal beslenme rejimine sahip bir insan vücudunda Solanaceae familyası sebzelerinde bulunan nikotin nedeniyle zarar görme riski bulunmamaktadır. Tütünde yoğun olarak bulunan bu madde, bağımlılıktan sorumlu olmakla birlikte kanserojen etki, esasen tütünün içeriğindeki diğer toksik maddeler tarafından özellikle de radyoaktif özellik taşıyanlar nedeniyle gerçekleşmektedir. Çok düşük dozlarda ve parçalanabilir nitelikteki tüketimle vücuda alınan sekonder metabolitlerin bağışıklık sistemini canlı tutan ve uyarıcı etkilerinin olabileceği de özellikle Ayurvedik beslenme rejimlerinde üzerinde durulan konular arasında yer almaktadır. Tüm bunların dışında Nightshade familyası olarak da adlandırılan Solanaceae bitkilerinin zengin sekonder metabolit içeriklerinin, bazı bünyelerde histamin intoleransına da yol açabileceği, alerjik yapılı kişilerde tüketimine özen gösterilmesi gereken besinler olarak bilindikleri de göz önünde bulundurulmalıdır.

## KAYNAKLAR


Adams, K.C., Campbell, J.K., Zaripheh, S., Jeffery, E.H. & Erdman, J.W. 2005. The tomato as a functional food. Journal of Nutrition, 135, 1226-1230.

Akan, S., Veziroğlu, S., Özgün, Ö. & Ellialtıoğlu, Ş. 2013. Turp (*Raphanus sativus* L.) sebzesinin fonksiyonel gıda olarak değerlendirilmesi. Y.Y.U. J. AGR. SCI., 23(3), 289-295.

Akıncı, I.E., Akıncı, S., Yılmaz, K. & Dikici, H. 2004. Response of eggplant varieties (*Solanum melongena*) to salinity in germination and seedling stages. New Zealand Journal of Crop and Horticultural Science, 32(2), 193-2004.

Amadi B., Onuoha N., Amadi C. & Ugbogu A. 2013. Elemental, amino acid and phytochemical constituents of fruits of three different species of eggplant. Int. J. Med. Arom. Plants, 3, 200–203.

Anonymous. 2017. Web Sitesi: http://faostat.fao.org. Erişim Tarihi: 01.09.2017.

Appendino, C. & Scalfi, O.T. 2003. Drug-like compounds from food plants and spices. In: Dietary Supplements of Plant Origin. Maffei, M. (eds), 43-74. London

Archer, V.E. & Jones, D.W., 2002. Capsaicin Pepper, Cancer and Etnicity. Medical Hypotheses 59(4): 450-457.

Asmah, R., Fadzelly, M.A.B., Abdah, M.A., Eliana, A.N. & Hafzan, Y. 2007. Antioxidant activity, total phenolic content and cytotoxic activity of various types of eggplants J. Trop. Agric. and Food. Sc. 35(1): 91-97.

Bazzano, L.A., He, J., Ogden, L.G., Ogden, G., Catherine, M.L., Vupputuri, S., Myers, L. & Whelton. P.K. 2002. Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. Am. J. Clin. Nutr., 76: 93-99.

Boyacı H.F. 2008. Bilinmeyen yönleri ile patlıcan. Meyve ve Sebze Dünyası, 1(7): 56-57.

Boyacıoğlu, D. 2013. Web Sitesi: http//www.dilekboyacioglu.com. Erişim Tarihi: 01.10.2014.

Bozokalfa, M.K. 2002. Bazı Yerli Biber Genotiplerinin Karakterizasyonu ve Sanayiye Uygunluklarının Belirlenmesi Üzerinde Araştırmalar. Doktora Tezi, Ege Üniversitesi, Fen Bilimleri Enstitüsü, Bahçe Bitkileri Anabilim Dalı, 243s, İzmir.

Brandt, S., Pek, Z., Barna, E., Lugasi, A. & Helyes, L. 2006. Lycopene content and colour of ripening tomatoes as affected by environmental conditions. Journal of the Sci. Food & Agri., 8, 568-572.

Chen, N.C. & Li, H.M. 2003. Cultivation and breeding of eggplant. Asian Vegetable Research and Development Center. http://203.64.245.61/fulltext_pdf/eam0137.pdf Erişim tarihi: 26.08.2017.

Demain, A.L. & Fang, A. 2000. The natural functions of secondary metabolites, Adv. Biochem. Eng. Biotechnol., 69: 1-39.

Demir, K., Bakir, M., Sarikamis, G. & Acunalp, S. 2010. Genetic diversity of eggplant (*Solanum melongena*) germplasms from Turkey assessed by SSR and RAPD markers. Genetics and Molecular Research, 9(3): 1568-1576.

Dorais, M., Gosselin, A. & Papadopoulos, A.P. 2001. Greenhouse tomato fruit quality. Hortic. Rev., 26: 239-306.

Fraser, P.D., Enfissi, M.A.E. & Bramley, P.M. 2009. Genetic engineering of carotenoid formation in tomato fruit and the potential application of systems and synthetic biology approaches. Archives of Biochemistry and Biophysics, 483: 196-204.

Furbee, B. & Wermuth, M. 1997. Life-Threatening Plant Poisoning. Crit. Care Clin., 13 (4): 849-888.

Gann, P.H., Ma, J., Giovannucci, E., Willett, W., Sacks, F.M., Hennekens, C.H. & Stampfer, M.J. 1999. Lower prostate cancer risk in man with elevated plasma lycopene levels: results of a prospective analysis. Cancer Res., 59: 1225-1230.

George, B., Kaur, C., Khurdiya, D.S. & Kapoor, H.C. 2004. Antioxidants in tomato (*Lycopersium esculentum*) as a function of genotype. Food Chemistry, 84: 45-51.

Gul, S., Ahmed, S., Gul, H. & Kaneez, F.S. 2011. Investigating the protective effect of *Solanum melongena*. Asian Scientific Journal, 1(1): 276-294.

Gould, W.A. 1983. Tomato Production, Processing and Quality Evaluation. Avi. Pub. Co., Westport, Co., 445pp.

Hasler, C.M. 1998. Functional Foods: Their role in disease prevention and health promotion. Food Technology, 52 (11): 63-70.

Hedges, L.J. & Lister, C.E. 2007. Nutritional attributes of spinach, silver beet and eggplant. Crop and Food Research Confidental Report No.1928, 16-21.

Helyes, L., Pék, Z. & Lugasi, A. 2006. Tomato fruit quality and content depend on stage of maturity. Hort Science, 41(6): 1400-1401.

Kades, I.J., Fategbe, M.A., Ibukun, E.O. & Rocha, J.B.T. 2013. A comparative study on ripe and unripe eggplant (*Solanum melongena*) as dietary antioxidant sources. Journal of Medicinal Plants Research, 7(6): 209-218.

Karaconji, I.B. 2005. Facts about nicotine toxivity. Arh. Hig. Rada Toksikol., 56: 363-371.

Kashyap, V., Vinod Kumar, S., Collonnier, C., Fusari, F., Haicour, R., Rotino, G.L., Sihachakr, D. & Rajam, M.V. 2003. Biotehnology of eggplant. Scientia Horticulturae, 97 (1): 1-25.

Kök, D. 2011. Deneysel diyabet oluşturulan ratların böbrek dokusu oksidan ve antioksidan durumu üzerine likopenin etkisi. Yüksek Lisans Tezi, Yüzüncü Yıl Üniversitesi, Van.

Kuti, J.O., & Konuru, H.B. 2005. Effects of genotype and cultivation environment on lycopene content in red-ripe tomatoes. J. Sci. Food &Agri., 85: 2021-2026.

Mars, B. 2004. Eggplant rawsome. Basic Health Publications, Inc. 28812 Top of the World Drive Laguna Beach, CA 92651, 42-43.

Moreno, C. S., Ancos, B., Plaza, L., Martinez, P. E., & Cano, M. P. 2008. Nutritional characterization of tomato juices. In: Tomato and Tomato Products-Nutritional, Medicinal and Therapeutic Properties. Predy, V.R. Watson, R.R. (eds), Science Publisher, 664, USA.

Naff, C.F. 2006. Nicotine and Tobacco. Reference Point Press. San Diego. USA.

Pernice, R., Parisi, M., Giordano, I., Pentangelo, A., Graziani, G., Gallo, M., Fogliano, V., & Ritieni, A. 2010. Antioxidants profile of small tomato fruits: Effect of irrigation and industrial process. Scientia Horticulturae, 126: 156-163.

Petro-Turza, M. 1987. Flavor of tomato and tomato products. Food Review International, 2 (3): 309-351.

Pugalendhi, L., Veeraragavathatham, D., Natarjan, S. & Praneetha, S. 2010. Utilizing wild relative (*Solanum viarum*) as resistant source to shoot and fruit borer in brinjal (*Solanum melongena* L.). Electronic Journal of Plant Breeding, 1(4): 643-648.

Rao, A.V. & Rao, L.G. 2007. Carotenoids and human health. Pharmacological Resarch, 55: 207-216.

Riboli, E. & Norat, T. 2003. Epidemiologic evidence of the protective effect of fruit and vegetables on cancer risk. Am. J. Clin. Nutr., 78: 559-569.

Sekera, A., Cebula, S. & Kunicki, E. 2007. Cultivated eggplants – origin, breeding objectives, and genetic resources, A review. Folia Horticulturae, 19(1): 97-114.

Shabana, M.M., Salama, M.M., Ezzat, S.M. & Ismail, L.R., 2013. In vitro and in vivo anticancer activity of the fruit peels of *Solanum melongena* L. against hepatocellular carcinoma. J Carcinogene Mutagene, 4: 149.

Şalk, A., Arın, L., Deveci, M., & Polat, S. 2008. Özel Sebzecilik. Namık Kemal Üniversitesi Ziraat Fakültesi, 488 s.

Taiz, L. & Zeiger, E. 2002. Plant Physiology. Sinauer Associates Inc., 690.

Talhouni, M. 2016. Patlıcanda Tuzluluk Stresine Dayanımın Artırılmasında Anaçların ve Yerel Gen Kaynaklarının Etkinliği Üzerinde Araştırmalar. Doktora Tezi, Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Bahçe Bitkileri Anabilim Dalı, 195s, Ankara.

Tümbilen, Y., Frary, A., Mutlu, S. & Doganlar, S. 2011. Genetic diversity in Turkish eggplant (*Solanum melongena*) varieties as determined by morphological and molecular analysis. International Research Journal of Biotechnology, 2(1): 16-25.

West, K.P., Jr, Katz, J. & Khatry, S.K. 1999. Double blind, cluster randomised trial of low dose supplementation with vitamin A or beta carotene on mortality related to pregnancy in Nepal. BMJ, 318: 570-575.

Wilson, N., Peace, J., Edwards, R. & Weerasekera, D. 2011. Smokers commonly misperceive that nicotine is a major carcinogen: National survey data. Thorax, 66 (4): 353-354.

Wink, M., 1999. Introduction: biochemistry, role and biotechnology of secondary metabolites. Annuals Plant Reviews, 2: 1-16.

Woolfe, J.A. 2009. The Potato in the Human Diet. Cambridge University Press. P. 248. London.

Wu, C., Siems, W.F., Hill, H.H. & Hannan, R.M. 1998. Analytical determination of nicotine in tobacco by supercritical fluid chromatography–ion mobility detection. Journal of Chromatography A, 811: 157–161.

Yazaki, K. 2006. ABC transporters involved in the transport of plant secondary metabolites. FEBS Letters, 580 (4): 1183-1191.

Yılmaz, E. 2001. The Chemistry of Fresh Tomato Flavor. Turkish Journal of Agriculture and Forestry, 25: 149-155.

## O -12 Development of New Cherry Cultivars Using Different Breeding Methods*

Mehmet BAŞ[1], Ayşe FİDANCI[1], Selma ÖZYİĞİT[1], Adnan DOĞAN[1], Burak KUNTER[2]

[1-] Atatürk Horticultural Central Research Institute, Yalova, Turkey

[2-] Turkish Atomic Energy Authority (TAEK), Sarayköy Nuclear Research and Training Center (SANAEM), Division of Agriculture, Ankara, Turkey

e-mail: mehmetbas77@yahoo.com, basmehmet@tarim.gov.tr

### Abstract

Turkey is one of the leading sweet cherry producers in the world; however, cherry exports of Turkey have not the desired level. While Turkey is expected to be a leader country in breeding of the cherry cultivars and rootstocks, there are not national cultivars but 0900 Ziraat. This cultivar has good fruit quality parameters (e.g. texture, flavor, color) but its yield is instable in some years. There is a need to develop some new cultivars harvested in different seasons to increase production and also meet consumer demands. The first cherry hybridization and mutation breeding program have been initiated to obtain new cherry cultivars at the beginning of the new Millennium by Atatürk Horticultural Central Research Institute in Yalova-Turkey. In this study, cross breeding method was applied to obtain new self-compatible, good fruit characteristics and yielding cultivars, crossed 0900 Ziraat and self-compatible cultivars (Stella and Sweetheart). Also mutation breeding method was used to obtain higher quality fruit, a compact growth and better yielded cultivars than 0900 Ziraat. Two mutant cherry cultivars (Burak and Aldamla) have been registered in the first step. Also good quality new hybrids were obtained from cross breeding program, which were over 27 mm calibration, 9.2-14.1 g fruit weight and self compatible. Using molecular methods and the calibration are our main selection criteria. Selections are still continuing in several cherry types and various new promising types have been selected among them. In addition to, new hybridization studies have been continued according to changing conditions.

**Keywords:** Cherry, Cultivar, Hybridization, Mutation, Breeding

**Acknowledgement*: This study is funded by General Directorate of Agricultural Research and Policies, Scientific Research Project # TAGEM/BBAD/16/A08/P01/01

### Introduction

Turkey is leading country in cherry production with an approximately 20% of World production but it ranks third in sweet cherry export in the world. In recent years, although our sweet cherry export has made great progress, it is almost the only cultivar '0900 Ziraat' used in exportation. Known as "Turkish Sweet Cherry", this cultivar can be stored for a long time and has excellent fruit quality. However, due to ecological effects, its yield is low for some years.

Sweet cherry breeding purposes show some changes according to the countries. Generally, they can be summarized as a reduction in tree vigor, early fruit bearing, regular and high quality yield, self-compatibility, a long harvesting period between early and late harvested cultivars, and progression in tolerance to cold and diseases. It is also aimed to develop cultivars which have large fruits, hard fruit flesh, dark color, good taste/aroma, and which are less susceptible to fruit cracking as fruit characteristic (Bargioni, 1996; Brown *et all*., 1996; Saunier, 1996).

Self-compatibility trait for sweet cherry which is naturally incompatible species is a very interesting feature for breeding purposes. However, self-compatibility is a rare occurrence naturally in sweet cherry (Wunsch and Hormaza, 2004). Recent years of breeding studies seem to concentrate on obtaining self-compatible sweet cherry cultivars. When genetic self-compatibility is combined with all cultivars, there will be no need for pollenizers for sweet cherry orchards. Because pollenizer cultivars are generally not as preferred as the main cultivars on the market, but they cover about 10% of the sweet cherry orchards (Brown *et all*., 1996).

Self compatibility is one of the most important and desirable feature in sweet cherry. Stella is the first sweet cherry cultivar developed as self-compatible and known as the most used parent in breeding studies for this pur-

pose (Kappel and Lay, 1997).

Some researchers have developed primers for each S-allele for the sweet cherry to be determined by the PCR method of S-incompatible alleles. In these studies primers of incompatible alleles from S1 to S16 were developed (Sonneveld *et all*., 2001; Wiersma *et all*., 2001; Sonneveld *et all*., 2003).

**Materials and Methods**

The first step of the hybridization study was initiated in 2001 and three combinations were created, namely "Stella x 0900 Ziraat", "0900 Ziraat x Stella" and "Sweetheart x 0900 Ziraat", and many hybrid individuals were obtained from these combinations. Then in 2009, five new combinations were created using Regina, Ferbolus Verdel and Sweetheart cultivars, along with two self-compatible types selected as parents among the first-stage hybrids.

Sweet cherry blossoms were pollinated artificially one day after being emasculated in the balloon phase. As the emasculated flowers are rarely visited by bees and other insects (Bargioni, 1996; Hesse, 1975), no covering material was used.

The fruits obtained by hybridization were collected at the normal harvest time and pits were removed and dried for one week. The seeds obtained by breaking the pits were immediately stratified and kept in a refrigerator at 4 ° C.

Hybrid seedlings were planted in the observation orchard both on their own roots and for early bearing, on dwarfed rootstocks (Gisela 5 and Gisela 6).

In the study, scions of 0900 Ziraat were also irradiated with gamma rays at 25, 30, 35, 40, 45, 50, 55 and 60 Gray doses at the end of the rest season in order to create mutations. Cobalt ($Co^{60}$) was used as a source of mutagen for irradiation of scions. After applying the irradiated buds, immediately they were budded on *P. avium* rootstocks using chip budding method. The budded seedlings were kept in a shaded greenhouse during the first growing season. Linear regression analysis was applied to determine the "effective mutation doze" (EMD) in the data obtained by measuring the shoot length at the 60th day after budding (Donini, 1980; Saamin and Thompson, 1998). The young trees obtained by irradiated buds were considered to be mutant candidates. They were planted in the observation orchard at the end of the following autumn with a spacing of 2x5 m.

The individuals obtained by hybridization and mutation breeding were predominantly evaluated in terms of tree, fruit characteristics and general health status. Considering self-compatibility especially in hybrid individuals, compact growth takes priority in mutant individuals; early bearing, regular and desired yielding in all individuals are determined as important tree characteristics. Fruit traits were taken into account as later maturing, cracking resistant and hard fruit flesh, especially dark fruit / flesh color and high fruit calibration (≥27 mm).

The self-compatibility status of hybrid individuals was determined from DNA of leaf samples (Kafkas and Perl-Treves, 2001, Doyle and Doyle, 1987). In obtaining the DNA, the Qiagen Kit was used. The S alleles of $F_1$ hybrid sweet cherries were determined by PCR reaction using primers developed by Sonneveld *et all.* (2001).

**Results and Discussion**

**Hybridization studies**

In the first phase of the study, approximately 550 hybrid individuals were obtained from the combinations. The number of obtained hybrid individuals was low for a breeding program. Compared to other fruit breeding programs, sweet cherry breeding studies are carried out with very limited numbers of plants (Iezzoni, 2008). Because of Stella has more plump seeds than 0900 Ziraat, the best germination rates were achieved from the combination of Stella used as female parent. For this reason most of the hybrid individuals belong to this combination (Table 1).

In general, the seeds after a week of drying were taken stratifiction and germination started after 60 days. Immediate stratification after harvesting of seeds affected the germination rate positively than those later stratification. Seeds germinated during stratification were planted regularly every week and this application continued for 6-7 months. Some seeds did not germinate during this time, though they were alive. Such seeds were sub-

jected to hot stratification at 21-22 ° C for 2-3 weeks and then taken again at 4 ° C. Almost all of the seeds in this situation germinated until the end of the next third month. It is stated that holding the stratification period for 6 months increases germination (Iezzoni 2008).

In 520 of the first hybrid individuals, the self-compatibility status was assessed in younger stages using molecular techniques. In 520 individuals of different combinations, the proportion of self-compatible S alleles was 56.1%, while the proportion of self-incompatible individuals was 40.0%, while 3.9% came from a pollenizer parent known as a different S-allele with undesired pollination (Table 1). This confirms that emasculated flowers can be exposed to a small amount of outsider pollination because they are not covered. The determination of the self-compatibility status of young individuals at younger ages has been an advantage for selection and evaluation in seedlings that are not yet in the bearing stage.

Hybrid individuals were planted on their own roots and grafted on dwarfed rootstock (Gisela 5) in the observation orchard. The trees on their own roots showed fruit bearing in the fifth and sixth year after planting, while the grafted trees on dwarfed rootstocks showed fruit at 2-3 years after grafting. In the first years, the product obtained from the trees on dwarfed rootstock were better quality than the trees on their own roots.

Some of the most important pomological characteristics of the priority hybrid individuals in the observation orchard are given in Table 2. Fruit weights were found to be 9.2– 14.1 according to the evaluations made every year. Fruits with a caliber less than 27 mm were eliminated and the elimination process continues every year. The fruit calibers of the hybrids ranged from 27 to 32 mm (Table 2). These values are high for domestic and foreign markets and they are an important indicator for the marketing of sweet cherry fruits. The values of dry matter content are also seen to be within the desired limits for sweet cherry breeding (Brown *et all.,* 1996; Sansavini and Lugli, 2001; Kappel, 2005).

Based on long years of measurement, observations and evaluations, 7 hybrids were selected and grafted on cherry seedling and Gisela 6 rootstocks and they were planted at trial orchard for the first advanced testing stage.

New parental combinations were created with 2 self-compatible types (B-13 and D-2), from the types included in the first stage hybridization study, and some cultivars (Regina, Ferbolus Verdel and Sweetheart). A total of 1886 new hybrid types were obtained after five years of hybridization studies. Since the beginning of the study (2001), a total of 2436 hybrid individuals have been obtained. Pomological evaluations were carried out by taking fruits from 660 of them. We did not receive enaugh fruits from the other hybrits for evaluation. Efforts to determine the self-compatibility status of these hybrid individuals by molecular methods are ongoing. Pomological evaluations are made every year and about 50-60% of hybrid types are eliminated as they are not suitable for the purpose of the project.

**Mutation breeding studies**

In the mutation breeding study, the scions of 0900 Ziraat sweet cherry cultivar were irradiated at eight different doses, with a five unit dose increasing between 25-60 Gy and the “effective mutation dose” was calculated to be 33.75 Gy according to the linear regression determined on the basis of shoot length after chip budding.

In the potential mutant types planted in the observation orchard, abnormal leaf shapes, chlorophyll mutations and chimeric occurrences were observed due to the effects of irradiation dose. In $M_1V_2$ generation, the random mutation frequency (MF) was calculated as 4.1%. This value is similar to the value obtained by Saamin and Thompson (1998) from the Bing sweet cherry cultivar.

Approximately 400 mutant types were observed annually and each mutant type was accepted as a new vegetative generation for each year ($M_1V_2$, $M_1V_3$, $M_1V_4$, etc.). Data on the characteristics of these vegetative generations have been recorded. In each vegetation observation, each branch was observed in detail along with general habitus. Some of the initial values are given in Table 3. According to this, some features of the mutant candidate types were found valuable. These tend to be development of flower cluster and dwarfed growth in general. Rarely, however, there is an increase or decrease in leaf size, rough or thin leaf formation, and a few dark colored leaves. In addition, very few increased in number nectary glands, nectary glands shrinkage and flat leaf ends formation were seen.

In the mutant types, there have been some differences in the habitus of the trees over the years. These tend to be vertical growth, steep-splay and splay growth tendency, semi-dwarfed, dwarfed and even very weak crown formation due to growing decline. Although very rare, some of the branches on the tree were obviously blossoming at different times, bearing different sizes of fruit and ripening fruit at different times. Such differences in mutation breeding have been carefully examined and recorded, when encountering such occurrences.

In addition, some branches of mutant types were bagged to self-pollinate at the time of flowering, but no fruit set was observed. However, this application has only been done once.

After observing for many years, 400 mutant candidates were evaluated and 110 mutant types were selected first. Ten of them were selected for the advanced performance test according to the dwarfed and semi-dwarfed growth tendency, high yield and fruit quality (attractiveness, fruit flesh firmness, taste etc.).

It is possible to add some desired properties to existing cultivars by mutation breeding and to obtain new cultivars in a shorter time than traditional breeding (Lapins, 1983). In our study, hybridization and mutation breeding studies were started at the same time, two mutant cultivars named '**Burak'** and '**Aldamla'** were previously registered, and there are also hopeful cultivar candidates obtained as a result of hybridization.

**Conclusion**

In the determination of the aims of the sweet cherry breeding, it is very important to predict the future consumer demands in advance for the breeding studies

Breeding goals should be treated appropriately when making selection in hybrid and mutant individuals. However, hybrid and mutant individuals with some rare characteristics should not be eliminated merely because they are not suitable for breeding purposes. However, breeders should be very selective while keeping such plants.

Sweet cherry cultivars have difficulties in obtaining seeds with high germination ability. In the sweet cherry hybridization breeding studies, it is desirable that the germination ability of the seeds of the female parent is particularly high. The parent's choice should have a positive impact on the number of hybrid individuals.

Stratification of precious hybrid seeds right after harvesting should be preferred for better germination. In order to have higher rates of germination, establishment of hygienic conditions is very important.

**Literature Cited**

Bargioni, G., 1996. Sweet Cherry Scions: Characteristics of the Principal Commercial Cultivars, Breeding Objectives and Methods. (Eds. A. D. Webster and N. E. Looney) Cherries: Crop Physiology, Production and Uses. CAB International, Oxon, UK: 73-112.

Brown, S.K., A.F. Iezzoni, H.W. Fogle, 1996. Cherries. (Eds: Janic, J. and James N. Moore) Fruit Breeding, Volume I: Tree and Tropical Fruits John Wiloy & Sons Inc. NY. USA.

Donini, B., 1980. Mutagenesis applied to improve fruit trees. Induced Mutations in Vegetatively Propagated Plants. Vienna 1982 IAEA Panel Proceeding Series.

Doyle, J.J. and J. L. Doyle, 1987. A Rapid Isolation Procedure for Small Quantities of Fresh Leaf Tissue. Phytochemical Bulletin, 19: 11-15.

Hesse, C.O., 1975. Peaches. (Eds. J. Janick and J. N. Moore) Advances in Fruit Breeding. Purdue University Press West Lafayette, Indiana: 285-335.

Iezzoni, A.F., 2008. Cherries. p. 687-693. (Eds Janick, J. and R E. Paull) The Encyclopedia of Fruits and Nuts, Wallingford, Oxfordshire: CABI Publishing.

Kafkas, S. and R. Perl-Treves, 2001. Morphological and Molecular Phylogeny of Pistacia species in Turkey. Theor. Appl. Genet. 102(6-7): 908-915.

Kappel, F. and W. Lay, 1997. Sweet Cherry Breeding in Canada from the Early 1900s to 1994. Fruit Varieties Journal, 51(4):233-238.

Kappel, F., 2005. New Sweet Cherry Cultivars from Pacific Agri-Food Research Centre (Summerland). Acta Horticulturae 667: 53-57.

Lapins, K. O., 1983. Mutation Breeding. (Eds. J. N. Moore and J. Janİck). Methods in Fruit Breeding. Purdue University Press West Lafayette, Indiana: 74-99.

Saamin, S. and M. M. Thompson, 1998. Radiation-induced mutations from accessory buds of sweet cherry, Prunus avium L. cv 'Bing'. Theoretical and Applied. Genetics 96: 912-916.

Sansavini, S. and S. Lugli, 2001. From the University of Bologna, Three New Self-Fertile Sweet Cherry Cultivars. Rivista di Frutticoltura e di Ortofloricoltura, 63(3): 57, 59, 61.

Saunier, R., 1996. Sweet Cherry Breeding at the Research Station in Bordeaux. Acta Hort. 410. ISHS, p: 35-40.

Sonneveld, T., T. P. Robbins, R. Boskovic, K. R. Tobutt, 2001. Cloning of six Cherry Self-incompatibility Alleles and Development of Allele-specific PCR Detection. Theor Appl. Genet 102:1046-1055.

Sonneveld, T., K. R. Tobutt, T. P. Robbins, 2003. Allele-specific PCR Detection of Sweet Cherry Self-incompatibility (S) Alleles S1 to S16 Using Consensus and Allele-specific Primers. Theor Appl. Genet 107:1059-1070.

Wiersma, P. A., Z. Wu, L. Zhou, C. Hampson, F. Kappel, 2001. Identification of new self-incompatibility alleles in sweet cherry (Prunus avium L.) and clarification of incompatibility groups by PCR and sequencing analysis. *Theor Appl Genet* 102: 700–708.

Wunsch, A. and J. I. Hormaza, 2004. Genetic and Molecular Analysis in Cristobalina Sweet Cherry, A Spontaneous Self-Compatible Mutant. Sexual Plant Reproduction, 17(4): 203-210.

Table 1. Status of $F_1$ progenies concerning S alleles*

| **Parents** | **Progenies** | **$S_3 S_{12}$** | **$S_3 S_4$,** | **$S_4$, $S_{12}$** | **Undesired Pollination** |
|---|---|---|---|---|---|
| **Stella x 0900 Ziraat** | 481 | 202 (42.0%) | 31 (6.4%) | 228 (47.4 %) | 20 (4.2 %) |
| **0900 Ziraat x Stella** | 23 | 2 (8.7%) | 13 (56.5%) | 8 (34.8 %) | --- |
| **Sweetheart x 0900 Ziraat** | 16 | 4 (25.0%) | 4 (25.0%) | 8 (50.0 %) | --- |
| **Total** | 520 | 208 (40.0%) | 48 (9.2%) | 244 (46.9 %) | 20 (3.9 %) |

***0900 Ziraat $S_3 S_{12}$, Stella $S_3 S_4$', Sweetheart $S_3 S_4$,**

Table 2. Fruit characteristics, yield and maturity time of some hybrid types

| Hybrid Types | Fruit Weight (g) | Fruit Size (mm) | Pit Weight (g) | Stem Lenght (mm) | Soluble Solids (%) | Cum. Yield (Kg/tree) | Maturity |
|---|---|---|---|---|---|---|---|
| E-11 | 13.0 | 31 | 0.55 | 55 | 15.7 | 1.4** | 03.06 |
| E-15 | 9.8 | 27 | 0.43 | 51 | 18.4 | 5.4** | 22.06 |
| E-18 | 10.4 | 28 | 0.53 | 55 | 18.6 | 13.1*** | 18.06 |
| G-36 | 12.8 | 29 | 0.45 | 57 | 16.9 | 10.2*** | 21.06 |
| G-37 | 11.5 | 29 | 0.44 | 56 | 16.0 | 13.6*** | 21.06 |
| J-2 | 10.3 | 28 | 0.38 | 59 | 18.0 | 10.3*** | 13.06 |
| J-13 | 13.6 | 30 | 0.46 | 49 | 19.6 | 6.9*** | 15.06 |
| J-51 | 10.1 | 27 | 0.44 | 51 | 17.7 | 17.3*** | 20.06 |
| H-15 | 11.8 | 28 | 0.41 | 48 | 20.1 | 12.1*** | 21.06 |
| H-17 | 9.8 | 27 | 0.40 | 54 | 16.4 | 31.5*** | 06.06 |
| H-22 | 10.8 | 28 | 0.44 | 51 | 15.3 | 17.8*** | 05.06 |
| H-38 | 11.2 | 28 | 0.46 | 62 | 17.2 | 18.1*** | 16.06 |
| H-46 | 9.6 | 27 | 0.36 | 47 | 16.9 | 12.5*** | 11.06 |
| M-7 | 11.4 | 28 | 0.40 | 45 | 16.5 | 16.5*** | 09.06 |
| M-11 | 10.3 | 28 | 0.41 | 51 | 18.0 | 14.0*** | 12.06 |
| M-13 | 10.8 | 28 | 0.35 | 43 | 15.9 | 5.7*** | 16.06 |
| M-41 | 10.5 | 28 | 0.48 | 51 | 18.1 | 13.1*** | 12.06 |
| M-43 | 9.2 | 27 | 0.38 | 45 | 15.9 | 19.1*** | 06.06 |
| N-19 | 9.4 | 27 | 0.40 | 48 | 15.4 | 9.8*** | 09.06 |
| N-30 | 14.1 | 32 | 0,37 | 57 | 17.4 | 0.7* | 05.06 |
| N-31 | 10.6 | 28 | 0.44 | 53 | 19.3 | 7.2*** | 12.06 |
| R-6 | 10.4 | 27 | 0.38 | 50 | 17.3 | 14.6*** | 18.06 |
| R-15 | 10.9 | 29 | 0.41 | 51 | 17.0 | 10.4*** | 18.06 |
| R-38 | 10.0 | 27 | 0.40 | 45 | 17.2 | 20.2**** | 17.06 |
| R-48 | 9.3 | 27 | 0.37 | 46 | 16.8 | 13.3**** | 17.06 |

* The number of symbols indicates how many years' cumulative values are.

Table 3. Morphological changes of some mutant types in early stages of development.

| Mutant Types | First Year Shoot Length (cm) | Second Year Shoot Length (cm) | Side Shoot Number | Remarkable features |
|---|---|---|---|---|
| 25-5 | 65 | 27 | 2 | Vigorous growth |
| 25-8 | 38 | 40 | 0 | Spot on the leaves |
| 25-10 | 56 | 27 | 1 | Rough textured leaves |
| 25-11 | 5 | 45 | 0 | Spot on the leaves |
| 25-13 | 20 | 12 | 2 | Dwarfed growth, smaller leaves |
| 25-15 | 8 | 48 | 0 | Rough textured leaves |
| 25-24 | 17 | 13 | 1 | Dwarfed growth |
| 25-25 | 40 | 10 | 1 | Smaller nectary glands |
| 25-34 | 4 | 3 | 0 | Very dwarfed growth |
| 25-37 | 47 | 16 | 0 | Flat leaf ends |
| 25-40 | 19 | 29 | 0 | Rough textured leaves |
| 25-42 | 45 | 14 | 1 | Smaller leaves |

| | | | | |
|---|---|---|---|---|
| **30-13** | **1** | **12** | **0** | **Dwarfed growth** |
| **30-19** | **8** | **49** | **0** | **Rough textured leaves** |
| **30-20** | **41** | **23** | **0** | **Darker leaves** |
| **30-21** | **18** | **7** | **1** | **Dwarfed growth** |
| **30-22** | **14** | **44** | **0** | **Rough textured leaves** |
| **30-25** | **1** | **18** | **1** | **Dwarfed growth, spot on the leaves** |
| **35-2** | **5** | **0** | **0** | **Very dwarfed growth** |
| **35-7** | **5** | **49** | **0** | **Spot on the leaves** |
| **35-9** | **51** | **22** | **0** | **Smaller and darker leaves** |
| **35-22** | **69** | **16** | **0** | **Fine textured leaves** |
| **35-28** | **48** | **16** | **0** | **Smaller leaves, multiple nectary glands** |
| **35-36** | **29** | **17** | **2** | **Smaller nectary glands** |
| **35-47** | **17** | **31** | **2** | **Rough textured leaves** |
| **40-2** | **28** | **14** | **2** | **Slit on the leaf** |
| **40-14** | **19** | **42** | **0** | **Very large leaves** |
| **40-15** | **68** | **12** | **0** | **Flower cluster development** |
| **40-16** | **6** | **51** | **0** | **Larger leaves** |
| **40-22** | **71** | **9** | **0** | **Flower cluster development** |
| **45-11** | **48** | **6** | **0** | **Smaller leaves with spot** |
| **45-22** | **41** | **24** | **1** | **Flower cluster development** |
| **45-44** | **2** | **30** | **0** | **Dwarfed growth** |
| **50-1** | **45** | **21** | **0** | **Flower cluster development** |
| **50-12** | **36** | **13** | **0** | **Flower cluster development** |
| **50-41** | **34** | **17** | **0** | **Smaller leaves** |
| **55-6** | **2** | **44** | **0** | **Rough textured leaves** |

# O-13 COMPARISON OF USING DIFFERENT HARVESTING METHODS ON WALNUT'S (*J. regia L.*) FRUIT

*M. YALÇIN[1] K. ALİBAŞ[2] Ü. ERTÜRK[3] Y. AKÇA[4]*

[1] Dr. Atatürk Bahçe Kültürleri Merkez Araştırma Ensitüsü, YALOVA, TURKEY,

0537 8879765, muammeryalcin1@hotmail.com, muammer.yalcin@tarim.gov.tr

[2] Prof. Dr., Uludağ Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Böl., BURSA, TURKEY,

0532 4522415, umrane@uludag.edu.tr

[3]Prof. Dr., Uludağ Üniversitesi, Ziraat Fakültesi, Biyosistem Müh. Böl., BURSA, TURKEY,

0543 4228127, alibas@uludag.edu.tr

[4]Prof. Dr., Gazi Osman Paşa Ün., Ziraat Fakültesi, Bahçe Bitkileri Böl., TOKAT, TURKEY,

0532 3735860, yasar.akca@gop.edu.tr

**Abstract**

Mechanization is one of the essential procedures in walnut growing. Among various mechanical applications, mechanical harvesting are essentials for economical and feasible walnut growing. Because these applications decrease the labour payment and increased the quality of nuts.

For these purpose the needed machines which should be cheaper and easy to use, were introduced from Italy and or to be made in Turkey.

In addiotion, maintenance, repair and most effectiveness, and also applicability to our orchard conditions must be suitable. So they can be presented to our walnut growers.

The mechanical harvesting machine so called trunk shaker machine was introduced. Additionally the branch shaker apparatus was also purchased which made in our country.

Some tree properties such as tree crown volume, trunk and crown height, and trunk diameter were recorded in the trial orchard. Fruit removal force was measured using a dynamometer during the harvest time. The effect of ethephone application (1000 ppm) on decreasing the "fruit removal force" was also determined.

Walnut fruis were harvested with the trunk and branch shakers.

The two machines were compared with respect to their efficiency in harvest facility. After being discussed the results of the study it was decided that trunk shaker machine was more effective than the brunch shaker and it can be recommended to the walnut growers to facilitate the harvesting.

Keywords: Walnut, harvest, trunk shaker, limb shaker, ethephone

## INTRODUCTION

In recent years, studies on the establishment of a garden, which is composed of only walnut trees in a certain area are increasing rapidly. As the number of individual walnut gardens increases, the importance of technical and cultural processes increases.

Harvesting in walnut is usually done traditionally by striking branches and shoots. The crop of the next year is decreasing due to shoots broken by this method (1). In addition, the sledgehammer falling out of the shed can be crippled.

When the walnut fruit is mature, the outer shell cracks after 3 weeks and while it is waiting for cracking, the inside is dark, in this case it reduces the quality and gives economic loss. Because of the resistance to breakage of the fruit in the stage of internal maturity, conventional harvesting is very difficult and requires a mechanical harvest. In this case, rupture is facilitated by using ethephone, and it is recommended that the harvest be performed by a machine (14). For this reason, a tricky harvesting machine that can be adapted and developed to the conditions of Turkey has been taken. In addition, an adjustable branch shaking harvester was made. A possible change in the partial budget (or partial plan) analysis in a business organization is a method used for changing identify (2). We can list the changes that partial budgeting is useful as follows:

The implementation of a new technology,

Expansion of the business,

Alternative activities,

Different production applications,

Instead of buying equipment,

Capital increase,

Making a good decision in marketing plan changes (8).

In Turkey, Niksar/Tokat and Yalova ecological conditions is recommended to dose of 1000 ppm ethephone in order to facilitate the fruit breaking force during stadies (1).

Gezer (6) compared in apricot harvest, hand harvesting, mechanical harvesting methods and traditional methods, about harvesting efficiency and work performance. As a result of the research harvesting activity, harvesting efficiency has been realized as 98.5% in hand harvest, 100% in conventional harvest and 96.4% in mechanical harvest. While business successes are as tree, product and domain business successes In the case of mechanical harvest, it has been found respectively; 0.20 tree/h, 32-36 kg/h and 0.02 da/h, and at traditionally harvest respectively; 2.30 tree/h, 368-414 kg/h and 0.23 da/h at mechanical harvest respectively 5 trees/h, 800-900 kg/h and 0.50 da/h.

Polat et al. (10) studied the mechanical damage of Pistachio (40, 50 and 60 mm) and different frequencies (10, 15 and 20 Hz) of the pistil with an inertial force type shaker. A constant shake time (10 s) was used for shaking. They also compared this method with the hand harvesting method. As a result, although the highest harvest rate (100%) is found at 60 mm amplitude and 20 Hz frequency, the machine can be better controlled during the harvesting process with 50 mm amplitude and 20 Hz frequency and therefore it is recommended to use last one values. They indicate that the most suitable harvest period in the red variety Pistachio is in early September according to the F/m measurements they have made.

Walnut production and quantities in the world and in Turkey are given in tables 1, 2, 3 and 4 (4).

Table 1. Walnut Production Areas of Some Countries (Ha)

| Countries | **2007** | **2008** | **2009** |
|---|---|---|---|
| USA | 88.222 | 90.246 | 90.246 |
| China | 210.000 | 275.000 | 305.000 |
| Frans | 16.928 | 17.126 | 17.454 |
| Iran | 65.000 | 65.000 | ? |
| **Turkey** | 82.117 | 84.917 | 86.533 |
| Ukrain | 14.060 | 14.100 | 13.400 |
| **World** | 737.489 | 805.572 | 834.874 |

Table 2. Walnut Production Quantities of Some Countries (Ton)

| Countries | **2007** | **2008** | **2009** |
|---|---|---|---|
| USA | 297.555 | 395.530 | 376.480 |
| China | 629.786 | 826.635 | 915.000 |
| Frans | 32.635 | 36.591 | 34.854 |
| Iran | 170.000 | 170.000 | ? |
| **Turkey** | **172.572** | 170.897 | 177.298 |
| Ukrain | 82.320 | 79.170 | 83.890 |
| **World** | **1.859.755** | 2.149.990 | 2.236.231 |

Table 3. Turkey walnut export and import quantities and income.

| Topic | Walnut feature | Amount (Ton) | amount ($) |
|---|---|---|---|
| Export | Kernel | 1.210,1 | 10.460.152 |
| | With shell | 19,2 | 41.525 |
| Import | Kernel | 7.891,8 | 45.321.864 |
| | With shell | 22.915 | 42.224.859 |

Some of the tree characteristics that result from measurements in the application garden are as follows:

Table 4. Physical measurements of 12 year old trees (m)

| **Tree features** | **Bursa-95** | **Kaman-1** | **Pedro** |
|---|---|---|---|
| **Crown radius** | 5 | 5.07 | 4.29 |
| **Crown height** | 3.92 | 4.17 | 3.57 |
| **Trunk height (average)** | 1.4 | 1.55 | 1.47 |
| **Body diameter (average)** | 31 | 28 | 25 |
| **Crown volume ($m^3$)*** | 384.37 | 419.62 | 257.67 |

**Vcrown=(D)²xhx(0,4909) (12).*

Walnut-Growing Zones in Turkey:

Our existing walnut presence is scattered all over our country. The distribution of walnut growing in our country like a walnut collecting garden and museum is classified as from more to less Black Sea, Eastern Anatolia, Central Anatolia, Aegean, Mediterranean, Marmara and South Eastern Anatolia in terms of total number of trees. When we deal with provinces, the first 7 sequences in terms of total tree existence are given below. These;

1. Zonguldak
2. Hakkâri
3. Çorum
4. Van
5. Kastamonu

6. Bursa
7. Kahraman Maraş (14).

**Walnut as a Food:**

Walnut has an important place in the nutrition of Anatolian people. Cookies are indispensable for long and cold winter nights. Go to the child's crib who goes to the school or go to the play, also go to the shepherd's bag that goes to grassland, than go to the guest's table. In addition it is an indispensable contributor to; halvah, sausage, Turkish delight, baklava, pie etc. Nutritional value of walnut kernel is a healthy dietary product due to high energy. It contains minerals, vitamins, antioxidants and unsaturated fatty acids. Especially the richness of polyphenol and omega-3 fatty acids increases the importance of walnut for healthy life. It is recommended as a preventive medicine for cardiovascular diseases. Improves the good cholesterol (HDL) on the side. Reduces bad cholesterol (LDL) and triglyceride levels (16). The walnut oil is rich in linoleic acid, this makes walnut a unique food. Recent epidemiological studies have shown that walnut consumption reduces cardiovascular deaths due to the antioxidant properties of polyphenols (17).

## MATERIAL AND METHOD

### Materiel

### Walnut trees

In the study, 10 x 10 m. 12 age-old Bursa-95, Kaman-1 and Pedro walnut varieties were used. The experiments were repeated two times in two years.

The crown of the trees used in the research was determined as Bursa-95: 384.37 m³, Kaman-1: 419.62 m³ and Pedro: 257.70 m³ (Table 4).

### Trunk-shaking harvester

It is designed for its own drive and harvest operations. It has 360 ° rotation feature in the garden. For operator it has ergonomic features and cabin and has the following features:

Hydraulic moving

Diesel, 130 HP

20-60 mm amplitude

20 Hz-58 Hz. Vibration frequency

Weight of 4000 kg

0-80 cm mouth opening retention pocket

### Branch shaking harvesting machine

Some features of the branch shaking harvester's as follows:

It is hanging from the shoulder.

Weight: 12 kg,

Amplitude: 62 mm. (54, 56, 58, 60, 62, 64, 66 mm

Changeable).

Acceleration: 48 mm / s.

Number of revolutions: 1200-1400 $min^{-1}$.

Rod length: 2 m (65 cm can be extended).

Power supply: 2-stroke, gasoline motor.

Hook opening: 6,5 cm (rubber covered).

**Traditional harvesting materials:**

Traditional harvesting materials were used, as well as floor cloths, stairs and carrying chests.

**Ethephone**

Ethephone has an effect that facilitates breakage by quickened the aging of the fruit, especially where the stalk is attached. Aprol (Etephone, 480 g / L) PH: 0.68. Sodium hydroxide (NaOH) M: 40 g / mol was used to adjust Tween-20 as the adhesive and pH to 7).

**Method**

The trial was set up in 3 replications, according to random block trial design. The date of harvest was determined by the fact that the honeycomb tissue of the walnut fruit began to brown (3).

**Trunk Shake Harvesting with Harvesting Machine:**

The shakers were held walnut trees under the crowning point and shaken. According to the harvesting time, maturation periods were determined and Bursa-95 variety of walnuts were harvested on August 17, Kaman-1 variety walnut on 24 August and Pedro variety on 7 September. There was no difference in harvest time between years. We were harvested on the same dates and the day after day by trunk shaker.

**Harvest by Branch Shaking Harvesting Machine:**

The harvest with the branch shaker was made by shaking the branches where the hook can be grasped, which can be reached either locally or exiting the stairs if necessary.

**Ethephon application:**

In order to determine the effect of the growth regulators on the fruit harvesting effect, ethephone application was carried out at doses of 0 and 1000 ppm with the start of the package tissue 1 week before the harvest. The application was made early in the morning with turbo sprayer moving from the tractor tail shaft. The application was made so as to cover the entire tree and harvested 1 week after application. Measurements of fruit breaking force (3) were made before and 1 week after application (during harvest). Applications were made with an analog dynamometer in kg. The fruit breaking strength measurements made before and after applying ethephone are as follows:

The fruit breaking force of 3.89 kgf, 2.46 kgf and 3.69 kgf in Bursa-95, Ka-man-1 and Pedro variety walnuts, respectively, before application, 1000 ppm of ethephone after one week (during harvest) The strength was 3,44 kgf, 3,05 kgf and 3,48 kgf, while the applied fruits were 3 kgf, 2,47 kgf and 1,22 kgf and it was found to be important at the level of 5%.

**Harvest by conventional method:**

The traditional harvest was carried out in successive days along with the trunk and branch shaker. In traditional harvesting, poles were used. In addition, harvesting was supported with floor cloths and carrying chests/buckets.

**Harvest Success/efficiency (%):**

For the harvest criteria examined in the study, the harvest effectiveness is determined separately per tree as follows; The harvest time is measured with a stopwatch (11).

$HY=K1 / (K1 + K2) * 100$

HY: Harvest Percentage/Efficiency

K1: Product to be harvested (kg/tree)

K2: After Harvest, remaining product in the tree (kg/tree).

**Harvest time (s):**

The harvesting time was calculated in minutes and determined with a chronometer.

**Meyve kopma kuvveti (kgf):**

This measurement was made in kgf with an analog dynamometer. Fruit breaking forces were determined by kg scale analog dynamometer about 40 fruits, from 4 directions of the tree. The stem of fruit was pulled through the double-ended hook of

the dynamometer in the form of a hook, and the number of the indicator was read as soon as break off (3).

## FINDINGS AND DISCUSSION

### Results for fruit breaking force:

In tial years it was found that the Ethephone application was affected on the breaking force in all three types (Table 5 and Table 6), but this effect was more similar to Kaman-1 and Pedro varieties, depending on the years.

### Examining the economic aspect of the work:

When the economic aspect of this study is taken into account, the following conclusion is drawn. (Partial budgeting technique in cost accounting Partial budgeting technique in cost accounting (Aksöz, I. 1972; Pierce, V., 1997) only the operations performed during the harvest were compared. This report contains a partial budget analysis of the machines that are working in the "Mechanisation" work package within the scope of the TÜBİTAK-KAMAG 106-G 152 project).

According to this, traditional hand harvesting methods showed positive net profits at different yields. Positive net profit could be calculated if yield was 750 kg/da when harvested with trunk shaker machine. In practice, it is thought that a farmer with about 1000 fertile grabs can take its own trunk shaker harvesting machine (18).

### Study on fruit breaking force:

Applications related to fruit breaking force were based on kernel of walnut maturity. In the beginning of the kernel maturity, the fruit breaking forces were measured with a dynamometer and ethephone was applied and measured again after waiting 1 week. Varieties have been evaluated within themselves. The results are given in tables 5 and 6.

Table 5. Removal force of fruit variety (year: 1st

| Varieties | Removal force of fruit (kgf) | | | | | |
|---|---|---|---|---|---|---|
| | Before ethephone aplication | | After one veek ethephone aplication | | | |
| | | | Control: (0 ppm) | 1000 ppm | | |
| | Date | Removal force | Date | Removal force | Date | Removal force |
| Bursa 95 | 10.08.2009 | 3.89 **a*** | 17.08.2009 | 3.44 **b** | 17.08.2009 | 3.00 **c** |
| Kaman I | 18.08.2009 | 3.46 **a** | 24.08.2009 | 3.05 **b** | 24.08.2009 | 2.47 **c** |
| Pedro | 31.08.2009 | 3.69 **a** | 07.09.2009 | 3.48 **b** | 07.09.2009 | 1.22 **c** |

* Mean separation within lines by LSD mutiple test at, 0.05 level

Table 6. Removal force of fruit variety (year: 2nd)

| Varieties | Removal force of fruit (kgf) | | | | | |
|---|---|---|---|---|---|---|
| | Before ethephone aplication | | After one veek ethephone aplication | | | |
| | | | Control: 0 ppm | 1000 ppm | | |
| | Date | Removal force | Date | Removal force | Date | Removal force |
| Bursa 95 | 09.08.2010 | 3.64 **a** | 16.08.2010 | 3.27 **a** | 16.08.2010 | 1.8 **b** |
| Kaman I | 16.08.2010 | 3.65 **a** | 22.08.2010 | 2.60 **b** | 22.08.2010 | 2.44 **b** |
| Pedro | 10.09.2010 | 3.11 **a** | 18.09.2010 | 2.30 **b** | 18.09.2010 | 1.68 **c** |

* Mean separation within lines by LSD mutiple test at, 0.05 level

**Machine Harvesting**

**First year studies:**

First year, the Bursa-95 variety was harvested on August 17, the Kaman-1 variety on August 24, and the Pedro variety on September 7. According to Table 7, the longest ha-sale period was observed in the harvesting with traditional directions in all three types, while the harvesting time was evaluated in terms of the harvesting statistics. As a statistic in the harvesting studies made with the branch shaking machine, the harvesting time is shorter than that of the traditional harvesting time. Ethephon applications were effective in the Bursa-95 and Kaman-1 range in terms of harvesting time according to the control application but did not make a difference in the Pedro variety. For the trunk shaker, all varieties are in the same group.

Table 7. Harvesting Works of Walnut Varieties for First Year.

| Aplications | *Varieties* | Dose of ethephone (ppm) | Harvesting time (min/per tree)* LSD: 5,47 Cv(%): 8,29 | The Success of harvest (%)* LSD: 2,591 Cv(%): 2,02 |
|---|---|---|---|---|
| Harvest by limb shaker | Bursa 95 | 0 | 50.33 **cd** | 57.75 **gh** |
| | | 1000 | 45.67 **d** | 64.01 **f** |
| | Kaman I | 0 | 54.33 **c** | 59.39 **g** |
| | | 1000 | 48.00 **d** | 64.62 **f** |
| | Pedro | 0 | 47.67 **d** | 55.26 **h** |
| | | 1000 | 44.67 **d** | 58.64 **g** |
| Harvest by trunk shaker | Bursa 95 | 0 | 3.50 **e** | 84.58 **c** |
| | | 1000 | 3.50 **e** | 88.26 **b** |
| | Kaman I | 0 | 3.73 **e** | 81.63 **d** |
| | | 1000 | 2.70 **e** | 85.70 **bc** |
| | Pedro | 0 | 4.23 **e** | 75.79 **e** |
| | | 1000 | 2.90 **e** | 81.32 **d** |
| Convantional harvesting | Bursa 95 | 0 | 96.67 **a** | 98.35 **a** |
| | Kaman I | | 96.00 **a** | 98.39 **a** |
| | Pedro | | 88.00 **b** | 97.85 **a** |

* Mean separation within columns by LSD mutiple test at, 0.05 level

Assessment made from the perspective of harvest time, harvest time with the trunk shaking harvesting machine was found to be the shortest. There was no effect of ethephone application in terms of harvest time.

The result of the statistical evaluation made in terms of the harvesting success, the harvesting by the conventional method, gave the highest value in terms of the harvesting success.

The highest harvest success after the traditional harvest was seen in the harvest with the trunk shaking machine. Harvesting success was mostly observed in Bursa-95 variety, followed by Kaman-1 and Pedro varieties respectively. Ethephon application increased harvest success. In terms of harvest success, working with a branching machine gave the lowest results. Ethephon aplication has made harvesting easier. Bursa-95 and Kaman-1 varieties of ethephone were found to be more successful in terms of harvest success than Pedro varieties.

**2nd year results:**

In 2nd year Bursa-95 type 16.08, Kaman-1 type 22.08. And the Pedro variety was harvested on 18.09. According to Table 8, the longest harvest time was observed in the conventional harvesting process, with the evaluating the statistics of the harvest time.

As a statistic in the harvesting studies made with the branching machine, the harvest time was shorter than the traditional harvesting method. Ethephon practices did not differ in terms of harvest time to control.

**2nd year working:**

Table 8. Harvesting Works of walnut varieties in 2nd year

| Aplications | Varieties | Dose of ethep-hone (ppm) | Harvesting time (min/ tree) LSD: 5,871 Cv(%): 9,54 | Success of harvest (%) LSD: 2,722 Cv(%): 2,09 |
|---|---|---|---|---|
| Harvest by limb shaker | Bursa 95 | 0 | 52.00 **c** | 61.3 **hi** |
| | | 1000 | 45.33 **d** | 64.7 **fg** |
| | Kaman I | 0 | 44.00 **d** | 62.6 **g** |
| | | 1000 | 44.33 **d** | 66.7 **f** |
| | Pedro | 0 | 44.00 **d** | 56.2 **j** |
| | | 1000 | 40.67 **d** | 59.2 **i** |
| Harvest by trunk shaker | Bursa 95 | 0 | 2.75 **e** | 86.3 **cd** |
| | | 1000 | 2.91 **e** | 88.7 **bc** |
| | Kaman I | 0 | 3.50 **e** | 81.4 **e** |
| | | 1000 | 2.38 **e** | 84.3 **de** |
| | Pedro | 0 | 3.10 **e** | 84.3 **de** |
| | | 1000 | 2.47 **e** | 90.1 **b** |
| Convantional harvesting | Bursa 95 | 0 | 94.67 **a** | 95.5 **a** |
| | Kaman I | | 87.67 **b** | 95.0 **a** |
| | Pedro | | 82.17 **b** | 93.5 **a** |

* Mean separation within columns by LSD mutiple test at, 0.05 level

Assessment made from the perspective of the harvest time, the shortest time was found in harvests made by the trunk shaker harvesting machine. There was no effect of Ethephone application in terms of harvest time.

The result of evaluating the statistics on the harvesting success is the highest value in terms of harvesting and harvesting success.

The highest harvest success after the traditional harvest was seen in the harvest with the trunk shaking machine. Ethephon aplications have affected the harvest success positively.

In the study on the harvest of Pistachio, three different branch shakers were tried and tested with hand harvesting method in terms of time and work power. In this study, ethephone application was also performed to investigate the effect of pistachios on the ripening process (9). Therefore, the brunch harvester and trunk shaking harvesting machines can be used for pistachio and olive harvest.

It emphasized that the geometrical structure of trees and branch lengths are important for harvesting efficiency (5).

When Ethephone is applied, the fruit breaking force is significantly affected (3). According to the tree structure and geometrical properties, it is stated that the success rate is increased when harvesting is done with appropriate frequency and amplitude scale (7). When working with a trunk shaker, the harvest time is extremely short as 2.5-3 minutes.

It has been reported that when inertial mass shakers are used, the efficiency of harvesting is improved and the harvesting time is increased (13).

## CONCLUSIONS AND RECOMMENDATIONS

In this study; While the longest period of traditional harvesting has been achieved, the shortest harvesting period has been achieved with a trunk shaker.

When we examine harvest success, the traditional method of harvesting has reached the highest level. This was followed by harvesting with trunk shaker and branch shaker respectively.

While there was no difference in the harvest time with the trunk shaker in terms of harvest time, 0 ppm of Bursa-95 seed was harvested longer by harvesting with branch shaker and in the case of traditional harvesting, Bursa-95 harvesting could be harvested longer than other varieties.

The result of this study is the necessity of making and developing the machines which are suited to the conditions of Turkey in the light of the data. If such machines can be made in Turkey, it will contribute to our economy.

The walnut harvest should be done when the fruit kernel reaches the maturity. Because; If the harvest is delayed the quality of the fruit falls and decreases, which reduces the price.

Taking into consideration that the harvest maturity varies from kind to kind, maturity determination should be done well.

The harvest should be in the cooler hours of the day as possible and the product should not be kept under the sun for a long time.

Walnut fruits should be free from green crusts and dried as soon as possible.

The application of Ethephon did not have a significant effect on the harvest time, especially with the shaking harvester.

Machines must be used by competent persons to prevent damage to the tree during machine harvesting.

Machine features must be appropriate. For example, the trunk of the tree or its grip should be covered with rubber.

It is necessary to give up the traditional harvesting, which damages tree branches and shoots and causes crop loss in the next year.

The garden floor must also be suitable for machine work. It is not easy to work with a machine on a soft floor and the garden floor breaks down due to the weight of the machine. In this case, it is difficult to carry out other cultural processes.

If we use trunk shaker for harvesting, the garden should not be watered for at least 10-15 days befor harvest, this is because the holding in the tree bark is not a peeling during shaking by the holding nipper.

**THANK**

I would like to thank everyone who has helped the test in this study and TUBITAK who gives financial support.

**RESOURCES**

1. **Akça, Y**., 2005. Ceviz Yetiştiriciliği Kitabı, *Tarım ve Köyişleri Bakanlığı, Yayın Dairesi Başkanlığı, Ankara.*
2. **Aksöz, İ.**, 1972. Zirai Ekonomiye Giriş, Zirai İşletmecilik, Genel Kısım. 2. Baskı. *Atatürk Üniv. Basımevi Erzurum. Yayın No: 252/c. Ziraat Fak. Yayın No: 15, Ders Kitapları Serisi No: 10. s:276-283.*
3. **Çelik, M., Özkaya, M. T. ve K**öksal**, A. İ**. 1999. Ethrel Uygulamalarının Ceviz (*J.regia*) de Hasat Kolaylığı ve Meyve Kalitesi Üzerine Etkileri. *Türkiye III. Bahçe Bitkileri Kongresi, 14-17 Eylül 1999. Ankara, 667-671.*
4. **Anonimous,** 2009. Walnut Production in The World.
5. **Gezer, İ.,1997**. Malatya Yöresinde Kayısı Hasadında Mekanizasyon İmkanlarının Araştırılması, *Doktora Tezi (YÖK Tez Tarama-iznli) . Selçuk Üniversitesi Fen Bilimleri Enstitüsü. Konya*
6. **Gezer, İ.,** 1998. Mekanik Meyve Hasında Kullanılan Toplama Sistemleri ve Tutma Platformları*, Tarımsal Mekanizasyon 18. Ulusal Kongresi Özet Kitabı ve CD'si, Tekirdağ.*
7. **Parameswarakumar, M., Gupta, C.P**., 1991.Design Parameters For Vibratory Mango Harvesting System. *Transaction Of The Asae Vol. 34 (1). 3406-(0014-20).*
8. **Pierce, V**., 1997. Partial Budgeting. *University of Missouri Commercial Agriculture. http://agebb.missouri.edu/download/university/partbudg.exe.*
9. **Polat, R**., 1999. Antepfıstğının Mekanik Hasat Olanakları Ve Mekanizasyona Yönelik Özelliklerinin Belirlenmesi Üzerine Bir Araştırma. . *Doktora Tezi (YÖK Tez Tarama-iznli). Trakya Üniversitesi Fen Bilimleri Üniversitesi, Tekirdag.*
10. **Polat, R., Gezer, İ., Güner, M., Dursun, E., Erdoğan, D. and Bilim H.C.,**2007*,* Mekanical Harvesting of Pistacio Nuts*, Journal of FoodEngineering, 79: 1131-1135.*
11. **Qabatty, A., ve Alayunt, F.,** 2010*,* Domat Zeytin Çeşidinde Farklı Hasat Yöntemlerinin Meyve Kalitesine Etkileri, *Doktora Tezi (YÖK Tez Tarama-iznli). Ege Ün., Fen Bil., Enst., Tarım Makinaları Ana Bilim Dalı, İzmir.*

12. **Lim, C., 2007.** Estimation of Urban Tree Crown Volume Based on Object- Oriented Approach and LIDAR Data**,** International Institute For Geo-Information Science And Earth Observation Enschede, The Netherlands.

13. **Sılınger, M., Moser, E**., 1983. Machinelle Steinobsternte Versuchsergebnisse Mit Verschiedenen *Erntemachinen Landtechnik 9.*

14. Şen, S**., M., Kazankaya, A., Yarılgaç, T., Doğan, A.,** 2006, Bahçeden Mutfağa Ceviz, **(**Kitap), *Sayfa 143-173, Ajanstürk, Ankara.*

15. Ünal, H**.,** 2005, Ceviz Yetiştiriciliğinde Hasat ve Hasat Sonrası Mekanizasyon Uygulamaları, Bahçe, Sayfa: 193-203, *II. Ulusal Ceviz Sempozyumu Özel Sayısı, Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü Dergisi, Yalova*

16. Şahin, İ**.,** 2005. Sağlıklı Beslenmede Ceviz. Bahçe, *Sayfa: 157-162, II. Ulusal Ceviz Sempozyumu Özel Sayısı, Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü Dergisi, Yalova*

17. **Yiğit, A., Ertürk, Ü., Korukluoğlu, M.,** 2005. Bahçe, Sayfa: 163-169, *II. Ulusal Ceviz Sempozyumu Özel Sayısı, Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü Dergisi, Yalova.*

18. **Pezikoğlu, F.,** 2012. Türkiye Ceviz Yetiştiriciliğinin Geliştirilmesi Entegre Projesi, *TÜBİTAK-KAMAG 106-G 152, Sonuç Raporu, Türkiye'de Ceviz Üretim ve Pazarlamasının Ekonomik Yönden Değerlendirilmesi, Atatürk Bahçe Kültürleri Merkez Araştırma Enstitüsü, Yalova.*

# O-15 The Morphological and Physiological Response of Garnem Rootstock Against Drought Stress *In Vitro* Culture Conditions

Muzaffer İPEK[1], Lütfi PIRLAK[1]

[1] Selçuk University, Faculty of Agriculture, Horticulture, Konya

e-mail: mipek@selcuk.edu.tr

**ABSTRACT**

In the present study, it was investigated the morphological and physiological response of Garnem rootstock under drought stress establishing on in vitro culture media including different Polyethylene Glycol-8000 (PEG-8000) levels. In order to make drought stress condition, three PEG levels (-0.5 MPa, -1.0 MPa, -1.5 MPa) was used. Plants were measured at 0, 3, 5, 7, 9, 11, 13 and 15 days for morphological and biochemical parameters such as plant height, relative plant weight, leaf area, chlorophyll content, proline content and protein content. The permeability of membranes and leaf relative water content (LRWC) were also measured. The highest growth of plant height was obtained by control (25.03 %), the lowest growth was obtained by -1.5 MPa drought stress level (3.88 %). The lowest increase rate of relative plant weight was measured from -1.5 MPa drought stress level (12.36 %). The lowest leaf area was determined to be 1.01 $cm^2$ in -1.5 MPa while the highest leaf area was determined to control (2.39 $cm^2$). The chlorophyll content was measured by SPAD-502 and the lowest value was obtained from -1.5 MPa application (16.78 SPAD units). According to the leaf membrane permeability result, -1.5 MPa (97.43 %) drought level was found the highest value. LRWC was the lowest in -1.5 MPa drought stress level (2.48 %). Total protein level decreased linearly from initial day to end of the study in all application. The highest changing rate of protein content was found at-1.5 MPa level. Unlike protein content, the proline content increased linearly from initial day to end of the study. The highest proline content was found in -1.5 MPa level (64.70 $\mu g\ g^{-1}$ FW).

**Keywords:** Drought stress, Garnem, PEG, Plant tissue culture

## 1. INTRODUCTION

Water deficit is an important environmental limitation to plant growth (Farooq, Wahid, Kobayashi, Fujita, & Basra, 2009). Because of the world's water supply is limiting, future food demand for rapidly increasing population pressures is likely to further aggravate the effects of drought (Somerville & Briscoe, 2001). While drought stress raises respiration in plants under drought stress, it causes to decrease of plant growth, yield, photosynthesis and disrupts water and nutrient content (Farooq et al., 2009).

Plants respond and adapt to survive under drought stress by the induction of various morphological, biochemical and physiological responses. As a morphological response, plants shorten life cycle or growing season to attain adaptation before the environment becomes dry. Flowering time is an important trait related to drought adaptation, where a short life cycle can lead to drought escape (Araus, Slafer, Reynolds, & Royo, 2002). As a drought period persists and soil drying becomes more severe, the plant closes stomata but it becomes unable to maintain hydration even with the stomata closed (Verslues, Govinal Badiger, Ravi, & M Nagaraj, 2014). In terms of physiological response, the low water availability in the soil decreases photosynthesis and carbohydrate accumulation (M. Chaves & Oliveira, 2004; M. M. Chaves, Maroco, & Pereira, 2003; Flexas, Bota, Loreto, Cornic, & Sharkey, 2004).

The plant tissue culture techniques are increasingly used for abiotic stress tolerance in numerous plants. *In vitro* culture conditions, stress treatments can be easily controlled so tissue culture techniques are useful for abiotic stress studies (Errabii et al., 2006).

## 2. MATERIAL and METHODS

The present study was conducted in the laboratory for plant biotechnology at Selçuk University (Turkey) between 2012 and 2014. Plantlets of almond x peach hybrid rootstock 'Garnem' was propagated through *in vitro* nodal explant cultures.

### 2.1. Establishing Drought Stress Conditions

The drought stress conditions were established according to do Michel (1983) formulation at different osmotic potentials (OP) (Control, -0.5 MPa, -1.0 MPa and -1.5 MPa). The liquid MS basal medium without plant growth regulators was prepared and then PEG was added into liquid media according to Michel's formula (1983). The OP was calculated using the following formula:

**OP**= 1.29 x $C^2$ x T−140 x $C^2$−4 x C

**OP=** Osmotic potential

**C =** PEG quantity

**T =** Temperature

### 2.2. Measurements of Morphological and Physiological Parameters

During study, plants were measured at 0, 3, 5, 7, 9, 11, 13 and 15days for morphological parameters (plant height, relative plant weight, leaf area, chlorophyll content) and collected leaves for proline and protein analysis. There were also measured the permeability of membranes and leaf relative water content (LRWC).

#### 2.2.1. Leaf relative water content

In order to determine LRWC, leaves collected from control and drought stress treated plants were measured for the fresh weight first. The samples were put into culture tube filled double distilled water for 4 h at room temperature for turgid weight (hydration). The turgid weight was measured and leaves were dried in an oven 65 °C for 48 h. The RWC percentage was calculated using the following formula of Sánchez, De Andres, Tenorio, and Ayerbe (2004):

LRWC (%) = (LFW – LDW) / (LTW – LDW) × 100

where FW is leaf fresh weight, LDW leaf dry weight, and LTW leaf turgid weight.

#### 2.2.2. Membranes permeability

Leaves of three plants per treatment were harvested 0, 3, 5, 7, 9, 11, 13 and 15 days and cut 1 $cm^2$ leaf disks. Leaf disks were washed with three changes of double distilled water to remove surface-adhered electrolytes. Leaf disks were placed in culture tubes containing 10 ml of double distilled water and incubated at 25 °C on a rotary shaker. The electrical conductivity of the bathing solution ($EC_1$) was determined by EC-meter after 24 h. Samples were then autoclaved at 121 °C for 15 min. and a last electrical conductivity reading ($EC_2$) was obtained upon equilibration at 25 °C. The electrolyte leakage was calculated as $EC_1$/ $EC_2$ and expressed as percent (Lutts, Kinet, & Bouharmont, 1996).

#### 2.2.3. Chlorophyll content

Leaves were harvested for Chlorophyll Content. Chlorophyll content of leaves was determined using portable chlorophyll reader SPAD-502 (Konica Minolta), measuring absorbance at 650 nm, as a nondestructive method. Three readings were made on each leaf. The results were expressed in SPAD units (Anonymous, 2017).

#### 2.2.4. Protein content and proline

The protein amounts in leaf extracts were determined by the Bradford (1976) using bovine serum albumin as a standard. Assessment of proline content was performed with the acid-ninhydrin method according to Bates, Waldren, and Teare (1973).

#### 2.2.5. Statistical analysis

All analyses were done using a completely randomized design with 3 replicates. All data were subjected to one-way analyses of variance (ANOVA). Duncan's multiple range test was used to separate statistically different means at $P < 0.05$ via SPSS 23.0 version.

## RESULT and DISCUSSION

Generally, drought stress occurs when the available water in the soil is reduced and atmospheric conditions cause continuous loss of water by transpiration or evaporation (Jaleel et al., 2009). Drought stress, which affects yield and plant growth, is one of environmental stress factors and triggers some physiological, biochemical and molecular mechanism (Ozfidan, Turkan, Sekmen, & Seckin, 2013). The studies of drought stress help to improve species and cultivars with the determination of physiological and biochemical responses to drought stress.

We found that plants which were under drought stress grew little during the study. When OP level was increased, plants height of Garnem slightly increased (table-1). Sustainable plant growth and development depend on the protection of plant water content. In the case of a deficit of water, cell division and development is limited so plants grow slowly (Bertamini, Zulini, Muthuchelian, & Nedunchezhian, 2006). Furthermore, photosynthesis rate is slowed due to lack of water and plant growth rate is decreased. Many studies result (Alizadeh, Alizade, Nassery, & Eivazi, 2011; Karimi, Yadollahi, Nazari-Moghadam, Imani, & Arzani, 2012; Rostami & Rahemi, 2013) supported our study. Cell growth is considered one of the most drought-sensitive physiological processes due to loss of turgor pressure (Karimi et al., 2012). Rostami and Rahemi (2013) reported that cell growth is limited due to loss of leaf turgor pressure.

In terms of change of the relative dry plant weight, when OP levels were increased, dry plant weight markedly decreased compared to control. The most of the losses of dry plant weight were calculated in -1.5 MPa at 15$^{th}$ day of stress (table-1). Our results are in agreement with the earlier reports (Abbaspour, Saeidi-Sar, Afshari, & Abdel-Wahhab, 2012; Bolat, Dikilitas, Ercisli, Ikinci, & Tonkaz, 2014; İpek & Pirlak, 2016). Decreased dry matter accumulation of leaves as a result of stress may be attributed to the altered carbon and nitrogen metabolisms (Kluge, 1976).

Karimi *et al.* (2012) reported that leaves under drought conditions show that leaf area development is more sensitive than dry weight accumulation in the leaves. Leaf growth is more sensitive than root against drought stress. Decreasing of leaf area helps to plants under lack of water. The excess of carbon in leaves was transferred to root and it improves root and increases root mass. Furthermore, small leaf area has low transpiration rate and lose less water (Taiz & Zeiger, 2002). In our study, leaf area was decreased when drought levels were risen. The smallest leaf was obtained from -1.5 MPa treatment (1.44 cm$^2$) (table-1). The results of our leaf area agreed with Nogues and Baker (2000) in olive and Klamkowski & Treder (2008) in strawberry and İpek and Pirlak (2016) in plum rootstock 'Myrobolan 29C'.

Under stress conditions, membranes are damaged by reactive oxygen species (ROS). The membranes which are damaged, cause to the leaking of ions into intracellular space. Ions damage cells which are responsible for regulators of osmotic potential and enzyme activity. We found that when drought levels and time were increased, membrane damages were heavily observed. Membrane permeability rates were range from 23.16 to 70.11 % end of the 15$^{th}$.day. the highest membrane permeability was calculated in -1.5 MPa stress treatment. Our data were agreed with Chai *et al.*(2005) in banana, Karimi *et al.* (2012) in 5 almond cultivars and GF 677 rootstock, Zonouri *et al.* (2014) in grape and İpek and Pirlak (2016) in Myrobolan 29C.

Water stress limits not only leaf size, but also leaf number (Taiz & Zeiger, 2002). Under drought stress, Garnem plantlets had lower LRWC rates than control. During drought stress, the highest average of LRWC rate was observed in control plants with 20.38 %, while the lowest average of LRWC rate was obtained from -1.5 MPa drought stress level with 8.23 %. The study results of Boutra *et al.*(2010), Keyvan (2010), Ghaderi and Siosemardeh (2011) and İpek and Pirlak (2016) are similar to our LRWC result.

Water is important for chlorophyll synthesis. Following a heavy rain, the chlorophyll content of plant leaves will often increase, but during a drought, the chlorophyll content will decrease. On the other hand, if the soil is saturated with water, this results in a decrease in the chlorophyll content of the leaves. The water content of the leaf must be high for maximum chlorophyll content. In our study, chlorophyll content decreased due to drought levels and time of stress treatment. When the control plants had about an average of 36 SPAD units during stress, chlorophyll content in -1.5 MPa drought level markedly decreased (41.77 to 16.78 SPAD units). Some researcher reported that plants have lower chlorophyll content under drought condition (Alizadeh et al., 2011; Ghaderi & Siosemardeh, 2011; İpek & Pirlak, 2016; Rad, Kadir, & Yusop, 2012; Zanjani, Rad, Naeemi, & Taherkhani, 2012).

Drought stress causes to changing of protein metabolism and protein synthesis is decreased (Kutlu, 2010). Protein content decreased from beginning of the stress to end of the stress. This would indicate that the Garnem rootstock tolerant to drought stress condition. Similar result was found in cowpea (Mukherjee & Choudhuri, 1983).

Stresses such as cold, heat, salt, drought, UV and heavy metal cause a significant increase in the proline concentration in a variety of plants. This increase occurs over several hours or days. Interpretations of proline accumulation vary from its role as a useful adaptive response, helping organisms to withstand the effect of stress, to merely a consequence of stress induced damage to the cells. Therefore, proline may not be just a by-product of stress defense, but a chemically active compound, crucially involved in the physiology of stress protection (Ashraf & Iram, 2005). Similar results were reported Abbaspour et al. (2012), Rostami and Rahemi (2013), Bolat et al. (2014) and İpek and Pirlak (2016).

## CONCLUSION

In this study, the performance of Garnem, which was used extensively for almond and peach, were determined in drought condition. The obtained data showed that Garnem is tolerant drought stress. There was no died plant in all stress level on 15.day of study. The maximum plant height was obtained from control plants (3.679 cm). Dry plant weight was higher in control (22.25 %) than stress conditions. The largest leaf area was measured in control plant (2.45 cm$^2$). The highest membrane permeability was calculated in -1.50 MPa stress level (70.11 %). The highest rate of LRWC was in control plants (20.38 %) while the lowest rate of LRWC was obtained from -1.5 MPa treatment (8.23 %). The average chlorophyll content in control plant (35.63 SPAD units) was higher than other treatments. The highest protein content was calculated in -1.5 MPa (475.07 $\mu g\ g^{-1}$ FW). The -1.0 MPa treatments had the highest proline content (44.42 $\mu g\ g^{-1}$ FW).

## ACKNOWLEDGEMENTS

This research was supported by a grant from Selçuk University, Scientific Research Project Institute, Turkey (Project No: 12101007).

**Table-1.** The results of drought stress treatment in Garnem.

| | 1.day | 3.day | 5.day | 7.day | 9.day | 11.day | 13.day | 15.day |
|---|---|---|---|---|---|---|---|---|
| **Change of Plant Height (cm)** | | | | | | | | |
| **Control** | 3,16 a | 3,36 a | 3,47 a | 3,65 a | 3,71 a | 3,84 a | 3,93 a | 3,96 a |
| **-0,5MPa** | 2,18 b | 2,22 b | 2,27 b | 2,47 b | 2,48 b | 2,51 b | 2,52 b | 2,63 b |
| **-1,0MPa** | 2,02 b | 2,06 b | 2,06 b | 2,10 b | 2,10 b | 2,11 b | 2,21 b | 2,21 b |
| **-1,5MPa** | 2,06 b | 2,10 b | 2,11 b | 2,11 b | 2,13 b | 2,13 b | 2,14 b | 2,14 b |
| **LSD** | 0,786** | 0,596*** | 0,661*** | 0,724*** | 0,740*** | 0,782*** | 0,830*** | 0,800*** |
| **Change of Dry Plant Weight (%)** | | | | | | | | |
| **Control** | 20,33 b | 20,76 b | 21,30 b | 21,41 a | 22,19 a | 22,47 a | 23,04 a | 26,56 a |
| **-0,5MPa** | 24,66 a | 23,82 a | 23,10 a | 22,01 a | 21,49 a | 20,93 a | 20,74 b | 20,76 b |
| **-1,0MPa** | 25,66 a | 22,42 a | 21,98 ab | 21,92 a | 19,69 b | 18,66 b | 18,00 c | 17,23 c |
| **-1,5MPa** | 23,98 a | 22,96 a | 20,94 b | 18,62 b | 16,18 c | 14,85 c | 14,27 d | 12,36 d |
| **LSD** | 1,266*** | 1,675** | 2,033* | 2,087** | 1,926*** | 2,031*** | 1,947*** | 2,069*** |
| **Change of Leaf area ($cm^2$)** | | | | | | | | |
| **Control** | 1,35 | 2,46 | 2,35 | 3,19 a | 2,39 a | 2,34 a | 3,14 a | 2,39 a |
| **-0,5MPa** | 1,88 | 1,83 | 1,85 | 1,60 b | 1,53 b | 1,49 b | 1,41 b | 1,25 b |
| **-1,0MPa** | 1,74 | 2,09 | 1,77 | 1,57 b | 1,57 b | 1,43 b | 1,29 b | 1,23 b |
| **-1,5MPa** | 1,72 | 2,12 | 1,67 | 1,56 b | 1,36 b | 1,04 c | 1,10 b | 1,01 b |
| **LSD** | Ö.D | Ö.D | Ö.D | 1,064** | 0,702** | 0,500*** | 0,741*** | 0,728*** |
| **Change of Membrane Permeability in leaf (%)** | | | | | | | | |
| **Control** | 18,58 c | 19,02 d | 20,04 d | 22,86 d | 24,87 d | 26,10 d | 26,08 d | 27,74 d |
| **-0,5MPa** | 24,20 b | 21,96 c | 37,68 c | 55,70 c | 64,07 c | 63,21 c | 71,85 c | 84,31 c |
| **-1,0MPa** | 24,60 b | 39,36 b | 53,21 b | 58,28 b | 65,03 b | 69,88 b | 74,00 b | 90,67 b |
| **-1,5MPa** | 34,04 a | 43,21 a | 55,80 a | 81,32 a | 82,51 a | 82,23 a | 84,36 a | 97,43 a |
| **LSD** | 0,889*** | 1,254*** | 0,811*** | 0,745*** | 0,417*** | 1,406*** | 1,447*** | 0,747*** |
| **Change of LRWC (%)** | | | | | | | | |
| **Control** | 17,68 c | 18,01 a | 19,20 a | 19,89 a | 21,01 a | 22,02 a | 22,46 a | 22,82 a |
| **-0,5MPa** | 24,29 a | 17,80 a | 16,66 b | 14,66 b | 10,25 b | 8,76 b | 5,49 b | 3,14 b |
| **-1,0MPa** | 18,81 b | 14,54 c | 13,37 c | 13,12 c | 8,45 c | 4,65 c | 3,64 c | 2,73 b |
| **-1,5MPa** | 15,27 d | 12,75 c | 11,08 d | 10,51 d | 7,29 d | 4,03 c | 2,49 d | 2,48 b |
| **LSD** | 0,980*** | 1,095*** | 0,665*** | 0,834*** | 1,000*** | 1,216*** | 1,290*** | 1,164*** |
| **Change of Chlorophyll content in leaf (ppm)** | | | | | | | | |
| **Control** | 33,63 c | 33,94 d | 35,06 a | 35,06 a | 36,01 a | 36,79 a | 37,21 a | 37,38 a |
| **-0,5MPa** | 39,14 b | 37,08 b | 33,54 b | 32,36 b | 27,43 b | 22,79 b | 22,43 b | 22,38 b |
| **-1,0MPa** | 42,08 a | 38,58 a | 31,98 c | 31,16 b | 21,69 d | 21,28 c | 20,09 c | 19,79 c |
| **-1,5MPa** | 41,77 a | 35,19 c | 31,18 c | 27,58 c | 23,13 c | 19,41 d | 16,79 d | 16,78 d |
| **LSD** | 1,559*** | 1,575*** | 1,598*** | 1,910*** | 1,610*** | 1,607*** | 1,675*** | 1,675*** |
| **Change of Protein Content in leaf (μg $g^{-1}$ FW)** | | | | | | | | |
| **Control** | 104,20 b | 100,87 b | 96,47d | 92,19d | 86,15 c | 81,19 c | 77,19 c | 75,52c |
| **-0,5MPa** | 187,85 b | 168,42b | 157,75 c | 111,31 c | 87,79 c | 77,22 c | 66,47 c | 61,33 c |
| **-1,0MPa** | 830,55 a | 765,52 a | 687,16 a | 479,08 b | 338,42 b | 275,08 b | 259,23 a | 165,52 a |
| **-1,5MPa** | 793,57 a | 634,89 a | 584,64 b | 549,86 a | 402,08 a | 295,08 a | 178,42 b | 111,31 b |
| **LSD** | 140,31*** | 193,48*** | 61,31*** | 14,96*** | 14,60*** | 10,71*** | 26,31*** | 25,14*** |
| **Change of Proline Content in leaf (μg $g^{-1}$ FW)** | | | | | | | | |
| **Control** | 11,41 b | 14,90 d | 16,90 c | 21,50 c | 22,50d | 25,96 c | 33,34 c | 35,81c |
| **-0,5MPa** | 16,83 a | 24,70 b | 32,37 a | 42,03 a | 43,16 c | 43,34 b | 53,30 b | 65,27 b |
| **-1,0MPa** | 10,38 bc | 27,33 a | 30,45 a | 45,50 a | 49,21 a | 53,90 a | 55,83 b | 82,78 a |
| **-1,5MPa** | 8,58 c | 16,50 c | 23,36 b | 36,38 b | 45,86 b | 50,27 a | 60,52 a | 64,70 b |
| **LSD** | 3,78** | 1,96*** | 3,10*** | 5,46*** | 3,28*** | 5,45*** | 5,11*** | 4,30*** |

* P<0,05, ** P<0,01, *** P<0,001

**LITERATURE CITED**


Abbaspour, H., Saeidi-Sar, S., Afshari, H., & Abdel-Wahhab, M. (2012). Tolerance of mycorrhiza infected pistachio (Pistacia vera L.) seedling to drought stress under glasshouse conditions. *Journal of Plant Physiology, 169*(7), 704-709.

Alizadeh, A., Alizade, V., Nassery, L., & Eivazi, A. (2011). Effect of drought stress on apple dwarf rootstocks. *Technical Journal of Engineering and Applied Science, 1*(3), 86-94.

Anonymous. (2017). https://www.konicaminolta.eu/en/measuring-instruments (Access Date: 10.08.2017).

Araus, J., Slafer, G., Reynolds, M., & Royo, C. (2002). Plant breeding and drought in C3 cereals: what should we breed for? *Annals of Botany, 89*(7), 925-940.

Ashraf, M., & Iram, A. (2005). Drought stress induced changes in some organic substances in nodules and other plant parts of two potential legumes differing in salt tolerance. *Flora-Morphology, Distribution, Functional Ecology of Plants, 200*(6), 535-546.

Bates, L., Waldren, R., & Teare, I. (1973). Rapid determination of free proline for water-stress studies. *Plant and soil, 39*(1), 205-207.

Bertamini, M., Zulini, L., Muthuchelian, K., & Nedunchezhian, N. (2006). Effect of water deficit on photosynthetic and other physiological responses in grapevine (Vitis vinifera L. cv. Riesling) plants. *Photosynthetica, 44*(1), 151-154.

Bolat, I., Dikilitas, M., Ercisli, S., Ikinci, A., & Tonkaz, T. (2014). The effect of water stress on some morphological, physiological, and biochemical characteristics and bud success on apple and quince rootstocks. *The Scientific World Journal, 2014*.

Boutraa, T., Akhkha, A., Al-Shoaibi, A. A., & Alhejeli, A. M. (2010). Effect of water stress on growth and water use efficiency (WUE) of some wheat cultivars (Triticum durum) grown in Saudi Arabia. *Journal of Taibah University for Science, 3*, 39-48.

Bradford, M. M. (1976). A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical biochemistry, 72*(1-2), 248-254.

Chai, T.-T., Fadzillah, N., Kusnan, M., & Mahmood, M. (2005). Water stress-induced oxidative damage and antioxidant responses in micropropagated banana plantlets. *Biologia Plantarum, 49*(1), 153-156.

Chaves, M., & Oliveira, M. (2004). Mechanisms underlying plant resilience to water deficits: prospects for water-saving agriculture. *Journal of experimental Botany, 55*(407), 2365-2384.

Chaves, M. M., Maroco, J. P., & Pereira, J. S. (2003). Understanding plant responses to drought—from genes to the whole plant. *Functional plant biology, 30*(3), 239-264.

Errabii, T., Gandonou, C. B., Essalmani, H., Abrini, J., Idaomar, M., & Skali-Senhaji, N. (2006). Growth, proline and ion accumulation in sugarcane callus cultures under drought-induced osmotic stress and its subsequent relief. *African Journal of Biotechnology, 5*(16).

Farooq, M., Wahid, A., Kobayashi, N., Fujita, D., & Basra, S. (2009). Plant drought stress: effects, mechanisms and management *Sustainable Agriculture* (pp. 153-188): Springer.

Flexas, J., Bota, J., Loreto, F., Cornic, G., & Sharkey, T. (2004). Diffusive and metabolic limitations to photosynthesis under drought and salinity in C3 plants. *Plant Biology, 6*(3), 269-279.

Ghaderi, N., & Siosemardeh, A. (2011). Response to drought stress of two strawberry cultivars (cv. Kurdistan and Selva). *Horticulture, Environment, and Biotechnology, 52*(1), 6-12.

İpek, M., & Pirlak, L. (2016). *Determination of Myrobolan 29C rootstocks reactions against drought stress in vitro conditions*. Paper presented at the VII International Scientific Agriculture Symposium," Agrosym 2016", 6-9 October 2016, Jahorina, Bosnia and Herzegovina. Proceedings.

Jaleel, C. A., Manivannan, P., Wahid, A., Farooq, M., Al-Juburi, H. J., Somasundaram, R., & Panneerselvam, R. (2009). Drought stress in plants: a review on morphological characteristics and pigments composition. *Int J Agric Biol, 11*(1), 100-105.

Karimi, S., Yadollahi, A., Nazari-Moghadam, R., Imani, A., & Arzani, K. (2012). In vitro Screening of Almond (Prunus dulcis (Mill.)) Genotypes for Drought Tolerance. *J. BIOL. ENVIRON. SCI, 6*(18), 263-270.

Keyvan, S. (2010). The effects of drought stress on yield, relative water content, proline, soluble carbohydrates and chlorophyll of bread wheat cultivars. *J. Anim. Plant Sci, 8*(3), 1051-1060.

Klamkowski, K., & Treder, W. (2008). Response to drought stress of three strawberry cultivars grown under greenhouse conditions. *Journal of Fruit and Ornamental Plant Research, 16*, 179-188.

Kluge, M. (1976). Carbon and nitrogen metabolism under water stress *Water and Plant Life* (pp. 243-252): Springer.

Kutlu, İ. (2010). Tahıllarda Kuraklık Stresi. *Türk Bilimsel Derlemeler Dergisi, 3*(1), 35-41.

Lutts, S., Kinet, J., & Bouharmont, J. (1996). NaCl-induced senescence in leaves of rice (Oryza sativa L.) cultivars differing in salinity resistance. *Annals of Botany, 78*(3), 389-398.

Michel, B. E. (1983). Evaluation of the water potentials of solutions of polyethylene glycol 8000 both in the absence and presence of other solutes. *Plant Physiology, 72*(1), 66-70.

Mukherjee, S., & Choudhuri, M. (1983). Implications of water stress□induced changes in the levels of endogenous ascorbic acid and hydrogen peroxide in Vigna seedlings. *Physiologia Plantarum, 58*(2), 166-170.

Nogués, S., & Baker, N. R. (2000). Effects of drought on photosynthesis in Mediterranean plants grown under enhanced UV□B radiation. *Journal of experimental Botany, 51*(348), 1309-1317.

Ozfidan, C., Turkan, I., Sekmen, A. H., & Seckin, B. (2013). Time course analysis of ABA and non-ionic osmotic stress-induced changes in water status, chlorophyll fluorescence and osmotic adjustment in Arabidopsis thaliana wild-type (Columbia) and ABA-deficient mutant (aba2). *Environmental and Experimental Botany, 86*, 44-51. doi:10.1016/j.envexpbot.2010.09.008

Rad, M. R. N., Kadir, M. A., & Yusop, M. R. (2012). Genetic behaviour for plant capacity to produce chlorophyll in wheat (Triticum aestivum) under drought stress. *Australian Journal of Crop Science, 6*(3), 415.

Rostami, A., & Rahemi, M. (2013). Responses of Caprifig Genotypes to Water Stress and Recovery (Original Research Article). *Journal of Biological and Environmental Sciences, 7*(21).

Sánchez, F., De Andres, E., Tenorio, J., & Ayerbe, L. (2004). Growth of epicotyls, turgor maintenance and osmotic adjustment in pea plants (Pisum sativum L.) subjected to water stress. *Field Crops Research, 86*(1), 81-90.

Somerville, C., & Briscoe, J. (2001). Genetic engineering and water.

Taiz, L., & Zeiger, E. (2002). Plant Physiology. 3rd. *Ed. Pub. Sinauer*.

Verslues, P. E., Govinal Badiger, B., Ravi, K., & M Nagaraj, K. (2014). Drought tolerance mechanisms and their molecular basis. *Plant Abiotic Stress, Second Edition*, 15-46.

Zanjani, K. E., Rad, A. H. S., Naeemi, M., & Taherkhani, T. (2012). Effects of zeolite and selenium application on some physiological traits and oil yield of medicinal pumpkin (Cucurbita pepo L.) under drought stress. *Current Research Journal of Biological Sciences, 4*(4), 462-470.

Zonouri, M., Javadi, T., & Ghaderi, N. (2014). Effect of Foliar Spraying of Ascorbic Acid on Cell Membrane Stability, Lipid Peroxidation, Total Soluble Protein, Ascorbate Peroxidase and Leaf Ascorbic Acid Under Drought Stress in Grapes. *International Journal of Advanced Biological and Biomedical Research, 2*, 349-354.

# O-16 Assessment Fungal Diseases onTomato Cultivation in Greenhouse and Determining Effectiveness of Some Fungicides Against Powdery Mildew(*Leveillula taurica*) in Antalya Province

Özkan KOÇ[1], Nuh BOYRAZ[2]

[1]: Antbirlik Cooperative, Antalya,Turkey

[2]: Selcuk University, Faculty of Agriculture, Plant Protection Department, Konya, Turkey

e-mail: nboyraz@selcuk.edu.tr

**Abstract**

This study was conducted in order to determine the effects of different fungicides against tomato Powdery mildew disease and rates of occurrence of fungal diseases in tomato greenhouses in Aksu, Serik and Manavgat districts of Antalya province.Ten tomato greenhouses from each county and twenty plants were randomly observed from each greenhouse every month and disease surveillance was carried out for eight months.The diseases caused by named causal agents (damping-off: *Pythium* spp.,*Fusarium* spp.,*Sclerotinia* spp.,*Rhizoctonia solani,Alternaria solani) Fusarium oxysporum* f.sp.*lycopersici,Sclerotinia sclerotiorum, Phytophthora infestans, Botrytis cinerea, Alternaria solani, Cladosporium fulvum, Leveillula taurica* were determined as 8.33%, 40.03%, 44.20%, 48.95%, 53.99%, 58.43%, 63.37% and 64.83% respectively.In order to determine the efficacy of some fungicides against the powdery mildew disease, which was highest in the uncovered tomato cultivation, a fungicide test was conducted in four replicates according to the randomized split-block trial design using the susceptible Keyta F1 hybrid tomato variety.As a result of the fungicide treatment,the highest effect was obtained with 92.30% from 80% micronised sulfur, which was followed by triadimenol 250g / l, Fluopyram 200g / l + Tebuconazole 200g / l, Azoxystrobin 250g / l Penconazole 100 g / l with 86.2%, 80.3%, 76.36% and 74.5% / L, respectively.

**Keywords**:Antalya,Fungicide,Greenhouse,*Leveillula taurica*,Powdery mildew,Tomato

**Introduction**

In Turkey, tomatoes are among the first vegetables in terms of production, consumption and the value of the economy. Tomato is one of the important income sources of farmers in the cultivated areas (Çelik and Özbay, 2015).

Tomato, one of the most grown vegetables in the world, also has an important production in Turkey. With the climatic conditions being compatible with tomato cultivation and with the advancement of the tomato processing industry since the 1970's, the world has risen to the first place in tomato production

According to 2013 data in Turkey, greenhouse tomato production is 253.334 decare area (3.200.930 ton). The Mediterranean region occupied the first place with a total production of 206,078 decares and an area of 2,501,733 tons. The province of Antalya is the province with the highest production with a total of 2,335,271 tons, including 202,055 decare terrestrial tableware (2,332,073 tons) and salting (3.198 tons). In the area of 164.551 decare, greenhouse production was made (2.134.374 tons) and production was realized (Tüik, 2013).

There are a number of factors that affect the development of tomato crops that are important for Turkey and which are particularly important in industrial production, such as being in other cultivated plants. These include fungi, bacteria, harmful insects, viruses, nematodes, weeds, etc. . One of the most important of these problems is tomato fungal diseases. Quality tomato production is closely related to the control of the organisms causing the disease. Fungal and bacterial agents directly affect the yield, killing the plant, and on the other hand increase the mold burden in processed products with fruit infections, thereby lowering quality and making product export difficult (Alperdem et al., 1985).

The tomato value is increasing day by day due to the increasing population and the intensity in the consumer demand. Taking into account consumer demands and seasonal changes; The target for the continuation of tomato cultivation; Healthy, high quality, residue-free, reliable production. Especially in recent years, the importance of human health and environmental cleanliness has shown that the pesticides to be used should be preferred to those with more specific and residual risks. In terms of producers, it is aimed to reduce production costs, to capture the quality of the product and to sell the product at a high price during harvest time. The catching of the quality of the product is related to the health of the product. Therefore, disease products can not be mentioned in quality, and most farmers use pesticides intensely and uninformedly to protect their products from diseases and insect. However, the fact that the MRL (Max. Residual Limit) value of the products is high is a problem especially in the domestic market and big markets. Since the methods used for the detection of pesticides in

plant products are highly developed and traceability is sought, producers have to implement an effective chemical program involving environmentally friendly preparations with no residual problems (Tosun et al., 2003).

This study was carried out to determine the fungal diseases seen in the greenhouse of tomatoes in Antalya province, at what time and condition it emerged, and the rates of occurrence in the plants. It is also the main objective of the study to examine the effects of different active-substance fungicides against the severe infection of *Leveillula taurica* in tomatoes and to make an appropriate program for controlling this disease.

**Material and Methods**

10 m x 7m underfloor greenhouse used in the shrinkage study, tomato varieties (Bestona F1, Keita F1, Monument F1, Çiğdem F1, Alyanak F1, Lamia F1) in the green provinces of the province of Antalya Aksu, Serik and Manavgat, 100 Keita F1 tomatoes, dripping devices,Luna Experience SC 400 (200 g / l Fluopyram + 200 g / l Tebuconazole), Conrad SC (250 g / l Triadimenol), Thiovit Jet WG (80% Micronized Sulfur), Shavit 25 EC L Azoxystrobin), Oscar 100 EC (100 g / l Penconazole) fungicides were taken as the main material of the study.

The plants were controlled for disease at different points in the sera, representing the whole of the 10 different greenhouses selected for each district from different locations of the districts, representing Antalya, Aksu, Serik and Manavgat districts In total, 200 plants were checked monthly in each district and the obtained data were recorded. The diseased plants in the total control plant were counted separately for each disease and the total plant percentage was calculated as% and the diseased plant percentage was found.

In order to investigate the efficacy of some fungicides against powdery mildew (Leveillula taurica) disease, 4 replicate experiments were carried out according to randomized parcels divided blocks trial design using 5 different active material fungicides in Yeniköy, Manavgat district of Antalya province. Each plum was planted with 25 plants, with a total of 100 plants susceptible to the disease, with Keita F1 tomato seedling planted.Later, fungicide applications were started. Five plants were left as controls and only water was pulverized. The remaining 20 plants were sprayed with 5 different fungicide, especially the lower parts of the leaves. Two days after the fungicide application, counts were started again and recorded according to 0-5 scale values. The disease severity was determined according to the Towsend-Heuberger formula. The activity of the fungicides was calculated according to the Abbott formula.

**Results and Discussion**

The results of land surveys in Antalya province undergrowth tomato production areas are given in Table 1.

According to Table 1, powder mildew disease(*Leveillula taurica*) was found the highest in the greenhouse tomato production areas of Antalya with 64.83% diseased plant ratio. This was followed by *Cladosporium fulvum*, *Alternaria solani* and *Botrytis cinerea* with 63.37%, 58.43% and 53.99% infected plant rates, respectively. Tomato downy mildew disease (*Phytophthora infestans*) known by the producers as the combatant, was ranked fifth among diseases with an infectious rate of 48.95%. *Phytophthora infestans* was followed by *Sclerotinia sclerotium* and *Fusarium* spp. with diseased plant ratios of 44.20% and 40.03%.

Table1. Fungal diseases and ratios detected in tomato greenhouse in Antalya province

| FUNGAL DISEASES | DISEASE RATIO (%) |
|---|---|
| *Leveillula taurica* | 64.83 |
| *Cladosporium fulvum* | 63.37 |
| *Alternaria solani* | 58.43 |
| *Botrytis cinerea* | 53.99 |
| *Phytophthora infestans* | 48.95 |
| *Sclerotinia sclerotiorum* | 44.20 |
| *Fusarium* spp. | 40.03 |
| *Çökerten (Phytium sp.,Fusarium sp.,Rhizoctonia solani.,Alternaria sp.,)* | 8.33 |

Within the scope of survey studies of *Botrytis cinerea* and *Sclerotinia sclerotiorum*, approximately 1% of total sowing area in 2010 and 2011 in the provinces and districts of Antalya has been examinedThe center of Alanya, Gazipaşa, Finike, Manavgat, Serik and Kumluca districts of Antalya were built in a total of 90 hectares in an area of 150 decares. It was determined that 88 decares of the total area surveyed in the provinces and districts of Antalya were contaminated with gray mold disease and 28 decares were contaminated with white rot disease. The prevalence rate of gray mold disease in all provinces was determined between 12.2% and 58.0% in 2010 surveys in Antalya province, and disease severity was found to vary between 7.5-40.4% in all provinces. The prevalence of white rot disease was found to be between 17.3% and 25.0%, while the disease severity was found to be between 16.3% and 24.4%.In the 2011 surveys, the prevalence of gray mold disease was found between 19.0% and 62.5%, and the disease severity was found to vary between 11.0% and 45.2%. The prevalence rate of white rot disease was determined between 12.2-22.0% while the disease severity was between 10.2-19.0% (Altınok, 2012).

*Fusarium oxysporum* is the most common form of domestication in *Fusarium* species.*Fusarium oxysporum* domateste *Fusarium oxysporum* f. sp. *lycopersici* (FOL) and f. sp. *radicis lycopersici* (FORL). Although they are tomato-like host pathogens, they form a disease in separate forms. While FOL wils, FORL causes root and root crown decays (Attitalla et al., 2004).

Fusarium species (81.08%) were obtained mostly in the isolations made from the plants showing signs in the survey studies in 1996-1997 in order to determine *Fusarium* spp., which is a problem in the stem root bottom of the plants in Aydın province and districts where tomato agriculture areas. The largest group of Fusarium species that were found to be pathogenic was *Fusarium oxysporum* f. sp. *lycopersici* (48.15%). It was found that *Fusarium solani* (33.33%) and *Fusarium equiseti* (18.52%) (Yıldız ve Döken, 2001).

They reported that *Alternaria solani* caused a disease known as 'Yanıkara' and caused significant damage in the study of Alternaria disease in tomatoes grown in plastic greenhouses in the Mediterranean region of Mersin in 1978-1981 in our country. In this study, they also emphasized that it is a pathogenic disease, but not important, in the case of *Alternaria alternata* in tomatoes (Akteke and Eraslan, 1985).

*Botrytis cinerea, Phytophthora infestans, Sclerotinia sclerotiorum* and *Fusarium oxysporum* started to appear in tomato greenhouse from December. *Botrytis cinerea, Phytophthora infestans* and *Sclerotinia sclerotiorum* until the end of the third month and *Fusarium oxysporum* until the end of the fourth month were found to be effective in these diseases which departed in December. It can be seen from that the most recent outbreak of *Cladosporium fulvum* in tomato plants in Antalya province is observed. It has been observed that this disease started early in February and lasted until the end of May. It can be said that it will provide significant benefits in determining the timing of the application of both cultural and chemical control against these diseases as well as determining the time of emergence of the diseases.

Table 2 shows that the highest effect against tomato powdery mildew disease was 80% micronize sulfur (Thiovit WP 80). Sulfur showed activity at% 92.30 against% 80 disease. It observed Triadimenol 250g / L (Shavit 25 EC) with 86.20% effect. Both fungicides were statistically in the same group although they differed in their effect levels. Fluoropram 200g / L + Tebuconazole 200g / L (Luna Experience SC 400) was in the third place with 80.35% effect. Statistically the effect values were in the same group as triadimenol effect values. Azoxystrobin was 76.36% against 250g / L (Conrad) And remained at a lower level than the other three fungi. The lowest effect was obtained from Penconazole 100g / L (Oscar 100EC).

Powder mildew disease was markedly controlled by both K2 SiO3 (potassium silicate) and Bayleton + sulfur. Potassium silicate applied at 12-day intervals is quite protective against the naturally occurring contagious disease in field conditions. In the study Triadimefon + sulfur application severity was calculated as 7.4% in 2006 and 4% in 2007 (Yanar et al., 2011).

Table 2. Effect of Some Fungicides Against Tomato Powdery Mildew Disease

| Active substanceand groups | Commercial preparation and formulation | Effect (%) |
|---|---|---|
| Mikronize Kükürt % 80 | Thiovit WG 80 | 92.30 A |
| Triadimenol 250g/L | Shavit 25EC | 86.20 AB |
| Fluopyram 200gr/L | | |
| + | Luna Experience SC 400 | 80.35 B |
| Tebuconazole 200g/L | | |
| Azoxystrobin 250g/L | Conrad | 76.36 B |
| Penconazole 100g/L | Oscar 100EC | 74.50 BC |

P<0.05

**Conclusion**

In order to be able to effectively control diseases that are problematic in tomato cultivation, it is important to know first what kind of disease and when to go out and how to follow a development course. It is important to know the density of these diseases if there is more than one disease in a production area.

Antalya province has encountered 8 fungal diseases that cause problems in greenhouse tomato cultivation and powdery mildew disease is seen as the most intensive disease. As the damaged leaves can not perform their functions, the plant can not feed the fruit. As a result, poor quality, weak, pale fruits are formed and the fruits are deformed as a result of exposure to the sun. In our study area, if there is no fight against disease, the disease severity is 68%, which causes significant loss of yield and quality in the disease severity at this level. In this study, it was determined that powdery mildew disease is the most important disease in the greenhouse tomato production areas and the fungicides which are effective against it in the effective chemical control are performing better. As a result of this experiment, micronized sulfur 80% (Thiovit WG 80) showed the best result with 92.30% effect. It was also found that Triadimenol (Shavit 25 EC), which has specific effects against powdery mildew diseases , is more effective than other fungicides. It can be concluded from this that it would be better to include the classical fungicides such as sulfur, which are more specific to the powdery mildew diseases and the narrow spectrum of action, instead of the modern fungicides of Strobilurin and Azole group, which have a broad spectrum of action on the chemical control of the tomato powdery mildew disease.

## References


Akteke, Ş., F. Erarslan, 1985. Studies on the early blight of tomato ( *Alternaria solani* Ell.and Martin) in the greenhouses of province İçel. The Journal of Turkish Phytopathology, Vol.14(3):102.

Alperdem, I., Aran, N., Topal, Ş. ve Varol, M., 1985, Hasattan Domates İşlemeye Kadar Domates ve Salçada Mikrobiyolojik Değişmeler ve Azaltma Olanakları. AKFA 1. Domates Yetiştirme ve Değerlendirme Teknikleri Simp., 25-26 Nisan.

Altınok, H., 2012. Antalya Ve Mersin Ili Örtü Altı Patlıcan Ekim Alanlarında Kurşuni Küf Ve Beyaz Çürüklük Hastalıklarının Yaygınlık Oranlarının Belirlenmesi,, Bitki Koruma Bülteni, cilt.52, ss.163-173,

Attitalla, I., 2004. Biological and molecular characteristics of microorganism- Stimulated defence responce in *Lycopersicon esculentum*-L., 2004. Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology 943.

Özer, N., H. Soran, 1991, Fusarium Genus and Fusarium species isolated from the cultivated plants in Turkey. J. Turk. Phytopath., 20(2-3):69-80.

Tosun, N., H.Türküsay,H. Saygılı, B.Tanyolaç, 2003. Sanayi Domatesi Yetiştiriciliğinde Geç Yanıklık (Phytophthora infestans(Mont.) de Bary) Hastalığının Kontrolünde Erken Uyarı Sisteminin Kullanılması Üzerinde Araştırmalar. Ege Üniversitesi Ziraat Fakültesi Bilimsel Araştırmalar Proje No: 2000/BIL/005, 2s.

Uçum, İ., Gülçubuk, B., Berk, A., Korkut, L. ve Saçtı, H., 2014. Kırsal Alanda Tarımda Kalkınmanın Sağlanmasında Kümelenme Yaklaşımı, XI. Ulusal Tarım Ekonomisi Kongresi, 3-5 Eylül Samsun, 282-289

Yanar Y., Yanar D. ve Gebologlu N., 2011, Control of powdery mildew (*Leveillula taurica*) on tomato by foliar sprays of liquid potassium silicate (K2SiO3). African Journal of Biotechnology. 10(16), pp. 3121-3123.

Yıldız, A.,T.Döken.,2001. Aydın ili Domates Ekim Alanlarında Saptanan *Fusarium* spp. ve Bazı Domates Çeşitlerinin Bu Etmenlere Karşı Reaksiyonlarının Belirlenmesi Üzerinde Çalışmalar. Türkiye IX. Fitopatoloji Kongresi 3-8 Eylül, Trakya Üniversitesi Rektörlüğü Yayınları No: 45 (364-371 s.)

# O-17 Evaluation of Chemical Control Approach, its Applications on Beans by Farmers and its effect on Human Health and Environment

Seda AYDIN[1], Nuh BOYRAZ[2]

[1]: Agricultural Credit Cooperatives, Konya,Turkey

[2]: Selcuk University, Faculty of Agriculture, Plant Protection Department, Konya, Turkey

e-mail: nboyraz@selcuk.edu.tr

**Abstract**

One way of achieving efficient and high quality crops in crop production is to protect crops against problems related to plant protection. For this, effective control against disease, insect and weeds must be carried out by using appropriate methods of agricultural control. The most widely used method of agricultural control is the chemical control, which is accepted by producers against diseases, harmful and weeds due to effective and short-term results. Although the use of pesticides in the agricultural control has a significant advantage in terms of effective control against disease, insect and weeds, it is also a disadvantage in terms of human health and the environment. The most important factor in creating the risk of the pesticide in terms of human health and environment is the chemical control approach and application behaviors of the pesticide users. We conducted this research in order to reveal the level of risk of human health and environment in terms of the chemical control approaches and practices of the bean breeding farmers. For this reason, it has been tried to evaluate the chemical control approaches and practices of human beings in terms of human health and environmental risk by asking face to face questions with the bean producers of Konya, where beans were produced the most. Analysis of the answers to questions asked by a total of 60 bean farmers surveyed revealed that about 70% of the farmers did not take the necessary precautions during the preparation phase of the pesticide and during the application.

**Keywords**: Bean,Farmer, Pesticide, Konya

**Introduction**

There are a large number of fungal, viral and bacterial diseases in bean plants grown worldwide, and these diseases cause yield losses at different levels (Hall, 1991).

It is only possible to reduce the yield and quality losses due to the diseases seen on bean, but by control these diseases with appropriate methods. Chemical control is one of the most preferred method by farmers in the control against bean diseases.

Agrochemicals which are the argument of chemical control which are accepted as indispensable materials all over the world due to easy application and quick results availability. However, the natural balance is disturbed by the conscious and uncontrolled application of agrochemicals which play a major role in increasing the yield, human, animal and environmental health are threatened, air, water, soil and wildlife are adversely affected.

It is possible to increase the yield level of bean, which is important for our country, to benefit from the unit area in the most effective way. For this, besides measures such as good soil preparation, adequate and balanced fertilization, proper irrigation, it is also necessary to carry out effective fertilization with diseases, insects and weeds. Inadequacies of farmers' methods of bean breeding and miscarriage practices have caused many problems in terms of human and environmental health, while reducing the yield and choosing chemical application widely in the fight against diseases and harms. For this reason, the problems and solution suggestions of the results obtained from the study in terms of human and environment are discussed (Aydın , 2015).

In this study, it is aimed to determine the farmers who make bean cultivation in Konya province which has the greatest potential in terms of bean production in Turkey and determine their approach to plant protection practices and identify the mistakes correctly known by the farmers in terms of ensuring the sustainability of sustainable bean cultivation and evaluate their risks in terms of human health and environment to raise awareness of the producers.

**Material and Methods**

Questionnaires were prepared to determine the approaches of chemical warfare and application of 60 bean farmers in each province with 20 sharps farmers who produced at least 20 decare beans in the provinces of Altinekin, Çumra and Ereğli, the largest bean production area in Konya. The distributions of the answers given to these questions are calculated as%. Assessment of chemical control applications in terms of human health and environmental risk has been made through these calculated rates.

The questionnaire forms were prepared and the questions directed to the farmers through the dialogue method were prepared under the following three headings in order to determine the chemical control applications and approaches of the bean farmers. These;

1.Approaches and behaviors before starting chemical control

2.Approaches and behaviors during chemical control applications

3. Approaches and behaviors after the application of chemical control

**Results and Discussion**

Before the chemical control begins, in order to determine the behavior of the farmers in the course of preparing the pesticides, what precautions do you take when preparing the agrochemicals? Of the farmers who read the survey stated that 30% of the farmers read the necessary information on the package of pesticides, 13.3% used gloves and glasses for drug preparation, 25% not to smoke and to eat something and 16.7% They did not take any precautions.

We can say that producers do not show the necessary sensitivity to protect against the toxic effects of pesticides especially when they are looking at the behaviors they show when preparing of pesticides. We can say that the producers may experience significant toxic effects of pesticides if they do not take sufficient protective measures during preparation of m psticides in order to protect them from effects such as acute or chronic poisoning.

In a study conducted in the Adana region, it was observed that the person preparing the pesticide without using short-sleeved shirt, short trousers, gloves, mask and glasses. When they are told that they should take necessary protective measures such as gloves, masks, glasses for their own health, they have used gloves, masks, masked edges in warm areas such as Cukurova as being overwhelming, more uncomfortable and even saying that they have become immune because they have done this for years . However, such conditions pose a great risk for acute or chronic pesticide poisoning (Emeli, 2006).

Reducing the risk of pesticides related to acute and chronic toxicity related health problems on users there is a great benefit in taking the necessary protective measures during the application of pesticides. When you look at the answer to the question "What do you pay attention to when you make pesticides", only 16.7% of the bean farmers are wearing protective clothing, 30% have never taken any precautions, 46.7% have been eating or drinking Reported that they were using both protective clothing and 6.6% of the respondents. As can be seen from these results, it is understood that only 7% of the bean farmers are sensitive to the personal protective measures to be taken to prevent the adverse effects of pesticides while spraying, and others are not sensitive to these issues.

A study of pesticide contamination in pesticide applications found that practitioners were exposed to pesticide, skin, respiratory and oral contaminants, and most of the contaminants were transmitted through the skin. Practitioner contamination is affected by the type of equipment used, the volume of the treatment and the type of the chemical used, and these contamination will be greatly reduced by the use of protective clothing and equipment such as gloves, masks, boots, long-sleeved T-shirts and trousers (Tücer, 1998).

During the application of agricultural chemicals, which are known to have many negative features in terms of human and environmental health, 40% of the manufacturers pay attention to the use of gloves, masks and glasses for protective measures; (50%) were generally smokers while they seemed to be a bit more careful about eating and drinking during the treatment (Emeli, 2006).

The question posed to them to determine what kind of personal care they are taking to reduce pesticide contamination ,after the application of the pesticide, 31.7% of the respondents answered that they had washed all clothes after washing, 55% had washed their body with water and soap, 13.3% had washed their clothes They reported that they had washed their body. According to these results, the best way to remove the pesticides which are used during the application and the pesticides which have been exposed to the open body parts is to remove the clothes which have not been used for a long time and wash both the clothes and the body while only 13.3% of the practitioners have either washed their clothes or just washed their bodies seen.

After the pesticides application, the pesticide solution is the question directed to them to determine the behavior of the bean farmers as to the way in which the increased water of medication and the tank cleaning water were destroyed. They Reported that 45% of the farmers had sprayed the increased medicanal water into empty land, 30% had turned it to a side of the field, and 16.7% had turned it into sewer, none of the farmers had dumped irrigation water or tank cleaning water. After pesticides applications, pouring of medicated water or tank cleaning water into the surrounding or irrigation channels causes the environmental pollution and natural life to be affected negatively. Here, the bean farmers' behavior towards the increased water supply to irrigation canals and stream sources is not favorable in terms of environmental health, but the uncontrolled spill of empty land and sewage on one side of the field is a negative behavior due to the negative effects of

environmental health and natural life .

Considering that, after the application of the pesticide, the empty packaging boxes will pose significant risks for environmental health if not properly disposed of these. In order to determine the behaviors of the bean farmers in this direction, it was determined that 30% of the producers randomly left the empty packaging residue on one side of the field, 26.7% put it in the trash box, 25% stored the empty packaging waste in one place after disinfection, Another 16.6% (used for different purposes) and 1.7% for irrigation channels or rivers. Leaving empty drug boxes at random after disinfection may cause environmental pollution and may be seen as a significant risk in other organisms. Pesticide packs that are thrown into dumps without any treatment may also cause environmental pollution and poisoning of many animals fed from the dumpsite. It can be said that 75% of the applications made by bean producers when carrying out the general evaluation of the methods of disposing empty packaging pesticide boxes occur in a way that harms the environment and poses a significant environmental risk to it.

According to a study done in Çukurova region, it was determined that 73.18% of the producers randomly laid empty packages, 17.28% burned, 5.45% buried in the soil, and 4.09% washed and used after the pesticide application (Üremiş et al., 1996) ,

According to a study carried out in İçel province, 45.29% of the producers randomly laid empty packages, 38.48% burned, and 16.23% buried in the soil after the spraying (Zeren and Kumbur, 1998).

In a study conducted in Konya region, 34.3% of the producers reported that they left drug boxes in the field after pesticides application, 23% cleared and used for different purposes, 20% buried in soil, 15.7% burned and 7% leaved in a garbage (İnan and Boyraz, 2002).

In a survey conducted with producers in İzmir's Menemen district, it was found that 2% (2 people) collected and sold drug boxes, 5% (4 people) bury, 18% (15 people) (18 people) reported burns while the remaining 52% (43 people) reported that they left the water spraying place of the sprayer (Demirkan and Uysal 2011).

The most important factor playing a role in the change of pesticide residue amounts in agricultural products is the waiting period. Taking this fact into consideration, only 38.3% of the respondents to the waiting period reported that they had carried out the crop harvest according to certain conditions without regard to the waiting period, while the bean producers were asked to determine their behavior regarding whether to pay attention to the waiting period after spraying.

Once pesticides are sprayed onto plants, they often lose their toxicity over time under the influence of environmental factors such as temperature, light, precipitation. The time to wait for the residue amount on the products to fall below the tolerance values after the use of the pesticides is called the "waiting period". If the harvest is made after the pesticide application is not followed in the necessary waiting period, continuous consumption of such foods with drug residues cause "chronic poisoning" in the consumer (Öztürk 1990).

When pesticide applications do not pay attention to the waiting period, pesticide in agricultural products brings with it residue problem. The main reason underlying this obstacle is the pesticide residue above the maximum residue level poses a risk for human health, as pesticide residues in agricultural products constitute a significant technical obstacle in the export of agricultural products among countries. For each pesticide used in each country, the maximum residue levels (MRL) of all agricultural products are determined, and according to these values, the pesticide residues required for the export and import of agricultural products are checked for pesticide residue. In our country, it is sometimes seen that product returns are due to pesticide residues on MRL in agricultural products. For example, the number of parties not eligible for pesticide residues from the plant product groups sent to EU countries in Turkey has been reported as 118, 61,39,67, 88,77 from 2011 to 2016 respectively. (Tiryaki, 2017).

The most important reasons for the residual problems in agricultural products as well as soil-related factors as well as plant type, chemical structure and properties of the pesticide, environment and climatic conditions, processes applied until the consumption of the hanthorn, overfilling of the pesticide and application dose,overdose use, non-target pesticide applications, and failure to comply with the time interval between the last application and harvest (Tiryaki, 2017).

In a study conducted in Manisa province, 18% of the producers were found to have harvested immediately according to their maturity after their products were applied, 4% of the respondents had realized the crop harvest according to the market conditions, 72% of those waiting for the waiting period and 6% (Karatas, 2009).

In a study carried out in the Çukurova region, the question "Are you paying attention to the time intervals between spraying and harvesting?" Asked that 47.6% of the growers had harvested their crops according to the maturation status after they had applied their pesticides, 15.9% While 23.4% of those who pay attention to the necessary waiting period and 13.1% of those who pay no attention to this situation (Emeli, 2006).
When surveyed bean farmers are asked about their views on pesticide residues, it is understood that 35% of the respond-

ents cared about this, while the rest of them regarded this as very important because it is important to control the disease and harm as well. Be aware that negative behaviors of bean farmers in this way will eventually adversely affect human health and make them aware of this issue by making the necessary informants to avoid their wrong practices.

**Conclusions**

Konya bean farmers are faced with the following consequences when chemical control applications and approaches to disease and harm are evaluated in terms of human health and environmental risk.

1.It can be said that the producers have not shown the necessary sensitivity to protect against the toxic effects of pesticides especially when they are behaving in the way they prepare agricultural pesticides. Here, we can say that, in the absence of adequate preventive measures in the preparation of the pesticide in order to protect it from effects such as acute or chronic poisoning of the agrochemical, the producers may experience significant health problems by being exposed to the toxic effects of the drugs.

2.It is understood that only 7% of the bean farmers during the application of the pesticides are sensitive to the personal protective measures that must be taken to avoid the adverse effects of the pesticides, while others are not fully sensitive to these issues. In this case, it can be said that bean farmers are exposed to toxic effects of pesticides in different forms and ignore their health.

3.It is evaluated that bean farmers' behavior toward the increased supply of irrigation water to irrigation canal and river resources is a positive behavior in terms of environmental health, but pouring uncontrolled land to an empty land and drainage on an edge of the field is a risky behavior due to the negative effects of environmental health and natural life .

4.It can be said that 75% of the applications made by bean producers when carrying out the general evaluation of the methods of disposing empty packaging pesticide boxes occur in a way that harms the environment and poses a significant environmental risk to it.

5.One of the most important reasons underlying the problem of pesticide residues in agricultural products is that crops are harvested and consumed without paying attention to the time (waiting time) between the last application and the harvest. Here too, the most important responsibility in this issue is to protect the crops from diseases and insects effects by the chemical control. It seems that bean farmers at this point are not at the desired level in their behavior at the point of harmonization with the time between the last spraying and the harvest.

6.It is understood that 35% of the bean farmers care about pesticide residues, and the rest of them regards this as very important because the answer is that controlling the disease and insect is important, as it is the second planet. Be aware that negative behaviors of bean farmers in this way will eventually adversely affect human health and make them aware of this issue by making the necessary informants to avoid their wrong practices.

**References**


Aydın,S., 2015. Konya İli Fasulye Üreticilerinin Bitki Koruma Uygulamalarına Yaklaşımlarının Belirlenmesi,Yüksek Lisans Tezi,Selçuk Üniversitesi Fen Bilimleri Enstitüsü,Konya

Demirkan, H. ve Uysal, F., 2011. Menemen (İzmir) Pamuk Üreticilerine Yönelik (Bitki Koruma Açısından) Bir Anket Çalışması. Ege üniversitesi Ziraat Fak.Derg.2011,48 (3) 277-283.

Emeli, M., 2006. Seyhan ve Yüreğir Havzasında Bitki Koruma Yöntemlerinin Uygulamadaki Sorunları Üzerine Bir Araştırma, Yüksek Lisans Tezi, Çukurova Üniversitesi Fen Bilimleri Enstitüsü,Adana,

Hall,R.,1991.Compendium of Bean Diseases,APS press,USA,73pp.

İnan, H., Boyraz N. 2002. Konya Çiftçisinin Tarım İlacı Kullanımının Genel Olarak Değerlendirilmesi. S.Ü. Ziraat Fakültesi Dergisi 16 (30): 88-101.

Karataş, E., 2009. Manisa İlinde Bitki Koruma Yöntemlerinin Uygulamadaki Sorunları Üzerine Bir Araştırma. Selçuk Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Konya

Öztürk, S. 1990. Tarım İlaçları. Hasat Yayıncılık ve Reklamcılık, Renk Ofset, İstanbul, 523s.

Tiryaki,O.,2017.Pestisit:Kalıntı Analizlerinde Kaliye Kontrol (QC) Ve Kalite Güvencesi (QA). Nobel Akademik Yayıncılık,Ankara.273s.

Tücer, A. 1998. Tarımsal İlaçlamalarda Uygulayıcıya Olan Pestisit Bulaşmaları. Akdeniz Ünv. Zir. Fak. Derg., 1998, 11, 129-136.

Üremiş, İ.,Ş. Karat, O. Gönen, E. Canıhoş, H. Kütük, U. Emekçi, V.Çetin, M. Aytaş, İ. Kadıoğlu, 1996. Çukurova Bölgesinde Zirai Mücadele İlaç Kullanımının Genel Değerlendirilmesi, II. Ulusal Zirai Mücadele İlaçları Sempozyumu (18-20 Kasım 1996),Ankara

Zeren, O., Kumbur H. 1998. İçel İlinde Tarımsal İlaç Pazarlama, Kullanım Tekniği ve Etkinliği Üzerinde Arastırmalar Türk-Koop Ekin Dergisi sayı: 5, s: 62-68.

# O-18 THE EFFECT OF METHYL JASMONATE AND SALICYLIC ACID ON YIELD AND TUBER QUALITY OF RADISH (*RAPHANUS SATIVUS L.*)

**O. Zambi[1] N. Akbudak[2a], S. Özkan[2] and A. Sahiner[2]**

[1]Kalecik Vocational School, Ankara University, Kalecik, Ankara, Turkey

[2]Department of Horticulture, Faculty of Agriculture, University of Uludag, Gorukle Campus, 16059 Bursa, Turkey

**Abstract**

This study investigates the effects of different 5 and 10 mM Methyl Jasmonate (MEJA) and 2, 5 mM Salicylic Acid (SA) doses on growth and tuber quality of Radish (*Raphanus sativus*) (cv. Akkaya). Tuber weight, tubers diameter (cm), tubers weight (g), leaf length (cm), number of leaf, total soluble solids (%), colour, total phenol (mg GA $kg^{-1}$) were determined in the harvested plants. At the end of the study, it was determined that SA applications were higher than MEJA applications in tuber weight. The same results were obtained in tuber diameter and tuber length. The highest total phenol was in 5 mM of MEJA (1056.12 mg GA $kg^{-1}$) and 2, 5 mM SA (908.12 and 935.68 mg GA $kg^{-1}$) applications respectively. The increasing MEJA applications caused an increase in total phenol.

**Keywords:** Colour, Plant growth regulator, Phenol, White radish, Yield

## INTRODUCTION

Since radish cater for vegetable of humans, it which has rich nutrient content is fairly important (Wang and He, 2005). Radish can be considered as an annual as well as a biennial crop. The portion of the root developed from the primary root is the edible portion. It is cool season vegetable and monthly means temperature of 10-15°C its growth and development. Plant growth is seasonal in temperate countries due to the large variations in temperature and day length during the year. Especially in countries in Asia consumption is increasing. Radishes production is so important in terms of healthful of radish consumption; production is low to production rate and quantity in Turkey. While white radishes manufacture was low in statistics until 2013, it has increased over the last three years compared to statistics in our country.

Radish consumed to tubers has different size, color and shape. Some are black, white and red. Radishes having small and red roots are defined as nuts (Vural et al., 2000). White radishes have some advantages. White and red radish contains high levels of carotenoids in comparison with black radish. Other benefits of white radishes are facilitated to digestion. White ones are less aromas and phytochemicals than black and red ones for example antioxidant (Stephens, 1994). However, there are not substances giving to color to radishes.

Scholars have determined that methyl jasmonate have been inhibitory effects in recent twenty five years (Staswick, 1992). Methyl jasmonate (MeJA), a natural plant growth regulator, plays important roles in plant growth and development, fruit ripening, and responses to environmental stress (Imanishi et al., 1998, Ziosi et al., 2009). It has revealed that salicylic acid is plant growth regulator and plays a fundamental role in interacting with other organisms (Harborne, 1980). Salicylic acid (SA) is considered a phytohormone-like compound as it is involved in the regulation of plant growth, development and other physiological processes (Fariduddin et al., 2003; Hayat et al., 2010). Natural occurrence of SA has been detected in the leaves and reproductive organs of about 34 important species (Raskin et al., 1990) where it is recognized as the endogenous regulator of plant metabolism. However, its exogenous application to the plants generates diverse physiological effects, such as inhibition of dry mass accumulation (Schettel and Balke, 1983), promotion of stomatal closure (Larque-Saavedra, 1979), and inhibition of ethylene synthesis (Leslie and Romani, 1986).

There is no definitive information on how biotic elicitors cause changes in pigment and phenols in external

applications of radish. So, in this study, the effects of SA and MeJa on the external vegetative application were comparatively determined.

## MATERIAL AND METHODS

The experiment was conducted during 2016-2017 growing season (October 2016-January 2017) in Uludag University. Seeds provided by Pasatohum (Turkey) were of commercial quality white radish (*Raphanus sativus* cv. "Akkaya") seeds were sown (15x30 cm) in field in October (Anonymous, 2016). Growing conditions consisted of a day/night temperature regime of 15±2/10±2°C. Organic fertilizer (stable manure: N 3.5%, $P_2O5$ 9.83% and $K_2O$ 2.40%) was applied in pre-sowing preparing of soil (1 kg $m^{-2}$).

**Treatments:** Methyl jasmonate (Sigma, St. Louis, USA) (5 and 10 mM) and salicylic acid (Merck, USA) (2, 5 mM) were dissolved in 0.2% ethanol. Biotic elicitors were applied as exogenous spraying on the three leaf stage with 30 ml of solution per plant (Raza, 2013; Baenas et al., 2014). At the same time control plants were sprayed only with water.

**Yield parameters:** Single harvest was carried out January. Plants with deformed swollen tuber were considered as unmarketable. Tuber fresh weight (g) and diameter (mm) were measured on 20 plants per plot, and leaf length (cm), number of leaf per plant. Total yield will also be determined per plots.

**Quality parameters:** The analysis of plant samples was performed immediately after harvesting in the fresh plant material. Total soluble solids (TSS) of radish were determined using a NOW refractometer (0-32%) (Tech-Jam International Inc., Tokyo, Japan) at 20°C.

Total phenolic matter was determined by folin-ciocalteu methods as gallic acid (GA) equivalent (Slinkard and Singleton, 1977). The radish tubers were harvested at 5 week after the treatment of MeJA.

Tuber shell colour was determined by two readings on the two different symmetrical faces of the radish in each replicate, using a Minolta CR 300 colorimeter (Konica-Minolta, Osoka, Japan), calibrated with a white standard tile. Hue[(1)] angle and Chroma[(2)] values were converted calculating by Carreńo et al. (1995) who definition to color index (CIRG).

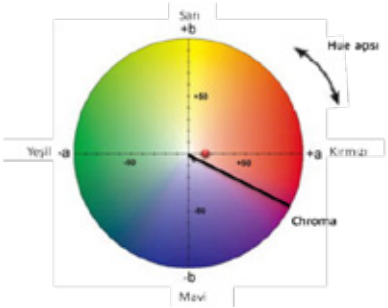



**Figure 1. CIE L* a* b* color plane**

[0] $H^o = \arctan(b^*/a^*)$

[(2)] $C = [(a^*)^2 + (b^*)^2]^{0.}$

### Statistical analysis

The experiment was constructed with a complete randomized plot design. All determinations were carried out in triplicate. Each replicate had 20 plants. Statistical analyses of variance were conducted at the 0.05 level, differences between mean values were tested by LSD Test at $p \leq 0.05$.

## RESULT AND DISCUSSION

Spraying of the plants with solutions influenced mean weight of the leaves and total weight (leaves+tuber) in a statistically significant way, yet it did not have any effect either on mean weight of tuber and the quantity of leaves per plant, leaf length. Smolen and Sady (2012) previously reported that SA application had no significant effect on leaves per plant of radish. An increase in leaf weight of radish plant resulting from foliar application of SA, being a part of the experiment presented in this paper, is corroborated in the research by Yildirim et al. (2008). Similar findings were reported by Gutierrez-Coronado et al. (1998) and Lian et al. (2000) for soybean, which foliar SA applications positively affected shoot and root growth parameters. However, in present study was concluded that SA was effective consistent with the observations of Smolen and Sady (2012). Çanakçı (2008) observed positive effect when SA doses are increased in radish seedlings on plant weight. In our study, it was determined that the developed applications positively increased the tuber weight, although it was not statistically significant (Table 1 and 2). These results were in agreement with the results determined by Çanakçı (2008).

Total soluble solids determined that between 2.45%- 4.70%. The highest total soluble solids of white radishes were obtained from SA 5 mM applications with 4.70%. The lowest total soluble solids of white radishes were established in MEJA 5 mM and control applications as 2.51%, 2.45% respectively (Table 3).

As can be seen in table 3 total phenol created three groups were obtained between 1056.12; 908.12 mg GA $kg^{-1}$. The highest total phenol was found in application MEJA 5 mM (1056.12 mg GA $kg^{-1}$) followed by MEJA 10 mM (1040.73 mg GA $kg^{-1}$), control (993.53 mg GA $kg^{-1}$), SA 5 mM (935.68 mg GA $kg^{-1}$) and while least in SA 2 mM (908.12 mg GA $kg^{-1}$). MEJA applications was more total phenol than SA applications. Smolen et al. (2012) was as 48.2 mg 100 $g^{-1}$ on plant applied SA in study. This results may have been low in our study because they applied on radish seedlings. A study by Kim et al. (2006) also found that MEJA applications increased phenolic compounds at sweet basil. Our results are similar to those of Kim et al. (2006). In the study carried out by Koca and Karaman (2015), It was determined that the total phenolic and flavonoid contents of the basil plants subjected to plant growth regulator were significantly increased compared to the control plants.

This study was detected that SA and MEJA applications on white radish positively effect on Croma and Hue. MEJA applications was the higher than SA applications on both of them (Table 4).

## CONCLUSION

In this study that affected to increase to total soluble solids and color of salicylic acid and methyl jasmonate applications. However, our investigation also observed increase total phenol compounds a parallel trend of increased Methyl jasmonate doses. Even though more detailed research is needed to explore the complex relationship between the methyl jasmonate and phenolic compound in radish tuber, this study has demonstrated to a certain extent that Methyl jasmonate and salicylic acid can significantly affect the quality parameters of radish and may be one useful tool for the induction of health-benefiting chemicals in our plant diet.

**Table 1. Effect of elicitor treatments on yield parameters**

| Treatments | Tuber Weight (g $plant^{-1}$) | Leaves Weight (g $plant^{-1}$) | Total Weight (T+L) |
|---|---|---|---|
| Control | 40.95 | 27.65 c | 68.60 b |
| MEJA 5 mM | 44.48 | 35.56 bc | 80.05 ab |
| MEJA 10 mM | 52.65 | 44.57 ab | 97.22 ab |
| SA 2 mM | 55.78 | 43.02 ab | 98.80 a |
| SA 5 mM | 58.62 | 46.48 a | 105.10 a |
| $LSD_{0.05}$ | ns | 10.41 | 28.86 |

MEJA: Methyl Jasmonate, SA: Salicylic acid

**Table 2. Effect of elicitor treatments on quality parameters**

| Treatments | Tuber Diameters (cm) | Tuber Leng-ht (cm) | Number of Leaves (leaf plant$^{-1}$) | Leaf Length (cm) |
|---|---|---|---|---|
| Control | 6.28 | 4.20 | 25.48 | 9.80 |
| MEJA 5 mM | 9.18 | 6.14 | 26.07 | 9.40 |
| MEJA 10 mM | 7.36 | 4.92 | 27.06 | 7.73 |
| SA 2 mM | 9.33 | 6.24 | 28.34 | 9.73 |
| SA 5 mM | 10.22 | 6.78 | 23.60 | 9.24 |
| $LSD_{0.05}$ | ns | ns | ns | ns |

**Table 3. Effect of elicitor treatments on total soluble solid and total phenol on radish tuber**

| Treatment | Total Soluble Solid (%) | Total Phenol (mg GA kg$^{-1}$) |
|---|---|---|
| Control | 2.45 c | 993.53 b |
| MEJA 5 mM | 2.51 c | 1056.12 a |
| MEJA 10 mM | 3.72 b | 1040.73 a |
| SA 2 mM | 3.65 b | 908.12 c |
| SA 5 mM | 4.70 a | 935.68 c |
| $LSD_{0.05}$ | 0.13 | 31.54 |

**Table 4. Effect of elicitor treatments on color on radish tuber**

| Treatmant | Croma | Hue |
|---|---|---|
| Control | 7.39 b | 36.33 b |
| MEJA 5 mM | 8.90 ab | 36.33 c |
| MEJA 10 mM | 10.39 a | 68.17 a |
| SA 2 mM | 8.54 b | 54.94 ab |
| SA 5 mM | 7.18 b | 62.09 ab |
| $LSD_{0.05}$ | 1.77 | 13.36 |

## LITERATURE CITED


Anonymous, (2016). http://www.pasatohum.com/urun/turp-akkaya-beyaz/102 (Available date: 02.6.2017).

**Baenas, N., García-Viguera, C., Moreno, D. A. (2014). Biotic elicitors effectively increase the glucosinolates content in Brassicaceae sprouts.** *Journal of Agricultural and Food Chemistry***, 62(8), 1881-1889.**

Carreno, J., Martinez, A., Almela, L., Fernadezlopez, J.A. (1995). Proposal of an index for the objective evaluation of the colour of red table grapes. *Food Research International,* 28, 373-377.

Çanakçı S. (2008). Effects of salicylic acid on fresh weight change, chlorophyll and protein amounts of radish (*Raphanus sativus* l.) seedlings. *Journal of Biological Science*, 8 (2), 431- 435.

Fariduddin, Q., Hayat, S., Ahmad, A. (2003). Salicylic acid influences net photosynthetic rate, carboxylation efficiency, nitrate reductase activity, and seed yield in *Brassica juncea. Photosynthetica*, 41, 281–284.

Gutierrez-Coronado, M. A., Trejo-Lopez, C., Larque-Saavedra, A. (1998). Effect of salicylic acid on the growth of roots and shoots in soybean. *Plant Physiology Biochemical*, 36. 563–565.

Harborne, J.B. (1980). Plant phenolics. In: secondary plant products. E.A. Bell, B.V. Charlwood (ed.), Encyclopedia of Plant Physiology, volume 8 Secondary Plant Products, Springer Verlag, Berlin, 329- 402p.

Hayat, Q., Hakat, S., Irfan, M., Ahmad, A. (2010). Effect of exogenous salicylic acid under changing environment: a review. *Environmental and Experimental Botany*, 68, 14–25.

Imanishi, S., Hashizume, K., Nakakita, M., Kojima, H., Matsubayashi, Y., Hashimoto, T., Sakagami, Y., Yamada, Y., Nakamura, K. (1998). Differential induction by methyl jasmonate of genes encoding ornithine decarboxylase and other enzymes involved in nicotine biosynthesis in tobacco cell cultures. *Plant Molecular Biology*, 38, 1101–1111.

**Kim, H.J., Wang, X., Rajapakse, N.C. (2006). Effect of methyl jasmonate on secondary metabolites of sweet basil (***Ocimum basilicum* **L.).** *Journal of Agricultural and Food Chemistry***, 54, 2327-2332.**

Koca, N. Karaman, Ş. (2015). The effects of plant growth regulators and L-phenylalanine on phenolic compounds of sweet basil. *Food Chemistry,* 166, 515-521.

Larque-Saavedra, A. (1979). Stomatal closure in response to acetylsalicylic acid treatments. – Z. *Pflanzenphysiol,* 93, 371-375.

Leslie, C., Romani, R. (1986). Salicylic acid: a new inhibitor of ethylene biosynthesis. *Plant Cell Report*, 5**:** 144-146.

Lian, B., Zhou, X., Miransari, M. and Smith, D. L. (2000). Effects of salicylic acid on the development and root nodulation of soybean seedlings. *Journal of Agronomy Crop Science*, 185: 187–192.

Raskin, I., Skubatz, Z., Tang, W., Meeuse, B.J.D. (1990). Salicylic acid levels in thermogenic and non-thermogenic plants. *Annual Botany*, 66, 369-373.

Raza, H.S., Shafiq, F. (2013). Exploring the role of salicylic acid to attenuate cadmium accumulation in radish (*Raphanus sativus*). *International Journal of Agriculture & Biology*, 15, 547-552.

Schettel, N.L., Balke, N.E. (1983). Plant growth response to several allelopathic chemicals. *Weed Science*, 31, 293-298.

Slinkard K., Singleton V.L. (1977). Total phenol analyses: automation and comparison with manual methods. *American Journal of Enology and Viticulture*, 28, 49– 55.

Smolen S., Sady W. (2012). Effect of foliar application of urea, molybdenum, benzyladenine, sucrose and salicylic acid on yield, nitrogen metabolism of radish plants and quality of edible roots. *Journal of Plant Nutrition*, 35, 8, 1113-1129.

Staswick, P.E. (1992). Jasmonate, genes and fragrant signals. *Plant Physiology*, 95, 804-807.

Stephens, J.M. (1994). Radish Chinese. Horticulture Science Department, Florida Cooperative Extension Service. [online]. [ref. 2009-05-15]. Available at: http://edis.ifas.ufl.edu/pdffiles/MV/MV12000.pdf

Vural H., Eşiyok D., Duman İ. (2000). Kültür Sebzeleri (Sebze Yetiştirme). Ege Üniversitesi Ziraat Fakültesi Bahçe Bitkileri Bölümü, Bornova-İzmir, 440s.

Wang, L.Z., He, Q.W. (2005). Chinese radish. *Scientific and Technical Documents Publishing House*, Beijing. pp. 292-370.

Yildirim, E., Guvenc, I. and Karatas, A. (2008). Effect of foliar salicylic acid applications on growth, chlorophyll, and mineral content of cucumber grown under salt stress. *Journal of Plant Nutrition*, 31, 593-612.

Ziosi, V., Bregoli, A.M., Fregola, F., Costa, G., Torrigiani, P. (2009). Jasmonate-induced ripening delay is associated with up-regulation of polyamine levels in peach fruit. *Journal of Plant Physiology*, 166, 938–946.

# O-21 Erciş Üzüm Çeşidine Ait Bir Yaşlı Dalların Besin Elementi İçerikleri

N. Keskin[1], B. Kunter[2], S. Keskin[3], A. Doğan[1], C. Uyak[1],
B. Arslan[1], R. İ. Gazioğlu Şensoy[1*]

*Sorumlu Yazar: rigazioglu@yyu.edu.tr

[1]YüzüncüYılÜniversitesi, ZiraatFakültesi, BahçeBitkileriBölümü, Van, Türkiye

[2]AnkaraÜniversitesi, ZiraatFakültesi, BahçeBitkileriBölümü, Ankara, Türkiye

[3]YüzüncüYılÜniversitesi, TıpFakültesi, BiyoistatistikAnabilim Dalı, Van, Türkiye

**Özet**

Sıcaklığın sınırlayıcı etkisi nedeniyle Van ilinde bağcılık sınırlı alanlarda yapılabilmektedir. Van ekolojik koşullarına uyum sağlamış yegane üzüm çeşidi Urartular döneminden günümüze kadar popülaritesini korumayı başarmış Erciş üzümüdür. Bu çalışmada, çelik elde etmek amacıyla kış budama döneminde budanan Erciş üzüm çeşidinin bir yaşlı dallarındaki besin element içeriklerinin belirlenmesi amaçlanmıştır. Besin elementleri olarak; N, Ca, Cu, F, K, Mg, Mn ve Z elementleri incelenmiştir. Çalışma beş tekerrürlü ve her tekerrürde üç adet omca olacak şekilde tesadüf parselleri deneme desenine göre kurulmuş ve her omcadan ikişer adet dal alınmıştır. Nisan 2015' de omca üzerindeki bir yaşlı dallar iki yıllık dal parçasıyla birlikte 16 göz üzerinden budanmıştır. Budama makası yardımıyla bir yaşlı dallar 1.-.4., 5.-8., 9.-12.ve 13.-16. boğum aralıklarına ayrılmış, etüvde kurutulmuş ve öğütülmüştür. Kurutulmuş ve öğütülmüş dal örnekleri analiz edilinceye kadar küçük polietilen poşetlerde serin ve kuru yerde saklanmıştır. Ele alınan besin elementleri bakımından, boğum sırasına göre gruplanan dal bölgeleri arasında fark olup olmadığını belirlemek amacıyla Friedman testi yapılmıştır. Çalışma sonucunda; Cu, F, Mn ve Z elementleri bakımından, dalların farklı bölgelerine ait ortalamalar arasındaki fark istatistik olarak önemli bulunmuştur ($p<0.05$). Ayrıca besin elementi değerleri N için; %1.020-1.15, Ca için; %0.39-0.50, Cu için; 15.22-27.40 ppm, Fe için;13.70-27.50 ppm, K için; %0.23-0.31, Mg için; %0.03-0.04, Mniçin; 9.53-12.90 ppm ve Zn için; 13.10-64.30 ppm, aralığında değişim göstermiştir.

**Anahtar kelimeler:** Asma, Beslenme, Dal, Makro ve mikro elementler

# Nutrient Contents of "Erciş" (*Vitis vinifera* L.) Grape Cultivar Canes

Viticulture can be performed in a limited area in Van due to the restrictive effect of the temperature. "Erciş" cultivar is unique grape variety that adapts to ecological conditions of Van and continues to its popularity from the Urartu civilization to nowadays. This study aims to determine nutrients content in one-year old canes that pruned in winter pruning season to obtain canes in "Erciş" cultivar. N, Ca, Cu, Fe, K, M, N and Z elements were considered as nutrients. The study was conducted to randomized plot design with five replications. Each replication was consisted of three vines and two pieces of canes were taken from each vine. Canes were pruned with two years-old branches over the 16 buds in April 2015. They were split to 4 pieces that 1.-. 4., 5.-8., 9.-12. and 13.-16 internodes by using pruning shears. Then these pieces were dried in an oven and grounded. Dried and grounded cane samples were stored in small polyethylene bag in cool and dry room until analysis.Friedman test was performed to determine whether differences between the internodes groups of canes for the considered nutrients.In conclusion; for Cu, Fe, Mn and P elements, the differences between the means of internodes were found statistically significant ($p<0.05$). In addition, nutrient values ranged from 1.020 to 1.15% for N, 0.39 to 0.50% for Ca, 15.22 to 27.40 ppm for Cu, 13.70 to 27.50 ppm for Fe, 0.23 to 0.31% for K, 0.03 to 0.04% for Mg, 9.53 to 12.90 ppm for Mn, and 13.10 to 64.30 ppm for Zn.

**Key words:** Cane, Grapevine, Nutrition, Macro and Micro elements

## GİRİŞ

Asmalarda dal kavramı bir yaşlı dalları ifade etmektedir. Bir yaşlı dal, yazlık sürgünün bir büyüme devresi sonundaki odunlaşmış halidir. Bu dallar, iki yaşlı dal ve/veya omcanın daha yaşlı odun kısmını oluşturan gövde ve kollar üzerinde bulunur. Bir yaşlı dallar asmalarda ürünü oluşturan kış gözlerini üzerinde taşımaları nedeniyle en önemli organlardır. Bir yaşlı dal üzerinde kış gözlerinden başka, boğum ve boğum araları, yaprak sapı izi, koltuk sürgünü veya izi, salkım sapı, sülük gibi organlar bulunmaktadır. Bir yaşlı dallar, alındığı omcanın bütün kalıtsal özelliklerini taşıdığı için, yetiştirilen yeni bitki de aynı özelliklere sahip olmaktadır. Bu nedenle, asmaların çelik, aşı ve daldırma yoluyla çoğaltılmasında fidan üretim materyali kaynağı olarak bir yaşlı dallar büyük önem taşımaktadır (Çelik ve ark. 1998). Bağların kaliteli fidanlarla kurulması bağcılık açısından son derece önemli olup, böyle bir fidan ancak uygun özellikteki bir yaşlı dal kullanılarak elde edilebilmektedir. Açık köklü aşılı fidanların gelişim ve randımanları, üretim materyalinde kök, kallus (yara dokusu) ve sürgün gelişimine bağlıdır. Bunlardan herhangi birinin aksaması, fidan gelişimini olumsuz yönde etkileyebilmektedir. Üretim materyali olan bir yaşlı dalın kalitesi üzerine; çeşidin genetik yapısı, terbiye sistemi, omcanın yükü, yedek karbonhidratların varlığı, üretim materyalinin alım dönemi ile alınan materyalin aşı zamanına kadar muhafazası etkili olmaktadır (Dardeniz ve ark. 2013a). Çelik ve ark.(1998)'e göre bağcılıkta fidan üretim materyallerinin kış (ürün) budaması sırasında alınması daha avantajlıdır. Böylece hem budama hem de çelik alma işlemi bir arada gerçekleştirilerek, iş gücünden tasarruf sağlanmakta, ayrıca söz konusu çeliklerin kış boyunca muhafaza sorunu ve masrafı da ortadan kalkmaktadır. Bu çalışmada, kış budama döneminde alınan Erciş üzüm çeşidine ait bir yaşlı dalların besin elementi içeriklerinin belirlenmesi amaçlanmıştır.

## MATERYAL VE YÖNTEM

Bu çalışmada, Van iline özgü yerel bir çeşit olan ve kendi kökleri üzerinde yetiştirilen 'Erciş' üzüm çeşidi materyal olarak kullanılmıştır. Geleneksel yer bağcılığı şeklinde yetiştirilen omcalardan Nisan 2015' de bir yaşlı dallar iki yıllık dal parçasıyla birlikte 16 göz üzerinden Nisan ayında budanmıştır. Budama makası yardımıyla bir yaşlı dallar 1.-.4., 5.-8., 9.-12.ve 13.-16. Boğum aralıklarına ayrılmış, etüvde 105 °C'de kurutulmuş ve öğütülmüştür. Kurutulmuş ve öğütülmüş dal örnekleri analiz edilinceye kadar küçük polietilen poşetlerde serin ve kuru yerde saklanmıştır. Öğütülmüş örneklerde N, Kacar (1994)'e göre Kjeldahl yöntemi kullanılarak, Ca, Mg, K, Fe, Mn, Zn ile Cu ise kuru yakma yöntemiyle Kacar (1994)'a göre ICP-OES (İndüktif Eşleşmiş Plazma-Optik Emisyon Spektrometresi)'de analiz edilmiştir. Üzerinde durulan özellikler için tanımlayıcı istatistikler; ortalama, standart hata, minimum ve maksimum değer olarak ifade edilmiştir. Bu özellikler bakımından grup ortalamalarını karşılaştırmada Tek yönlü Varyans analizi yapılmıştır. Varyans analizini takiben farklı grupları belirlemede Duncan çoklu karşılaştırma testi kullanılmıştır. Hesaplamalarda istatistik anlamlılık düzeyi %5 olarak alınmış ve hesaplamalar için SPSS istatistik paket programı kullanılmıştır.

## BULGULAR VE TARTIŞMA

Çalışmada Erciş üzüm çeşidinin bir yaşlı dallarında farklı boğum aralıklarındaki element içerikleri incelenmiştir. Ele alınan elementler, azot, kalsiyum, bakır, demir, potasyum, magnezyum, mangan ve çinko' dur. Bu elementler bakımından yapılan karşılaştırma sonuçları Çizelge 1 de verilmiştir. Çizelge 1' de görüldüğü üzere; bakır, demir, mangan ve çinko elementleri dışındaki diğer elementler bakımından boğumlar arasındaki fark istatistik olarak önemli bulunmamıştır. N; %1.020-1.15, Ca; %0.39-0.50, Cu; 15.22-27.40 ppm, Fe;13.70-27.50 ppm, K; %0.23-0.31, Mg; %0.03-0.04, Mn; 9.53-12.90 ppm, Zn; 13.10-64.30 ppm, aralığında değişim göstermiştir. Azot bakımından uç ve dip boğumlar aynı değere (%1.06) sahip iken en yüksek azot 9.-12. boğum arasında (%1.15) elde edilmiştir. Kalsiyum bakımından farklı boğum arasındaki değerler birbirine yakın çıkmış olsa da en yüksek değer dip gözlerin boğum aralarında saptanmıştır. Bakır içeriği yönüyle ele alındığında, boğumlar arası farklılık incelendiğinde; en yüksek ortalama 27.40 ile 1-4. boğumdan elde edilirken, bunu 22.30 ile 5-8. boğum 17.50 ile 9-12. boğum ve 15.22 ile 12-16. boğum izlemiştir. Demir elementi bakımından ise en yüksek ortalama; 27.50 ile 5-8. boğumdan elde edilirken, en düşük ortalama 13.70 ile 9-12 boğumdan elde edilmiştir. K elementi yönüyle elde edilen değerler oldukça bir birine yakın olsa da, 5.-8. boğum aralarında elde edilen değer diğerlerinden daha yüksek bulunmuştur. Benzer şekilde, Magnezyum için de; 1-4. boğumdan olanı farkı istatistik olarak önemli olmamakla birlikte, en

yüksek ortalama 12.90 ile 5-8. boğumdan elde edilirken, en düşük ortalama 9.53 ile 9- 12. boğumdan elde edilmiştir. Çinko bakımından ise en yüksek ortalama 64.30 ile 9-12. boğumdan elde edilirken, bunu 18.80 ile 1-4. boğum izlemiştir. En düşük ortalama ise 5-8. boğumdan olan farkı istatistik olarak önemli olmamakla birlikte, 12-16. boğumdan elde edilmiştir. Gökbayrak ve ark. (2009), 5BB anacının besin elementi içeriğini inceledikleri çalışmalarında, N; %0.51-0.64, P; %0.12-013, K; %0.37-0.42, C; %44.3-46.6, Fe; 68.5-99.2 mg/L, Mg; 1069-1169 mg/L, Zn; 6.78-8.34 mg/L, Na; 74.0-87.3 mg/L, Mn; 18.6-25.0 mg/L, Cu; 4.96-7.44 mg/L arasında değişim göstermiştir. Türkmen ve ark.(2011), 140Ru anacında besin elementi içeriğini N; %0.61-0.70, P; %0.13-0.14, K; %0.41-0.44, C; %44.7-45.9, Fe; 89-104 mg/L, Mg; 1230-1312 mg/L, Zn; 7.3-7.9 mg/L, Na; 73-84 mg/L, Mn; 23.2–3.0 mg/L, Cu; 5.5-7.1 mg/L olarak belirlemişlerdir. Yalova Çekirdeksizi üzüm çeşidi kalemlerinin besin elementi içerikleri Al; 9.5-83.6 ppm, Mo; 0-1.650 ppm, Ca; 8818-12166 ppm, B; 13.87-22.29 ppm, Cd; 0-0.034 ppm, Cr; 0.230-0.413 ppm, Cu; 21.27-165.91 ppm, Fe; 56.90-83.39 ppm, K; 7461-9988 ppm, Mg; 2385-3065 ppm, Mn; 24.89-51.25 ppm, Na; 280-430 ppm, Ni; 0.585-0.875 ppm, P; 1007-1888 ppm, Pb; 0.428-0.604 ppm, S; 620-966 ppm, Se; 0.269-0.933 ppm, Zn; 68.2-196.9 ppm, C; %42.90-43.72, N; %0.955-1.430 arasında değişim göstermiştir (Dardeniz ve ark., 2013b). Gökbayrak ve ark. (2009), 5BB anacının besin elementi içeriğini inceledikleri çalışmalarında, N; %0.51-0.64, P; %0.12-013, K; %0.37-0.42, C; %44.3-46.6, Fe; 68.5-99.2 mg/L, Mg; 1069-1169 mg/L, Zn; 6.78-8.34 mg/L, Na; 74.0-87.3 mg/L, Mn; 18.6-25.0 mg/L, Cu; 4.96-7.44 mg/L arasında değişim göstermiştir. Türkmen ve ark.(2011), 140Ru anacında besin elementi içeriğini N; %0.61-0.70, P; %0.13-0.14, K; %0.41-0.44, C; %44.7-45.9, Fe; 89-104 mg/L, Mg; 1230-1312 mg/L, Zn; 7.3-7.9 mg/L, Na; 73-84 mg/L, Mn; 23.2–3.0 mg/L, Cu; 5.5-7.1 mg/L olarak belirlemişlerdir. Yalova Çekirdeksizi üzüm çeşidi kalemlerinin besin elementi içerikleri Al; 9.5-83.6 ppm, Mo; 0-1.650 ppm, Ca; 8818-12166 ppm, B; 13.87-22.29 ppm, Cd; 0-0.034 ppm, Cr; 0.230-0.413 ppm, Cu; 21.27-165.91 ppm, Fe; 56.90-83.39 ppm, K; 7461-9988 ppm, Mg; 2385-3065 ppm, Mn; 24.89-51.25 ppm, Na; 280-430 ppm, Ni; 0.585-0.875 ppm, P; 1007-1888 ppm, Pb; 0.428-0.604 ppm, S; 620-966 ppm, Se; 0.269-0.933 ppm, Zn; 68.2-196.9 ppm, C; %42.90-43.72, N; %0.955-1.430 arasında değişim göstermiştir (Dardeniz ve ark., 2013b). Italia üzüm çeşidi kalemlerinde, besin elementleri bazında genel olarak; Al; 5.3-100 ppm, Mo; 0-0.038 ppm, Ca; 9759-13155 ppm, B; 14.69-17.77 ppm, Cd; 0-0.0165 ppm, Cr; 0.203-0.435 ppm, Cu; 19.91-103.60 ppm, Fe; 48.68-79.11 ppm, K; 7279-8014 ppm, Mg; 2603-3267 ppm, Mn; 31.90-46.06 ppm, Na; 275-496 ppm, Ni; 0.920-1.638 ppm, P; 870-1313 ppm, Pb; 0.504-0.791 ppm, S; 617-859 ppm, Se; 0.195-1.970 ppm, Zn; 89.2-156.2 ppm, C; %42.47-43.86, N; %0.948-1.400 aralığında değişmiştir (Dardenizve ark., 2013a). Yalova İncisi üzüm çeşidinde besin elementleri, Al; 40.6-67.5 ppm, Mo; 0-1.190 ppm, Ca; 7422-10318 ppm, B; 12.36-21.97 ppm, Cd; 0-0.022 ppm, Cr; 0.220-0.525 ppm, Cu; 45.3-101.8 ppm, Fe; 54.43-92.10 ppm, K; 5315-8332 ppm, Mg; 1983-3282 ppm, Mn; 27.71-37.32 ppm, Na; 294-514 ppm, Ni; 0.392-0.893 ppm, P; 664-1371 ppm, Pb; 0.338-0.774 ppm, S; 614-1138 ppm, Se; 0.225-1.389 ppm, Zn; 75.9-222.7 ppm, C; %42.70-44.23, N; %0.878-1.325 ve C/N; 32.55-49.27 aralığında değişim göstermiştir (Müftüoğlu ve ark., 2013).

Çizelge 1. Erciş üzüm çeşidinin bir yaşlı dallarındaki besin elementi içerikleri

| Elementler | Boğumlar | Ort | Std. Hata | Min. | Mak. | p |
|---|---|---|---|---|---|---|
| N (%) | 1.-4. | 1.06 | 0.05 | 1.02 | 1.09 | .087 |
| | 5.-8. | 1.02 | 0.01 | 1.01 | 1.03 | |
| | 9.-12. | 1.15 | 0.02 | 1.13 | 1.16 | |
| | 12.16. | 1.06 | 0.04 | 1.03 | 1.09 | |
| | Genel | 1.07 | 0.06 | 1.01 | 1.16 | |
| Ca (%) | 1.-4. | 0.50 | 0.07 | 0.45 | 0.55 | .504 |
| | 5.-8. | 0.43 | 0.04 | 0.40 | 0.46 | |
| | 9.-12. | 0.39 | 0.04 | 0.36 | 0.42 | |
| | 12.16. | 0.45 | 0.44 | 0.30 | 8.00 | |
| | Genel | 0.44 | 2.68 | 0.30 | 8.00 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cu (ppm) | 1.-4. | 27.40 a | 0.28 | 27.20 | 27.60 | .001 |
| | 5.-8. | 22.30 b | 0.42 | 22.00 | 22.60 | |
| | 9.-12. | 17.50 c | 0.71 | 17.00 | 18.00 | |
| | 12.16. | 15.22 d | 0.16 | 15.11 | 15.33 | |
| | Genel | 20.61 | 5.02 | 15.11 | 27.60 | |
| Fe (ppm) | 1.-4. | 19.20 b | 0.14 | 19.10 | 19.30 | .001 |
| | 5.-8. | 27.50 a | 0.71 | 27.00 | 28.00 | |
| | 9.-12. | 13.70 d | 0.14 | 13.60 | 13.80 | |
| | 12.16. | 16.51c | 0.71 | 16.01 | 17.01 | |
| | Genel | 19.23 | 5.53 | 13.60 | 28.00 | |
| K (%) | 1.-4. | 0.25 | 0.05 | 0.21 | 0.28 | .381 |
| | 5.-8. | 0.31 | 0.04 | 0.28 | 0.34 | |
| | 9.-12. | 0.23 | 0.04 | 0.20 | 0.26 | |
| | 12.16. | 0.26 | 0.04 | 0.23 | 0.28 | |
| | Genel | 0.26 | 0.05 | 0.20 | 0.34 | |
| Mg (%) | 1.-4. | 0.03 | 0.01 | 0.30 | 0.36 | .585 |
| | 5.-8. | 0.04 | 0.01 | 0.03 | 0.05 | |
| | 9.-12. | 0.03 | 0.01 | 0.03 | 0.03 | |
| | 12.16. | 0.04 | 0.01 | 0.04 | 0.04 | |
| | Genel | 0.11 | 0.14 | 0.03 | 0.36 | |
| Mn (ppm) | 1.-4. | 11.83 ab | 0.04243 | 11.80 | 11.86 | .006 |
| | 5.-8. | 12.90 a | 0.28 | 12.70 | 13.10 | |
| | 9.-12. | 9.53 c | 0.74 | 9.01 | 10.05 | |
| | 12.16. | 11.50 b | 0.28 | 11.30 | 11.70 | |
| | Genel | 11.44 | 1.34 | 9.01 | 13.10 | |
| Zn (ppm) | 1.-4. | 18.80 b | 0.28 | 18.60 | 19.00 | .001 |
| | 5.-8. | 14.60 c | 0.14 | 14.50 | 14.70 | |
| | 9.-12. | 64.30 a | 0.42 | 64.00 | 64.60 | |
| | 12.16. | 13.10 c | 0.14 | 13.00 | 13.20 | |
| | Genel | 27.70 | 22.70 | 13.00 | 64.60 | |

Müftüoğlu ve ark. (2014), Cardinal üzüm çeşidinin yıllık dallarının dip boğum aralıklarında (1.-4.) N miktarının düşük olduğunu, orta ve uç boğum aralıklarına (9.-12. ve 13.-16.) doğru ise N miktarının yükseldiğini saptamışlardır. Fe, Mg, Na, Zn ve N elementlerinde, boğum aralıkları bazında önemli farklılıklar görülmüş, bu elementlerin hepsi yıllık dalın dip boğum aralıklarında en düşük sonuçları verirken, orta ve uç boğumlara doğru düzenli şekilde arttıkları gözlenmiştir. Önemli farklılık görülmemesine karşın; Al, Ca, B, P ve S elementlerinde, yıllık dalın dip boğum aralıklarından uç boğum aralıklarına doğru rakamsal olarak artışlar, Cr, Cu, Mn ve Se elementlerinde ise rakamsal olarak azalışlar saptanmıştır. Bununla birlikte, yıllık dal boyunca Cd, K, Pb ve C elementlerinde dalgalanmalar görülmüş, Co ve Mo elementlerine hiç rastlanılamamıştır.

## SONUÇ

Bağcılıkta fidan kalitesinin alınan kalem ile ilişkili olması nedeniyle, bu çalışmada kış budama döneminde alınan Erciş üzüm çeşidi kalemlerinin besin elementi içerikleri belirlenmiştir. Çalışma sonucunda en yüksek N (%), Ca (%) ve Cu (ppm), 1.-4., Fe (ppm), K(%), Mg (%) ve Mn (ppm) 5.-8.ve Mg ise 9.-12. boğumlarda elde edilmiştir. Yapılan çalışmanın asma fidanı üretim materyal kalitesinin tespiti açısından son derece yararlı olacağı ve gelecek çalışmalara ışık tutacağı düşünülmektedir.

## KAYNAKLAR


Çelik, H., Ağaoğlu, Y.S., Fidan, Y., Marasalı, B., Söylemezoğlu, G., 1998a. Genel Bağcılık. Sun Fidan Eğitim Serisi No:3. Ankara.

Dardeniz, A., Müftüoğlu, N.M., Türkmen, C., Sakaldaş, M., Akçal, A., 2013a. Italia üzüm çeşidi kalemlerinin besin element içeriklerinin belirlenmesi. ÇOMÜ Zir. Fak. Derg. 1 (1): 29-34.

Dardeniz, A., Müftüoğlu, N.M., Türkmen, C., 2013b. Kış budama döneminde alınan Yalova Çekirdeksizi üzüm çeşidi kalemlerinin besin elementi içeriklerinin belirlenmesi. 6. Ulusal Bitki Besleme ve Gübre Kongresi. Genişletilmiş Bildiri Özetleri Kitabı. 387-391. 03-07 Haziran, Nevşehir.

Gökbayrak, Z., Dardeniz, A., Müftüoğlu, N.M., Türkmen, C., Akçal, A., Tunçel, R., 2009. Reserve nutrient contents of the 5BB grape rootstock canes. American-Eurasian J. Agric. and Envir. Sci. 5(5): 599-602.



Gökbayrak, Z., Dardeniz, A., Müftüoğlu, N.M., Türkmen, C., Akçal, A., Tunçel, R., 2009. Reserve nutrient contents of the 5BB grape rootstock canes. American-Eurasian J. Agric. and Envir. Sci. 5(5): 599-602.



Kacar, B.1994. Bitki ve Toprağın Kimyasal Analizleri: III, Toprak Analizleri. Ankara Üniv. Zir. Fak. Eğitim Araş.ve Geliş. Vakfı Yayınları, No: 3, Ankara.

Müftüoğlu, N.M., Dardeniz, A., Türkmen, C., Sakaldaş, M., Akçal, A. 2013. Nutritional content of the canes of the Yalova İncisi grape variety. Soil-Water Journal (Special Issue for AGRICASIA'2013; 1st Central Asia Congress on Modern Agricultural Techniques and Plant Nutrition, 01-03 October 2013, Bishkek, Kyrgyzstan), 2 (2): 765-770.

Müftüoğlu, N.M., Dardeniz, A., Türkmen, C., Akçal, A., Sakaldaş, M., 2014. Cardinal Üzüm Çeşidi Kalemlerinin Besin Elementi İçeriklerinin Belirlenmesi. Türk Tarım ve Doğa Bilimleri Dergisi 1(3): 405-412.

Türkmen, C., Dardeniz, A., Müftüoğlu, N.M., Gökbayrak, Z., Kabaoğlu, A., 2011.Nutrient contents of 140 Ruggeri rootstock canes in dormant season. The Journal of Animal and Plant Sciences 21 (4): 730–733.

# O-23 Determination of Oyster mushroom (*Pleurotus ostreatus*) Postharvest Quality Losses in Modified Atmosphere Storage Conditions

R. Yanmaz[1], S.S. Bilgin[2], S. Akan[1] and N. Halloran[1]

E-mail: sakan@agri.ankara.edu.tr

[1]Department of Horticulture, Faculty of Agriculture, University of Ankara, Ankara, Turkey.
[2]Graduate School of Natural and Applied Sciences, University of Ankara, Ankara, Turkey.

**Abstract**

In the research, the oyster mushrooms were stored at + 4 ° C in modified atmosphere conditions for 20 days in polyvinyl chloride (PVC), polystyrene containers and commercial plastic bags. During the storage weight loss, soluble solids, respiration rate, titratable acidity and color changes were determined 5 days intervals. The rate of quality loses of the oyster mushroom that stored in polyvinyl chloride (PVC) containers is slower than polystyrene containers and commercial bags. The mushrooms could be stored in PVC containers for 10 days.

**Keywords:** Oyster mushroom, *Pleurotus ostreatus*, storage, quality, modified atmosphere packaging, shelf life.

# INTRODUCTION

Oyster mushrooms (*Pleurotus ostreatus*) are produced mostly in China, Japan and Taiwan in the world. Oyster mushroom cultivation started in 1980, but demand was increased rapidly in the last decade for commercial production.

The shelf life of mushroom is rather short due to the absence of cuticular layer. Ethanol accumulation, softening, mold, off-odour and respiration rate are increased in the mushroom kept at room temperature for 4 days (Villaescusa et al., 2003). In order to maintain the postharvest quality of the mushrooms and to extend the shelf life, it is necessary to reduce the cap temperature, to sending with packaged to the market, and to protect the cold chain until the consumption of harvest.

Modified atmosphere packaging (MAP) is effective in preventing postharvest losses such as weight loss, browning and spore formation in mushrooms. In previous studies at different MAP technique using for storage of *Pleurotus* species that shelf life was determined to be 8-11 days at 0°C, 4-6 days at 5°C, 2-3 days at 10°C and 1-2 days at 20°C (Choi et al., 2003). According to the results of the research, appearance and discoloration of mushrooms are prevented and the respiration rate is slowed down by using film packaging,

The cold chain must be protected in order to extend the shelf life of mushrooms kept in cold storage at postharvest. On the other hand, it is known that in cold storage, especially by changing the composition of $O_2$ and $CO_2$ in the package, induce bacterial or mold source microorganism activity. For this reason, the technical properties ($O_2$, $CO_2$ and water vapor permeability, package type and thickness) of the packaging material used in the MAP storages are important.

The aim of this study is to determine the quality losses in the storage and during shelf life of oyster mushrooms stored in different MAP conditions.

# MATERIALS AND METHODS

The mushrooms used as material in the research were purchased from a mushroom producer in the Kazan/Ankara province in Turkey. Stem growth, stem color, smell and appearance were taken into account as the harvest criterion.

**Packaging material**

250 gram of polyethylene (PE) packages (commercial plastic bag), PVC (polyvinyl chloride) and polystyrene containers were used to create MA conditions in the study. Control group of oyster mushrooms kept in the open air in the plates. The mushrooms placed in the polystyrene containers are covered with stretch film with using Emapack Sarman-U packaging machine. Then, all of packaged mushrooms were stored at +4°C and 50-60% relative humidity in cooling conditions. During the 20 day storage period, the following measurements and analyzes were made on the mushroom samples at intervals of 5 days.

**Weight Loss**

Weight losses are calculated as percentage of pre-storage and post-storage weights of each package, based on initial weight.

**Color**

Mushrooms cap of color is determined by Minolta CR-200 model color meter. Color was measured as L, a, b but "L" value was considered (McGuire, 1992). In each mushroom sample, color measurements were calculated from three different sides of cap area and the average of results were taken.

**Respiration Rate ($mLCO_2kg^{-1}h^{-1}$)**

The respiration rate of the mushrooms were calculated by the Servomex $CO_2$ analyzer in terms of the $CO_2$ % level. Percentage of $CO_2$ given to the closed atmosphere (jar) by the mushrooms kept in the glass jar with 3 L capacity for 1 hour and therefore the respiration rate values with considering the mushroom volume and weight were analyzed to be $mLCO_2kg^{-1}h^{-1}$ (Halloran et al., 2000).

**Soluble solid content (SSC)**

Soluble solid content (SSC) was evaluated by digital Abbe refractometer (Leica) previously calibrated to 20 °C. The mushroom samples were squeezed and results are expressed in Brix % (AOAC, 1990).

**Titratable Acidity (TA)**

Titrable acidity (TA) was determined after squeezing of mushrooms (5 mL) using juicer machine and added 50 mL distilled water, then mixed and titrated to pH = 8.1 using 0.1 N NaOH and then analyzed with automatic titrator (DL 50 Mettler Toledo) and results were expressed as percentage of citric acid (Anonymous, 2017).

# RESULTS AND DISCUSSION

**Effect of different packaging types on weight loss of oyster mushrooms**

MAP storage reduced weight losses of mushrooms compared to the control group. However, the weight loss is increased by the increase of the storage period. At 4 °C, the lowest weight loss at the end of the 5th day was in PVC (2.3%) packages, followed by polystyrene (3.8%), PE (5.1%) and control group (10%). Weight loss was 48% in control, 11.8% in PVC and 15.8% in Polystyrene in 20 days of storage (Table 1). The lower gas permeability of the PVC container reduced weight loss by slowing the deterioration of the oyster mushroom. Kader et al., (1989) also had similar results.

In the mushroom storage, the highest acceptable weight loss value is around 8% (Karaçalı, 2010). According to this, although the weight loss at the end of the 15th day in PVC container was 7.8%, but the consumption quality decreased. Considering appearance and weight losses, 10 days shelf life for PVC container was found to be effective on mushroom quality.

Table 1 Effect of different packaging materials on weight loss of oyster mushrooms (%)

| Storage duration (Days) | Package type | | | |
|---|---|---|---|---|
| | Control | PE | Polystyrene | PVC |
| 0 | 0,0 | 0,0 | 0,0 | 0,0 |
| 5 | 10,0 | 5,1 | 3,8 | 2,3 |
| 10 | 15,6 | 11,8 | 7,9 | 3,8 |
| 15 | 29,6 | 15,8 | 11,8 | 7,8 |
| 20 | 49,6 | 19,8 | 15,8 | 11,8 |

**Color**

The increase in weight loss also affected the appearance of the mushrooms and the color. Textural deterioration accelerated due to water loss. Mycelium growth was observed due to the spillage of spores and moisture in the caps of the mushrooms that kept in polystyrene and PVC containers. Hereby, it affected the decrease in L (brightness) values (Figure 1). In addition, the microbial deterioration and surface browning due to increase moisture are also effective in the decrease of mushroom L value. The mushrooms in PVC containers maintained the color until 10th day compare to other groups. Similar results were reported by Choi et al., (2003).

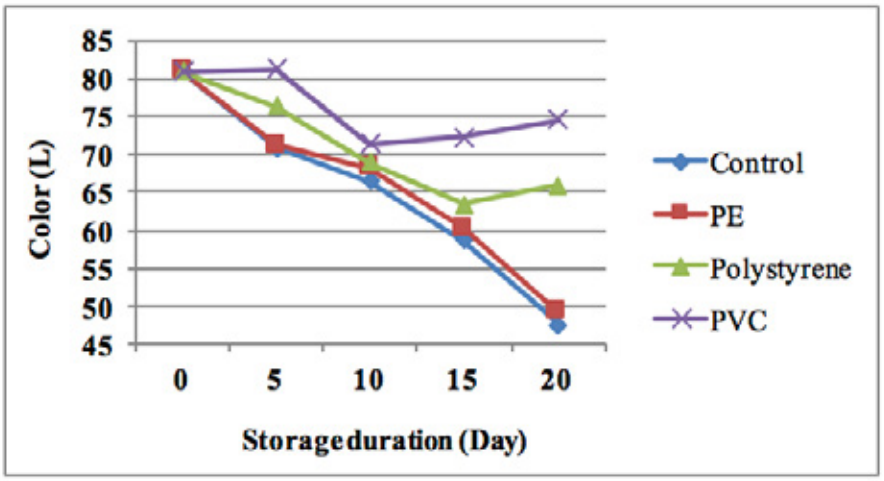



Figure 1. Effect of different packaging materials on cap color (L) values of mushrooms during storage

Table 2. Effect of different packaging materials on cap color (L) of oyster mushrooms

| Storage duration (Days) | Package type | | | |
|---|---|---|---|---|
| | Control | PE | Polystyrene | PVC |
| 0 | 80,8 | 80,8 | 80,8 | 80,8 |
| 5 | 70,7 | 71,2 | 76,3 | 81,2 |
| 10 | 66,5 | 68,3 | 68,9 | 71,4 |
| 15 | 58,8 | 60,3 | 63,4 | 72,3 |
| 20 | 47,7 | 49,3 | 65,9 | 74,5 |

**Respiration Rate**

MAP storage has increased the amount of $CO_2$ due to the increase in storage time. The increase in $CO_2$ concentration was less in the 5$^{th}$ day in polystyrene and PVC containers, but increased in the following days (Table 2 and Figure 2). The results of the study were found to be in accordance with Choi et al., (2003) and Sapata et al., (2009). On the other hand, the respiration rates of the control group (unpackaged) mushrooms are lower than that of packaged mushrooms. This is caused by modified atmospheric packages causing in-pack gas accumulation and moisture condensation by encouragement of respiration of the mushrooms.

Table 3. Effect of different packaging materials on respiration rate of oyster mushrooms

($mLCO_2kg^{-1}h^{-1}$)

| Storage duration (Days) | Package type | | | |
|---|---|---|---|---|
| | Control | PE | Polystyrene | PVC |
| 0 | 3 | 3 | 3 | 3 |
| 5 | 6 | 5 | 5 | 5 |
| 10 | 7 | 16 | 15 | 15 |
| 15 | 9 | 15 | 14 | 14 |
| 20 | 14 | 13 | 13 | 13 |

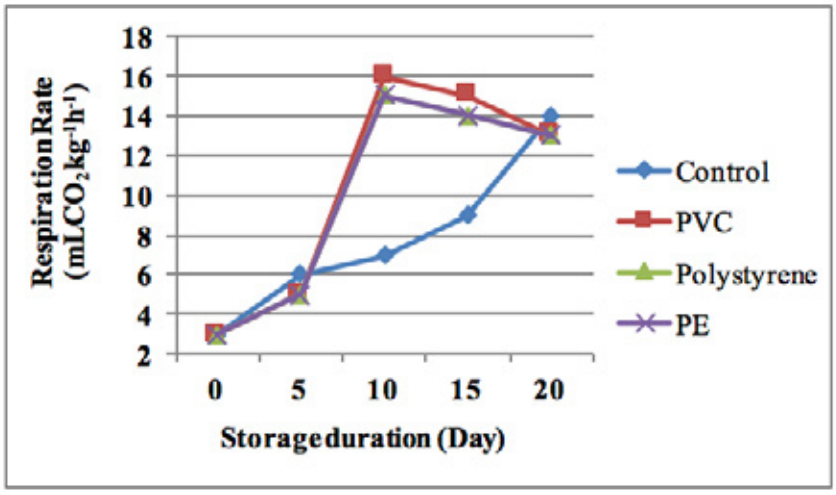



Figure 2. Effect of different packaging materials on respiration rate values of mushrooms during storage

**Soluble Solid Content (SSC) and Titratable Acidity (TA)**

Soluble solid content increased during storage due to water loss. Table 3 and Figure 3 are examined, SSC in the control group of mushroom was a little higher than other groups, but no significant change was detected.

Table 4. Effect of different packaging materials on SSC of oyster mushrooms

| Storage duration (Days) | Package type | | | |
|---|---|---|---|---|
| | Control | PE | Polystyrene | PVC |
| 0 | 3,4 | 3,4 | 3,4 | 3,4 |
| 5 | 6,1 | 5,9 | 5,8 | 5,4 |
| 10 | 6, 5 | 6,2 | 6,0 | 5,8 |
| 15 | 6,4 | 6,4 | 6,3 | 6,0 |
| 20 | 6,5 | 6,4 | 6,3 | 6,1 |

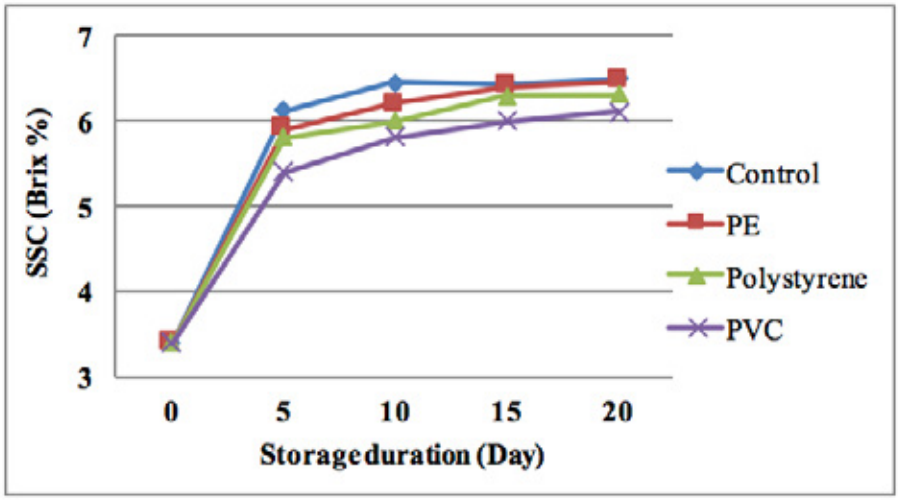



Figure 3. Effect of different packaging materials on SSC values of mushrooms during storage

Titratable acid reached the maximum level at the end of 5 th day s in all treatments. Though, TA showed a slight decrease in the following days, remained at a h igher level than the initial (Table 4 and figure 4). This state is based on increase in microb i al activity in the mushrooms.

Table 5. Effect of different packaging materials on Titratable Acidity (TA) of oyster mushrooms (Citric acid %)

| Storage duration (Days) | Package type | | | |
|---|---|---|---|---|
| | Control | PE | Polystyrene | PVC |
| 0 | 1,7 | 1,7 | 1,7 | 1,7 |
| 5 | 3,6 | 3,4 | 3,9 | 3,7 |
| 10 | 3,1 | 3,0 | 2,8 | 2,6 |
| 15 | 2,9 | 2,5 | 2,7 | 2,3 |
| 20 | 2,7 | 2,3 | 2,5 | 2,1 |

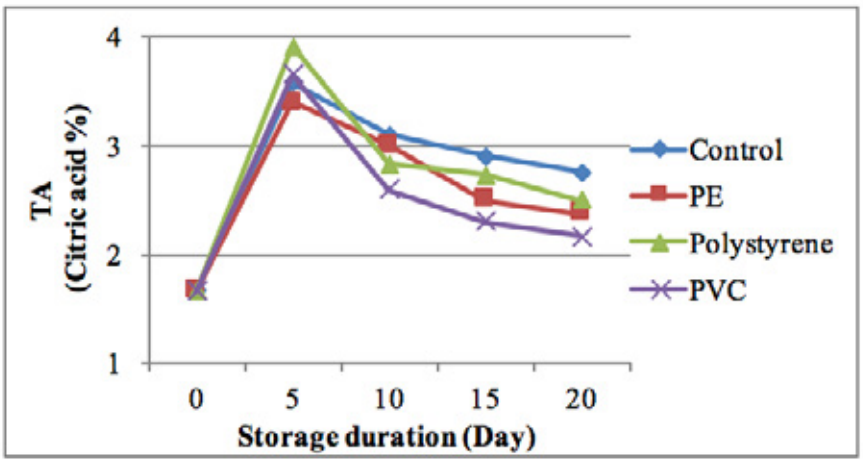



Figure 4. Effect of different packaging materials on TA values of mushrooms during storage

# CONCLUSION

In an investigation conducted to determine the effect of oyster mushrooms kept in PVC, Polystyrene containers and PE commercial bags on storage at +4°C temperature and 50-55% relative humidity, based on results of weight loss, color (brightness), SSC, TA and respiration rate analyses, oyster mushroom can be stored for 5 days in PE, 10 days in Polystyrene and 20 days in PVC containers. However, considering observations and consumer demands such as vitality, appearance, color and smell criterias, it was determined that oyster mushrooms kept for 10 days in PVC containers were ideal for the shelf life and in terms of consumers.

There are frequent problems on transportation, distribution and marketing of mushrooms that rapidly decay after harvest. Therefore, investigate the factors causing these losses and minimize the loss level using appropriate techniques are so important to determine the quality losses at harvest and postharvest period.

# REFERENCES

Anonymous. 2017. In Mettler Toledo, Retrieved July 20, 2017, from http://tr.mt.com/tr/tr/home.html.

AOAC. (1990). Solids (soluble) in fruits and fruits products. In: K, Helrich. (ed.) *Official methods of analysis*. 15thed., AOAC Inc., pp. 1230, Arlington, VA.

Choi, M. H., & Kim, G. H. (2003). Quality changes in Pleurotus ostreatus during modified atmosphere storage as affected by temperatures and packaging material, *Acta Horticulturae*, *628*(2), 358-359.

Halloran, N., Yanmaz, R., Kasım, M.U., & Kasım, R. (2000). Modified atmospheric storage of Kandil bell pepper cultivar. *Food Journal*, *25*(2), 129-132.

Kader, A., Zagory, D., & Karbel, E. L. (1989). Modified atmosphere packaging of fruits and vegetables. *Critical Reviews in Food Science and Nutrition*, *28*, 1-30.

Karaçalı, İ. (2010). *Bahçe ürünlerinin muhafazası ve pazara hazırlanması*. Faculty of Agriculture University of Ege Publisher, Number, 494.

McGuire, R. G. (19929. Reporting of objective color measurements. *HortScience*, *27*(12), 1254-1255.

Sapata, M., Ramos, A., Ferreira, A., Andrada, L., & Candeias, M. (2009). Quality maintenance improvment of Pleurotus ostreatus mushrooms by modified atmosphere packaging. *Acta Scientiarum Polonorum Technologia Alimentaria*, *8*(2), 53-60.

Villaescusa, R., & Gil, M. I. (2003). Quality improvement of Pleurotus mushrooms by modified atmosphere packaging and moisture absorbers. *Postharvest Biology and Technology*, *28(1),* 169-179.

# O-28 The Response of Sweet Cherry Sapling Applied Plant Growth Promoting Rhizobacteria (PGPR) Against Salinity*

Şeyma ARIKAN[1], Lütfi PIRLAK[1]

[1]: Department of Horticulture, Faculty of Agriculture, University of Selçuk, Konya, Turkey

e-mail: arikan@selcuk.edu.tr

**ABSTRACT**

In present study was conducted with cultivar '0900 Ziraat' grafted on MaxMa-14 rootstock both 2014 and 2016 years. The effect of PGPR (*Bacillus subtilis* EY2, *Bacillus atrophaeus* EY6, *Bacillus spharicus GC subgroup B* EY30, *Staphylococcus kloosii* EY37 and *Kocuria erythromyxa* EY43) were investigated under salt stress conditions. PGPR's effects were tested on plant growth (shoot length and diameter, trunk diameter, leaf area, plant fresh and dry weight and root fresh and dry weight), leaf relative water content (LRWC), membrane permeability, stomatal conductivity, photosynthetic activity and chlorophyll content (by SPAD-502). The saplings were grown in pots filled 2:1:1 torf: perlite: sand. Salinity was obtained by NaCl: $Na_2SO_4$: $CaCl_2$: $MgSO_4$ (7:9:3:1) solution mix. The salt mix was applied twice a week with irrigation during the growing period. When the salinity reached 2-2.5 $dScm^{-1}$, salt mix application was ended. All bacteria treatments significantly increased plant growth compared with the salt treatment in both two years. As estimated, the control had highest values in all parameters. In the EY43 treatment, shoot length and shoot diameter was found 50.99 cm and 6.30 mm, respectively. The LRWC range from 12.01 % (salt treatment) to 21.63 % (EY43 treatment). The highest rate of membrane permeability was found in salt (31.95 %). The stomatal conductivity was decreased in the salt application (149.93 mmol $m^{-2}s^{-1}$) unlike EY37 treatment (322.92 mmol $m^{-2}s^{-1}$). Similarly, EY73 treatment significantly increased photosynthetic activity (12.89 µmol $CO_2$ $m^{-2}s^{-1}$) compared with the salt treatment (8.78 µmol $CO_2$ $m^{-2}s^{-1}$).

**Keywords**: 0900 Ziraat, PGPR, Salt Stress, Sweet Cherry

## 1. INTRODUCTION

Plants are directly exposed to the stress because they do not have the ability to escape the stress. This direct effect causes the death of tissues and organs adversely affecting plant growth and development (Kardaş and Ökmen, 2014). Stress factors are examined in two groups as abiotic and biotic stress factors. The abiotic stress factors that affect the plant may be listed as such that drought, mineral salts, high and low temperatures, flooding, heavy metals and pesticides (Schulze et al., 2005). Salinity from these abiotic stress factors is one of the biggest problems in the territory of the country (Çakmakçı, 2009). Because of saline soil occurs in the arid and semi-arid zones of the world, the most of the soils in the world has saline structure. In such areas, long periods of drought coincide with high temperatures (Alizadeh et al., 2011). However, salinity occurs quickly in these regions with irrigation. Salt in the upper layers of soil transported to by capillary during the irrigation and evaporation and accumulates in the rhizosphere. The wrong applications of irrigation, the presence of high soluble salts level in the water, lack drainage and salinity are among other causes. Salinity is one of the major problems in the agricultural area of Turkey. Agricultural fields, about 1.500.000 ha, are faced with salinity problem in Turkey (Anonymous, 2008). Salinity is one of the most effective factors which limited yield and soil fertility in production areas. Salt stress cause increasing of respiration rate, ion toxicity, changes of plant growth, mineral disorders, damaging of membrane permeability, decreasing of photosynthetic activity. On the other hand, soil salinity has negative impacts on nitrogen and carbon metabolism. The plants are divided into halophytes and glycophytes due to differences in tolerance to salinity. Many natural plants are glycophytes and cannot withstand salt stress. Halophyte plants grow naturally under high salinity and therefore are tolerant to salt stress (Zhu, 2007). The salinity tolerances of different species or cultivars and their sensitivity at different stages of growth, different soil and environmental conditions show differences. The reactions of fruit species to salinity were examined (Maas and Hoffman, 1977) and it was observed that many fruit species are very sensitive to salinity (Table-1).

In order to the breeding of soil salinity, it needs lots of time and more money. Therefore, these methods cannot be applied prevalently countries. Many studies focused on chemical treatments and suitable rootstocks against for saline soil but nowadays, biological treatments with plant growth promoting rhizobacteria (PGPR) have been started to use for solving this problem (Ashraf et al., 2004; Karlidag et al., 2010). Using of the bio-fertilizers composed of beneficial microorganisms instead of the synthetic fertilizers prevent to environmental problems and help to improve plant growth and protection environmental health and soil productivity (O'connell, 1992). PGPR are free-living microorganisms as colonizing in the rhizosphere of plants (Karlidag et al., 2010). Strains of the genera such as *Aeromonas, Azoarcus, Azospirillum, Azotobacter, Arthobacter, Bacillus, Clostridium, Enterobacter, Gluconacetobacter, Klebsiella, Pseudomonas and Serratia*, have been identified as PGPR, while the search for additional strains continues (Bloemberg and Lugtenberg, 2001; Vessey, 2003; Niranjan Raj

et al., 2005; Esitken, 2011). These bacteria have a great importance in sustainable agriculture which increased root growth and plant pathogens kept under the control. Such as biocontrol of plant disease, plant growth promoting, bio-fertilizers and growth regulator substances production have functions (Antoun and Prévost, 2005). PGPR effects on plants a-symbiotically notwithstanding plant species. In nature, bacteria which stay in low concentration is applied to plant roots, it effects on plant growth and development. PGPR can have beneficial effects on plant growth and yield by two main mechanisms. There are direct and indirect mechanisms. There are different ways in the direct effect mechanism. Direct mechanisms may act on the plant itself and auxins, cytokinins, and gibberellins or lower of the ethylene in plant, solubilization of inorganic phosphate and mineralization of organic phosphate, a symbiotic fixation of atmospheric nitrogen, and stimulation of disease-resistance mechanisms (Zahir et al., 2003; Antoun and Prévost, 2005). In the indirect mechanism, PGPR acts like biocontrol agents reducing disease or stimulate other beneficial symbioses or protect the plant (Jacobsen, 1997). Additionally, PGPR improves plant's tolerance to stresses, such as drought, high salinity, metal toxicity, and pesticide load (Bashan and de Bashan, 2005). Salt-tolerant bacteria inoculants may be useful in developing strategies to facilitate plant growth in salinity conditions (Karlidag et al., 2013). Some of the beneficial rhizobacteria such as *Rhizobium, Bradyrhizobium, Azotobacter, Azospirillum, Pseudomonas, Bacillus*, etc. are effective in desert ecosystems, acid soils, saline and alkaline areas (Paul and Lade, 2014). In previous studies, it was found that PGPR can ameliorate the negative effect of salt stress on the plant growth in tomato and pepper (Mayak et al., 2004), squash (Yildirim et al., 2006), radish (Yildirim et al., 2008), lettuce (Yıldırım et al., 2011), strawberry (Karlidag et al., 2011; Karlidag et al., 2013) and citrus rootstocks (Arikan and Pirlak, 2016). However, studies on the effects of PGPR on fruit products are limited. Studies have shown that these bacteria increase nutrient uptake and yield in strawberries and increase plant and root growth in citrus rootstocks (Karlidag et al., 2011; Karlidag et al., 2013; Arikan and Pirlak, 2016).

**Table-1.** Response of fruit species against Salinity

| Tolerant | Moderately Sensitive | Too Sensitive |
|---|---|---|
| *Pheoneix dactylifera* | *Ficus carica* | *Citrus paradisi* |
| | *Punica granatum* | *Citrus limon* |
| | *Olea europea* | *Citrus reticulata* |
| | | *Citrus sinensis* |
| | | *Prunus amgydalus* |
| | | *Prunus armeniaca* |
| | | *Prunus avium* |
| | | *Pyrus communis* |

In the present study, we aimed to determine effect of PGPR strains (*Bacillus subtilis* EY2, *Bacillus atrophaeus* EY6, *Bacillus spharicus* GC subgroup B EY30, *Staphylococcus kloosii* EY37, *Kocuria erythromyxa* EY43) which were identified positive effects on plant growth, leaf relative water content and membrane permeability of sweet cheery saplings under the salt stress.

## 2. MATERIAL and METHODS

This study was conducted at Selçuk University Department of Horticulture in 2014 and 2016 in Turkey. The 0900 Ziraat sweet cherry cultivar grafted on MaxMa 14 was used as plant materials and their saplings were planted to 12 liter pots in March for both of years. The pots contained 2:1:1 peat: perlite: sand mixture.

The strains of bacteria, EY2, EY6, EY30, EY37, EY43 were obtained from the University of Iğdır in Turkey (Assos. Prof. Dr. M. Figen Dönmez). These bacteria have ability to grow on a saline culture medium (Karlidag et al., 2013). All bacteria strain inoculation roots before planting. Roots were held in bacterial suspensions of the concentration of $10^9$ CFU $mL^{-1}$ for 30 minutes. After planting saplings were watered two times with bacterial suspensions once in a month. Saplings of bacterial inoculation were made after one-month planting with irrigation once a week NaCl: $Na_2SO_4$: $CaCl_2$: $MgSO_4$ (7:9:3:1) solution mix application in pots and have continued during the growth period. When the EC of soil reached 2-2.5 $dScm^{-1}$, salt mix application was ended. Growth promoting effects of bacterial treatments were evaluated by shoot length and diameter, stem diameter, leaf area, plant fresh and dry weight and root fresh and dry weight, leaf relative water content (LRWC), membrane permeability, stomatal conductivity, photosynthetic activity and chlorophyll content (by SPAD-502) in sweet cherry saplings. Experiment divided into seven application groups including nine saplings with three replicates in a completely randomized design. The collected data were analyzed statistically using the SPSS 23. All data in the present study were subjected by analysis of variance (ANOVA) and means were separated by Duncan's Multiple Range Tests at 5% level of significance.

## 3. RESULTS and DISCUSSION

In this study, shoot length range from 30.29- 52.44 cm. The highest shoot lengths was obtained from control saplings (52.44 cm) and EY43 bacteria treatment (50.99 cm), while the lowest shoot length was measured in salt treatment (30.29 cm). The EY43 bacteria strain increased by %68.33 shoot length in comparison to salt treatment (table-2). The diameter of the shoot was increased all bacteria treatments in comparison with salt treatment (3.90 mm). The highest shoot diameter was measured in EY43 bacteria strain followed by EY2 with 5.80 mm, EY37 with 5.70 mm, EY30 with 5.39 and EY6 with 4.94 mm. In terms of trunk diameter of sapling varied from 11.58 to 16.03 mm. The control saplings had the highest trunk diameter with 16.03 mm, while the lowest diameter of trunk was found in salt treatment with 11.58 mm. The all bacteria treatments increased by 17.44- 32.55% trunk diameter in comparison with salt treatment. The leaf area showed differences in treatments. The largest leaf area was found in control saplings (28.34 $cm^2$), while the smallest leaf was measured in salt treatment (13.10 $cm^2$). The salt treatment decreased by approximately 100% leaf area but bacteria treatments increased by about 48- 95 % leaf area. As these result, some bacteria strain treatments overcame salt and were seen as the control treatment. The fresh plant weight range from 140.68 to 224.08 g in all treatments. The highest fresh plant weight was calculated in the control saplings, while the lowest was found in salt treatment. The bacteria applications raised by the fresh plant weight 17.77- 49.26%. The best result of bacteria treatments was obtained from EY43 strain (209.99 g). The similar result was found in dry plant weight. The highest dry plant weight was detected in control saplings (160.09 g) followed by EY43 (139.88 g) and the lowest dry plant weight was found in salt treatment (86.49 g) (table-2). These results were explained that soil salinity reduces the soil water potential and the ability of plants to take up water. These reduces the rate of cell expansion in growing tissues (Munns, 2011). However, Jha and Subramanian (2013) reported that PGPR under saline conditions increase 31% plant height in paddy rice. Similarly, *Pseudomonas* strain treatment was significantly increased plant height compared with any treatment under salt stress in rice plants (Sen and Chandrasekhar, 2014). The fresh and dry root weight showed similarity in all treatments. The control treatment was found the highest result in both traits of root. The salt treatment had the lowest fresh and dry root weight. The all bacteria treatments increased fresh and dry root weight in comparison with salt treatment. The highest fresh and dry root weight result of bacteria application was EY43 strain with 175.33 g and 106.52 g respectively. The higher concentrations of NaCl caused a significant reduction in root length. The reduction in root length might be due to the inhibitory effects of salt on the metabolic activities which associated with cell division, differentiation and elongation (Heszky et al., 1992; Abdel-Hussein, 2006). Some author reported that PGPR treatments increase root growth. Sen and Chandrasekhar (2014), in ADT43 rice genotype, decreasing of root length was measured in the treatment of *Pseudomonas* strain TDK1 under salinity. Like-wise, Yildirim *et al*. (2008) was found that PGPR treatment had greater root length than the control treatment in radish under salt stress conditions. The chlorophyll content ranged from 32.45 to 45.01 SPAD units in present study. The bacteria treatments increased by about 30– 50 % chlorophyll content in comparison with salt treatment. The highest chlorophyll content was calculated in control saplings followed by EY43 bacteria strain with 42.70 SPAD units (table-3). Karlidag et al. (2010) reported that EY2 and EY43 increased chlorophyll content in strawberry plants. Our result was accordance with this study. The bacteria treatment decreased membran damaged. The EY6 bacteria treatment was the most effective against to membrane damage. The membrane permeability rate was measured 31.95 %, which was the highest, in salt treatment. The lowest membrane permeability rate was found in control group (17.56 %). The control group were followed by bacteria treatments; EY6, EY30, EY2, EY37 and EY43 respectively. The results of membrane permeability showed similarity with Karlidag et al. (2010). The researchers found that all bacteria strain reduced membrane permeability comparison with salt treatment in strawberry. The LRWC varied from 12.01- 24.67 % in all treatments. The result of control group was approximately twofold salt treatment in LRWC. The bacteria treatments increased LRWC in comparison with salt treatment. The best result of bacteria treatment was measured in EY43 with 21.63 % LRWC. The LRWC result of our study is supposed by Karlidag *et al*. (2010) in strawberry. The stomatal conductivity is reduced by abiotic stress condition such as drought, salt, heat, cold and etc. The stomatal conductivity was found lower in salt treatment than other applications. The highest stomatal conductivity was measured in control (336.86 $mmolm^{-2}s^{-1}$), EY43 strain (317.24 $mmolm^{-2}s^{-1}$) and EY37 strain (322.92 $mmolm^{-2}s^{-1}$). The reduced membrane permeability, increased fresh root and plant weight, increased leaf area and increased LRWC contributed to stomatal conductivity in saplings. The EY43 and EY37 bacteria strains increased photosynthetic activity with control group. The lowest activity was found in salt treatment with 8.78 µmol $CO_2$ $m^{-2}s^{-1}$. The all bacteria treatments helped to increased photosynthetic activity under salt stress. The LRWC, stomatal conductivity, leaf area and chlorophyll content increased by PGPRs risen to photoshytetic activity (table-3).

## 4. CONCLUSIONS

The results of the present study showed that used bacteria strains had been ameliorative of the deleterious effects under salt stress in sweet cherry. This study was observed to improved plant growth and reduced membrane injury with bacterial applications. Control group (16.03 mm) had the best effect on trunk diameter but the highest increase in trunk diameter was obtained from EY43 (15.35 mm) bacteria strain compared to salt (11.58 mm) treatment. In shoot length and shoot diameter, EY43 bacteria strain was found the best result compared with the salt mix treatment. All the bacteria treat-

ment significantly increased leaf area except for control. Maximum fresh root weight was obtained from EY43 (175.33 g) and max. dry root weight EY43 (106.52 g) in all bacteria applications. Similarly, EY43 bacteria strain had the best fresh plant weight (209.99 g) and dry plant weight (139.88 g) after the control group.

The maximum LRWC was obtained from control plants (24.67 %) in sweet cherry saplings. The salt (31.95 %) treatment increased membrane permeability compared with all the bacteria applications. The stomatal conductivity was found lower in salt (149.93 $mmolm^{-2}s^{-1}$) treatment than other applications. The EY43 and EY37 bacteria strains increased photosynthetic activity with control group.

**Table-2.** Effect of Salt mix treatments on morphological parameters of 0900 Ziraat saplings

| | Shoot length (cm) | Diameter of shoot (mm) | Trunk diameter (mm) | Leaf area ($cm^2$) | Fresh plant weight (g) | Dry plant weight (g) | Fresh root weight (g) | Dry root weight (g) |
|---|---|---|---|---|---|---|---|---|
| **Control** | 52.44 a | 6.89 a | 16.03 a | 28.34 a | 224.08 a | 160.09 a | 190.56 a | 115.29 a |
| **Salt mix** | 30.29 e | 3.90 f | 11.58 d | 13.10 f | 140.68 g | 86.49 g | 99.50 g | 51.23 g |
| **EY2+Salt mix** | 41.42 c | 5.80 c | 13.60 c | 21.73 d | 197.37 c | 136.21 c | 149.46 c | 91.99 c |
| **EY6+Salt mix** | 36.55 d | 4.94 e | 13.76 c | 19.38 e | 165.69 f | 113.65 f | 118.07 f | 68.44 f |
| **EY30+Salt mix** | 39.78 c | 5.39 d | 13.88 c | 21.33 d | 180.72 e | 129.26 e | 125.10 e | 74.26 e |
| **EY37+Salt mix** | 44.81 b | 5.70 c | 14.12 c | 23.20 c | 186.42 d | 133.52 d | 134.81 d | 83.09 d |
| **EY43+Salt mix** | 50.99 a | 6.30 b | 15.35 b | 25.60 b | 209.99 b | 139.88 b | 175.33 b | 106.52 b |

**Table-3.** Effect of Salt mix treatments on physiological parameters of 0900 Ziraat saplings

| | Chlorophyll content (SPAD Unit) | Membrane Permeability (%) | LRWC (%) | Stomatal Conductivity ($mmolm^{-2}s^{-1}$) | Photosynthetic activity (μmol $CO_2$ $m^{-2}s^{-1}$) |
|---|---|---|---|---|---|
| **Control** | 45.01 a | 17.56 f | 24.67 a | 336.86 a | 13.25 a |
| **Salt mix** | 32.45 e | 31.95 a | 12.01 f | 149.93 d | 8.78 c |
| **EY2+Salt mix** | 39.40 c | 22.69 d | 18.79 c | 270.05 b | 10.53 b |
| **EY6+Salt mix** | 37.89 d | 26.46 b | 14.45 e | 229.33 c | 9.34 bc |
| **EY30+Salt mix** | 38.85 cd | 24.40 c | 16.41 d | 243.65 c | 9.76 bc |
| **EY37+Salt mix** | 41.95 b | 21.01 e | 20.23 b | 322.92 a | 12.88 a |
| **EY43+Salt mix** | 42.70 b | 18.61 f | 21.63 b | 317.24 a | 12.89 a |

**Literature Cited**


Abdel-Hussein, M. A.-A., 2006, Evaluation of MM106 and Omara apple rootstocks for salt tolerance in vitro, *Journal of Karbala University*, 4 (2), 184-191.

Alizadeh, A., Alizade, V., Nassery, L. & Eivazi, A., 2011, Effect of drought stress on apple dwarf rootstocks, *Technical Journal of Engineering and Applied Science*, 1 (3), 86-94.

Anonymous, 2008, www.fao.org Access date: 2016.

Antoun, H. & Prévost, D., 2005, Ecology of plant growth promoting rhizobacteria, In: PGPR: Biocontrol and biofertilization, Eds: Springer, p. 1-38.

Arikan, Ş. & Pirlak, L., 2016, Effects of Plant Growth Promoting Rhizobacteria (PGPR) on Growth, Yield and Fruit Quality of Sour Cherry (Prunus cerasus L.), *Erwerbs-Obstbau*, 58 (4), 221-226.

Ashraf, M., Hasnain, S., Berge, O. & Mahmood, T., 2004, Inoculating wheat seedlings with exopolysaccharide-producing bacteria restricts sodium uptake and stimulates plant growth under salt stress, *Biology and Fertility of Soils*, 40 (3), 157-162.

Bashan, Y. & de Bashan, L., 2005, Plant growth-promoting, *Encyclopedia of soils in the environment*, 1, 103-115.

Bloemberg, G. V. & Lugtenberg, B. J., 2001, Molecular basis of plant growth promotion and biocontrol by rhizobacteria, *Current opinion in plant biology*, 4 (4), 343-350.

Çakmakçı, R., 2009, Stres Koşullarında ACC Deaminaze Üretici Bakteriler Tarafından Bitki Gelişiminin Teşvik Edilmesi, *Atatürk Üniv. Ziraat Fak. Derg.*, 40 (1), 109-125.

Esitken, A., 2011, Use of plant growth promoting rhizobacteria in horticultural crops, In: Bacteria in Agrobiology: Crop Ecosystems, Eds: Springer, p. 189-235.

Heszky, L. E., Gyulai, G. & Csillag, A., 1992, Plant regeneration of NaCl-pretreated cells from long-term suspension culture of rice (Oryza sativa L.) in high saline conditions, *Plant cell, tissue and organ culture*, 29 (2), 75-82.

Jacobsen, C. S., 1997, Plant protection and rhizosphere colonization of barley by seed inoculated herbicide degrading Burkholderia (Pseudomonas) cepacia DBO1 (pRO101) in 2, 4-D contaminated soil, *Plant and Soil*, 189 (1), 139-144.

Jha, Y. & Subramanian, R., 2013, Paddy plants inoculated with PGPR show better growth physiology and nutrient content under saline condition, *Chilean journal of agricultural research*, 73 (3), 213-219.

Kardaş, Ş. & Ökmen, G., 2014, ACC Deaminaz ve Mikroorganizmalar, *Türk Bilimsel Derlemeler Dergisi*, 7 (1), 69-78.

Karlidag, H., Esitken, A., Yildirim, E., Donmez, M. F. & Turan, M., 2010, Effects of plant growth promoting bacteria on yield, growth, leaf water content, membrane permeability, and ionic composition of strawberry under saline conditions, *Journal of plant nutrition*, 34 (1), 34-45.

Karlidag, H., Esitken, A., Yildirim, E., Donmez, M. F. & Turan, M., 2011, Effects of plant growth promoting bacteria on yield, growth, leaf water content, membrane permeability, and ionic composition of strawberry under saline conditions, *Journal of plant nutrition*, 34 (1), 34-45.

Karlidag, H., Yildirim, E., Turan, M., Pehluvan, M. & Donmez, F., 2013, Plant growth-promoting rhizobacteria mitigate deleterious effects of salt stress on strawberry plants (Fragaria× ananassa), *HortScience*, 48 (5), 563-567.

Maas, E. V. & Hoffman, G., 1977, Crop salt tolerance\-current assessment, *Journal of the irrigation and drainage division*, 103 (2), 115-134.

Mayak, S., Tirosh, T. & Glick, B. R., 2004, Plant growth-promoting bacteria that confer resistance to water stress in tomatoes and peppers, *Plant Science*, 166 (2), 525-530.

Munns, R., 2011, Plant adaptations to salt and water stress: differences and commonalities, *Adv Bot Res*, 57, 1-32.

Niranjan Raj, S., Shetty, H. S. & Reddy, M., 2005, Plant growth promoting rhizobacteria: potential green alternative for plant productivity, In: PGPR: Biocontrol and Biofertilization, Eds: Springer, p. 197-216.

O'connell, P. F., 1992, Sustainable agriculture-a valid alternative, *Outlook on Agriculture*, 21 (1), 5-12.

Paul, D. & Lade, H., 2014, Plant-growth-promoting rhizobacteria to improve crop growth in saline soils: a review, *Agronomy for Sustainable Development*, 34 (4), 737-752.

Schulze, E., Beck, E. & Hohenstein, K., 2005, Environment as stress factor: stress physiology of plants, *Plant Ecology. 702p*.

Sen, S. & Chandrasekhar, C., 2014, Effect of PGPR on growth promotion of rice (Oryza sativa L.) under salt stress, *Asian J Plant Sci Res*, 4, 62-67.

Vessey, J. K., 2003, Plant growth promoting rhizobacteria as biofertilizers, *Plant and soil*, 255 (2), 571-586.

Yildirim, E., Taylor, A. & Spittler, T., 2006, Ameliorative effects of biological treatments on growth of squash plants under salt stress, *Scientia Horticulturae*, 111 (1), 1-6.

Yildirim, E., Turan, M. & Donmez, M. F., 2008, Mitigation of salt stress in radish (Raphanus sativus l.) by plant growth promoting rhizobacteria, *Roumanian Biotechnol Lett*, 13, 3933-3943.

Yıldırım, E., Turan, M., Ekinci, M., Dursun, A. & Cakmakcı, R., 2011, Plant growth promoting rhizobacteria ameliorate deleterious effect of salt stress on lettuce, *Scientific Research and Essays*, 6 (20), 4389-4396.

Zahir, Z. A., Arshad, M. & Frankenberger, W. T., 2003, Plant growth promoting rhizobacteria: applications and perspectives in agriculture, *Advances in Agronomy*, 81, 97-168.

Zhu, J.-K., 2007, Plant salt stress, , In: Encyclopedia of life sciences, Eds: CrossRef Google Scholar, p.

# O-35 Some Eco-friendly and RNAi-based Biotechnological Applications against Phytopathogenic Fungi

Ö. Salman[1], N. Boyraz[1]

[1]: Selcuk University, Faculty of Agriculture, Plant Protection Department, Konya, Turkey

e-mail:ozdensalman@selcuk.edu.tr

## Abstract

The food needs of the world have become unrecoverable due to reasons such as the rapid increase of the world population, the gradually decrease of agricultural land, resistance problems in chemical control. Nowadays, scientists have begun to look for eco-friendly ways of struggle in order to minimize the loss of crops caused by plant diseases and pests. In recent years, with the increase in research in the field of agricultural biotechnology, new ideas have emerged in terms of the struggles and these struggles have begun to be accepted. RNA interference (RNAi), one of these control ways, is a mechanism that plays a role in the regulation of gene expression. This mechanism is seen a natural process in living organisms, and dsRNA (double-strand RNA) molecule which is homologous to the target gene minimize or block the gene expression by degrading the mRNA molecule. In mechanism, dsRNA molecules that are homologous to the gene sequence responsible for virulence of plant pathogens are artificially produced. As a result, gene expression is reduced or eliminated. RNAi in combating phytopathogenic fungi is applied in different forms; such as host-induced gene silencing (HIGS) which is generally used hairpin RNA (hp-RNA), BSMV (*Barley stripe mosaic virus*)-mediated HIGS. In this review, the information on RNAi-based biotechnological applications and limited aspects of these applications will be provided.

**Key Words:** dsRNA, RNA, HIGS, hp-RNA, Vector.

## 1. Introduction

Over the next 35 years, the world population is expected to reach about 10 billion people. Every passing day, the need for food has become irrecoverable due to reasons such as the increase of the world population and the decrease of cultivable agricultural land. For this reason, the efficiency obtained from the unit area needs to be increased (Girard et al., 2016). Plant diseases, one of the most important threats for world agriculture, cause serious yield losses. Plant fungal diseases constitute more than 70% of important plant diseases. Chemical treatments are generally used to fight plant fungal diseases. Chemical struggle is very effective against some diseases. However, some beneficial organisms and pathogens are adversely affected. As a result, it has undesirable consequences for health, safety and the environment (Wani et al., 2010).

Scientists have adopted a number of methods to reduce losses caused by plant diseases and to obtain resistant plants. One of these methods is also conventional plant breeding methods. However, the genetic resources of many plants are limited and the breeding process takes a long time. For this reason, the last two decades have begun to focus on RNAi-based resistance in order to obtain resistant plants (Karthikeyan et al., 2013). As is evident from RNA interference (RNAi) name, it suppresses gene expression by causing specific messenger RNAs (mRNAs) to break down (Willams et al., 2004). In other words, it is a mechanism that causes post-transcriptional gene silencing (PTGS) by double-stranded RNA (dsRNA) molecules to prevent the expression of specific genes (Younis et al., 2014). Biotechnologically, it is defined as the activation of messenger RNA of the gene by using double-stranded synthetic RNA molecules that match a spesific gene sequence (Campbell and Reece). In 1998, RNAi was first identified in *C. elegans*. The dsRNAs complementing a specific gene in this nematode are triggered RNAi. This mechanism was initially thought to be used as a defense mechanism against invasive viruses and transposons. However, with the work done over the last fifteen years, it has been determined that small non-coding RNAs (sRNAs) are used to regulate different cellular, developmental and physiological processes in the RNAi pathway (Chang et al., 2012). Thus, in plants RNAi have begun to be used against fungal, bacterial and viral infections (Karthikeyan et al., 2013).

## 2. RNA silencing mechanism in plants

The silencing of RNA is called differently in different organisms. This mechanism is called RNAi in animals, co-supression in plants and quelling in filamentous fungi (Nunes and Dean, 2012). Dicer, one of the key enzymes in RNAi, is one of the members of the ribonuclease-III (RNase) family. Dicer recognizing long double-stranded molecules, splice into short double stranded dsRNA molecules such as microRNA (miRNA) and small interfering RNA (siRNA) molecules. Sequence RNA complementary to target mRNA is linked to a significant sequence of mRNA on RISC factor (Induced Silencing Complex), a nuclease-active RNA multi-protein complex. The gene silencing is controlled by this RISC factor. The mRNA that

interacts with the protein named ‘Argounate’ found in the RISC factor is recognized and interrupted by the ‘Dicer’ enzyme, which is a ribonuclease in the RNase-III family. Thus, silencing is performed (Song and Rossi, 2017).

The RNAi mechanism is carried out by two types of molecules in eukaryotic organisms. The RNAi mechanism is as shown in Figure 1. These molecules are miRNA (microRNA) which is 22 nucleotides in length and small interfering RNA (siRNA) which is 21-23 nucleotides in length (Aras et al., 2015). miRNAs are processed from primary transcripts known as pri-miRNA, to short stem loop structures called pre-miRNA. Drosha plays an enzymatic role at this stage. Pre-miRNAs are transferred to the cytoplasm and converted to miRNA duplexes via Dicer, another RNase. Following the function of the dicer enzyme, one of the short dsRNA duplexes interacts with the RISC factor to bind to the target mRNA via base pairing. The miRNAs have the capacity to inhibit translation or mediate degradation of mRNAs. With these properties, they have taken their place among the interesting subjects of modern molecular biology (Hutvagnerg and Zamore, 2002). Transformational suppression in plants or direct disruption of mRNAs depends on where the miRNAs bind to the target mRNA. If it is linked to the untranslated region (UTR) of the mRNA, incomplete complementarity occurs and translation is suppressed. When linked to the open reading frame (ORF) region, it exhibits complete complementarity and degradation of the mRNA by Argonaute2 (AGO2). The precursor of siRNAs is dsRNA. The dsRNAs are cleaved by the Dicer enzyme. As a result, siRNAs of 20-25 bp occur. siRNAs which are double stranded structure, tranformed into single stranded structure by combining with RISC. They play a role of gene silencing (Nowotny and Yang, 2009). Genetic engineers are surprised that some organisms (especially plants) have the silencing ability of novel genes introduced into their genomes by cloning techniques. Now we know that if a random gene is inserted upstream of a promoter directing the synthesis of a whole or a portion of a nonsense RNA copy, this type of silencing can occur. As shown in figure 2, this RNA produces double-stranded RNA by base pairing with the transgene’s sense RNA synthesized from its own promoter. dsRNAs trigger the RNA interference pathway (Brown, 2015).

Once the function of RNAi has been determined in plants, scientists have synthetically produced short RNA molecules in the target cell to knock down the expression of genes that play an important role in maintaining the viability of plant pathogens. As a result, the expression of these genes has been inhibited or reduced (Girard et al., 2016).

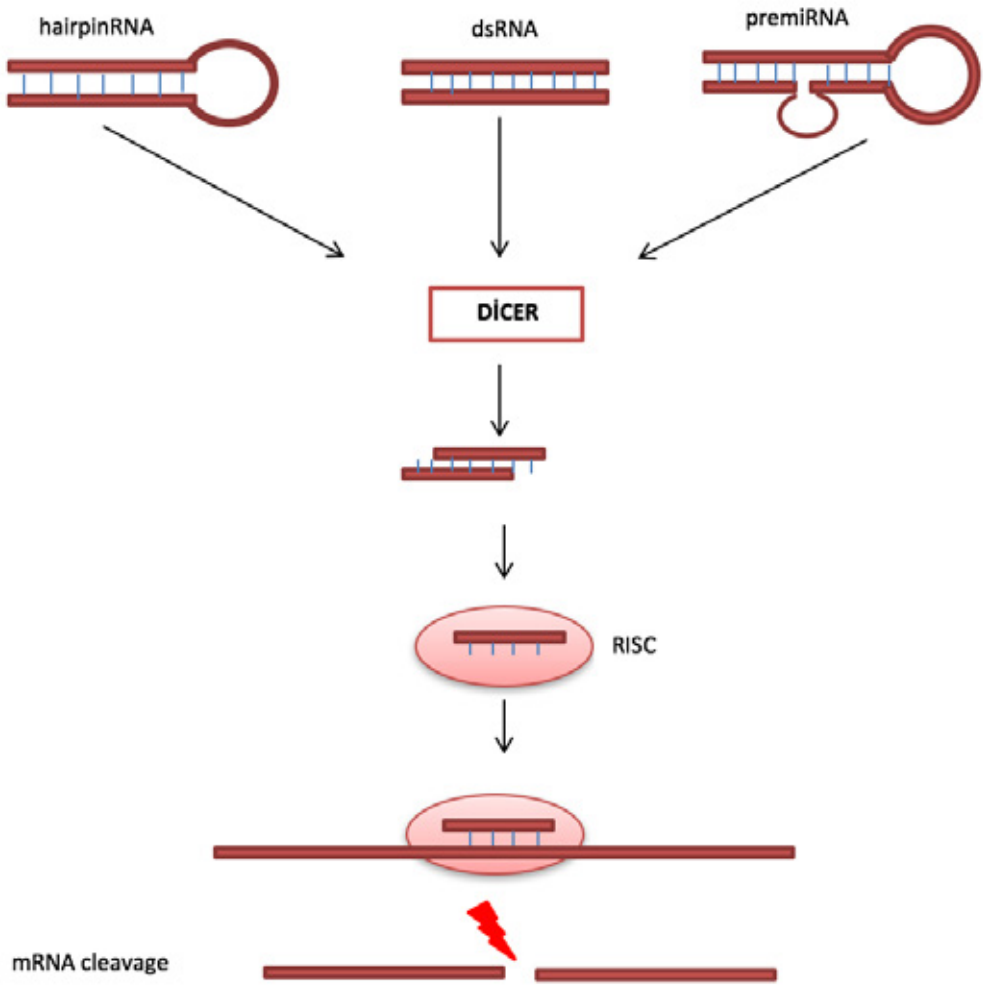



Figure 1: Mechanism of RNAi. Source: Kusaba (2004).

One of the biggest challenges in RNAi research is the introduction of active molecules that will trigger the RNAi pathway in plants. In these systems, there are several methods for delivery of dsRNA or siRNA to different cells and tissues. Selected genetic transfer patterns are as follows: transformation of dsRNA-forming vectors via *Agrobacterium*, transformation of GFP (green fluorescent protein) reporter genes into epidermis cells of plants such as maize, barley and wheat by particle bombardment, infiltration to tomato via *Tobacco rattle virus*-based vector, infecting plants with dsRNA-producing viral vectors. Among these, agroinfiltration, micro-bombardment and VIGS are the most reliable and widely used approaches to delivering dsRNA to plant cells (Wani et. al., 2010).

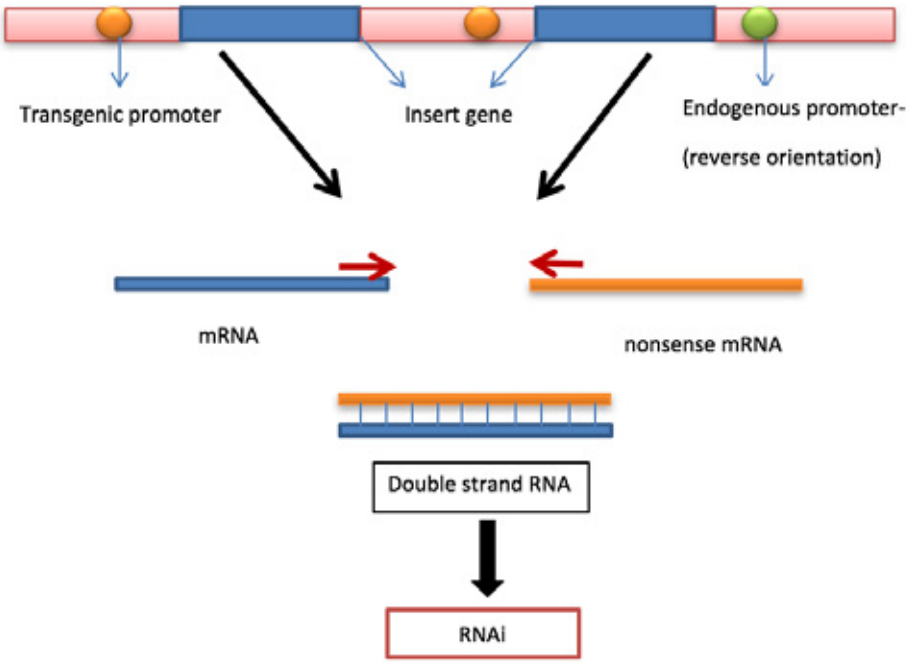



Figure 2: This figure explains why transgenes are sometimes inactive. Source: Brown (2015).

### 2.1. Agroinfiltration

Agroinfiltration is a method for the temporary expression of genes to produce a desired protein in a plant. This method is used in plant biology and plant biotechnology and results in 2-5 days. This facilitates the evaluation of gene expression (Pawar and Maghmare, 2016). Agroinfiltration is also used as a powerful method in RNAi-related studies. Agrobacterium, which carries similar DNA constructs to trigger RNA silencing, is known to be injected into the intracellular spaces of leaves, agroinoculation or agroinfiltration (Hilly and Liu, 2007). In most cases, agroinfiltration is used to initiate systemic silencing or to monitor the effect of suppressor genes. In plants, cytoplasmic RNAi can be efficiently induced by agroinfiltration for the transient expression of T-DNA vectors after the transfer of *Agrobacterium tumefaciens*. Temporarily expressed DNA encodes either hairpin (hp) RNA or ss-RNA. While the infiltration of hairpin constructs is highly influenced by the fact that the dsRNA can directly be processed into siRNAs, ssRNA-exiting structures may be useful in inducing silencing. Agroinfiltration also provides a fast, versatile and convenient way to obtain a gene expression at a very high level (Johansen and Carrington, 2001).

### 2.2. Micro-Bombardment

In this method, a linear or circular template is transferred to the nucleus by microbombardment. Synthetic siRNAs are delivered with biolistic pressure to the plant to silence GFP expression. In addition to sense or antisense RNAs, bombardment cells with dsRNA, siRNA or DNA-coated particles that encode hairpin constructs activate the RNAi pathway. The silencing effect of RNAi is sometimes detected one day after the bombardment and continues until 3 to 4 days after the bombardment. The systemic spread of silence occurs in vascular tissues nearest to the leaves of *Nicotiana benthamiana*, bombarded with bombardment attacks after 2 weeks. Loss of GFP expression after a month is also seen in non-vascular tissues. Biolistically transfered siRNAs as a result of RNA blot hybridization with systemic leaves have been shown to trigger the formation of siRNAs that cause systemic silencing (Klahre et al., 2002).

### 2.3. Virus Induced Gene Silencing (VIGS)

Viruses that have been modified as RNA silencing triggers are used as a means for the induction of RNA in plants. Different RNA and DNA viruses have been modified to function as vectors for gene expression. Some viruses such as *Tobacco mosaic virus* (TMV), *Potato virus X* (PVX) and *Tobacco rattle virus* (TRV) can be used for both protein expression and gene silencing (Kumagani et al., 1995). Expression vectors derived from all RNA viruses (virus-derived expression vectors) are not useful as silencing vectors. Because most of these vectors have strong anti-silencing proteins such as TEV (*Tobacco etch virus*) that directly inhibit host silencing mechanisms (Palmer and Rybicki, 2001). Similarly, DNA viruses are not widely used as expression vectors because they may cause problems in terms of movement due to their size. However, the non-mobile *Maize streak virus* (MSV) derived vector has been used for a long time to produce long-term protein in maize cell cultures. The use of viral vectors to silence endogenous plant genes requires the cloning of viral homologous gene fragments, incompatible with viral replication and movement (Wani et al., 2010).

## 3. RNAi Strategy for Fungi

In plant pathogenic fungi, RNAi is triggered in three different ways; 1- using a plasmid expressing hairpin-RNA (hpRNA) 2-using the dual promoter system 3- Direct delivery of siRNA/ dsRNA to fungal cells (Bashyal and Aggarwal, 2011).

### 3.1. RNA using a hairpin RNA (hpRNA) expressing plasmid

It has shown that hpRNA-expressing constructs induce more efficient and stable silencing (Goldoni et al. 2004). The first example of the induction of RNAi via the fungal hpRNA-expressing plasmid was shown by Liu et al. (2002) in basidiomyceteous yeast *Cryptococcus neoformans*. hpRNA or intron-containing hpRNA (ihpRNA) are the most common and reliable molecules that induce RNAi in fungi. Such vectors are used to demonstrate RNAi using model genes and to investigate the function of genes in host range of fungal species. With the increased work on this subject, various hpRNA producing vectors have been developed for plants. However, for plant pathogenic fungi still functional analogous molecular means are still rare (Bashyal and Aggarwal, 2011).

### 3.2. RNAi using an opposing-dual promoter system

ihpRNA-expressing application is usually limited to small or medium-sized scale analyses. Because the forming of such vectors normally requires two step cloning. A opposing-dual promoter system developed for fungi such as *Magnoporthe oryzae* RNAi vectors allowed for the construction of vectors by a single cloning step. In these systems, sense and antisense RNA of the target gene, which is expected to form dsRNA in the cell, is transcribed independently. PSilent-Dual1 (pSD1) has two opposing promoters called trpC and gpd. This vector was used in *M. oryzae*. The efficacy of pSD1 in gene silencing is lower than that of iVpRNA-expressing vectors (However, strong gene silencing (> 80% reduction) occurred in only a small fraction of the resulting transformants (Nguyen et al., 2008).

### 3.3. Direct delivery of siRNA/dsRNA into fungal cells

The direct delivery of synthetic siRNA to cultured cells to administer RNAi has been reported very rarely in fungi. In Aspergillus nidulans, the ornithine decarboxylase (ODC) gene plays an important role in the polyamine biosynthesis. It has been determined that synthetic siRNA molecules produced for silencing this gene are taken up in germinating fungi in the culture medium and induce RNAi (Bashyal and Aggarwal, 2011).

## 4. HIGS (Host Induced Gene Silencing)

Scientists have developed an effective disease control strategy called HIGS, producing transgenic plants that trigger exogenous RNAi to successfully silence essential genes in pathogens and pests. *Arabidopsis thaliana* and *Nicotiana benthamiana*, as well as successfully applied against some pathogens that cause problems in cultivated plants such as wheat, barley, *Medicago*, and banana. The use of HIGS to combat fungal pathogens causes fungal morphologic changes, inhibition of plant growth and, most importantly, reduction of virulence. In addition, HIGS is also used as a powerful tool to study gene function in some species (Weiberg et al., 2015). Host-induced gene silencing (HIGS) is an RNAi-based process in which genes selected as pests or pathogens are silenced by small RNAs synthesized in plants. The small RNAs used herein are short double-stranded RNAs (dsRNAs) as in VIGS (Lee et al., 2012). Small RNAs are usually produced by the production of double-stranded RNA (dsRNA) in transgenic plants, but can be sent to plant cells via viruses or *Agrobacterium* that

propagate with the dsRNA for experimental purposes. To date, gene silencing has been commercialized against viruses in crops (Yin and Hulbert, 2015).

In HIGS, siRNA molecules synthesized in transgenic plants expressing dsRNAs of a fungal specific gene sequence generate traffic between host and host-infecting fungus. In contrast, virus-induced gene silencing (VIGS) utilizes from viruses to transmit sequences homologous to a target gene fragment and thus initiates RNAi (Senthil-Kumar and Mysore, 2011). However, in the case of HIGS, dsRNAs are targeted at pests or pathogens rather than plant transcripts. dsRNAs are transferred to the host by following one of the different delivery methods and are produced in plant cells (Nunes and Dean, 2012). Plants expressing dsRNA triggers (dsRNA trigger) transiently or stably are inoculated with the organism (pest or pathogen) of interest and thus the role of the targeted gene can be examined during infection (Lee et al., 2012).

HIGS is obtained by transformation of plant embryos with a vector containing a fragment of the target gene from the pathogen or a dsRNA construct The structure that is formed after integration with the selected target gene-vector is called vector-target gene, HIGS structure. HIGS structure in the infected plant cells combines with genomic DNA and it is transformed into dsRNA molecules in consequence of the transcription of the HIGS structure. The generated HIGS structure is transferred to the plant nucleus by different gene transductions such as electroporation or agroinfiltration. Once this structure is integrated with the genomic DNA, the resulting dsRNA structure is transferred to the cytoplasm with the aid of the Exportin-5 protein. HIGS dsRNA molecules are exported from plant cells when fungal infections. Target gene regions of fungal transcripts are silenced in fungal infections. How the dsRNA is processed in host plants and how these constructs are sent to pathogens from plants has not yet been fully determined (Nunes et al., 2012).

First, the RNAi structure was bombarded individually into the epidermal cells of barley leaves, one of the genes of *Blumeria graminis* f.sp. *hordei*, known to be expressed in plants throughout the course of the infection process. The ability of the fungus to form haustorium, a special nutritional structure to absorb nutrients from plants, was then analyzed in these epidermal cells of the host. Remarkably, nearly one-fourth of the tested RNAi constructs induced significant decreases in haustorium formation. The functions of two fungal genes (GTF1 and GTF2) targeted by these constructs were investigated using transgenic RNAi barley lines (GTF1 only) and also BSMV-HIGS. Both approaches have proven successful and have been shown to have different roles for these two genes in fungal development. It was determined that GTF1 plays a role in the formation of haustorium at the beginning and GTF2 plays a role in the development of secondary hyphae necessary for colony formation. (Nowara et al., 2010).

Studies have shown that HIGS is effective against many phytopathogenic fungi such as *B. graminis*, *Puccinia triticina*, *Fusarium graminearum* and *F. oxysporum*. However, the same success has not been achieved against natural infections in field trials. It is not known exactly what the effect of HIGS against *Verticillium dahliae* is. Zhang et al. (2016) have studied the hygrophobin (VdH1) gene of *V. dahliae* to determine if HIGS could suppress the target gene in fungal cells and produced the mutant VdaDvdh1. They showed that the VdH1 gene plays a role in the fungal pathogen (Zhang et al., 2016).

The most effective way to combat *Fusarium* wilt in bananas is to develop a resistant variety. It has been determined that the genes necessary for the survival of Fusarium oxysporum cubense (Foc) can be silenced by host-induced post transcriptional -ihpRNA-linked gene silencing and found that effective resistance to pathogens can be achieved in plants (Ghag et al., 2014).

Some vectors used as virus vectors are also used to induce HIGS. VIGS is a natural defense mechanism of PTGS in plants that are effective against virus infection in plants. All plant viruses either produce long double-stranded RNAs or produce highly structured single-stranded RNAs (Lee et al., 2015). A part of the plant gene in VIGS is added to a virus vector to generate a recombinant virus that stimulates PTGS targeting both the viral RNA and homologous endogenous plant RNA sequences for degradation. So far only one plant virus with RNA genome, the *Barley stripe mosaic virus* (BSMV), could be transformed into a VIGS vector for wheat. BSMV-mediated VIGS was successfully applied to enlighten some wheat-pathogen interactions such as *Puccinia triticina*, *Puccinia striiformis* f.sp. *tritici* and *Blumeria graminis*. *Barley stripe mosaic virus* (BSMV), one of the RNA viruses, was developed as a VIGS vector at the beginning of the 2000s and is used to study the function of wheat genes. There are many variations of BSMV vectors. In order for these vectors to function, transcription of viral RNA is required. The transcription of viral RNA is transcripted differently according to variants. Some of these viral RNAs are transcripted *in vitro*, while others are transcribed DNA-based vectors transformed via plant bombardment or *Agrobacterium tumefaciens* to plant cells (Lee, 2015).

*Barley stripe mosaic virus* (BSMV) has recently been developed as an effective tool for virus- induced gene silencing (VIGS) in monocotyledons. A number of studies have subsequently been conducted to determine whether BSMV can be

used to determine the role of fungal genes during host pathogenic interactions and to induce HIGS (BSMV-HIGS) in plant cells (Panwar, 2016). The PtMAPK1, PtCYC1 and PtCNB genes were selected as target genes. With these genes selected, the effect of the BSMV-HIGS system on the struggle against *P. triticina* was investigated. Virus-infected wheat leaves were found to be candidate silencing molecules specific to the candidate *P. triticina* gene. As a result, the symptoms of *P. triticina* disease (less sporulation and fungi biomass) in wheat decreased due to the decreased expression of PtMAPK1, PtCYC1 and PtCNB genes (Panwar, 2016).

## 5. Advanteges and disadvantages aspects of RNAi-based applications

The RNA interference (RNAi) mechanism has provided important contributions not only to learning the functions of genes for which we do not know how to function, but also to the development of defense mechanisms against diseases caused by pathogens, obtaining transgenic plants resistant to stress factors (Aras et al., 2015). Pathogens that cause diseases such as rust and congestion can evolve rapidly and break down the durability of resistant varieties. It is thought that HIGS-mediated resistance can come from above these problems (Nunes et al., 2012). In the future, with the development of technological tools, it will be possible to understand in more detail the post-transcriptional regulatory mechanisms in different plants under different conditions (Aras et al., 2015).

However, the realization of RNAi has some disadvantages, such as the lack of stability of hairpin constructs in fungal cells, the difficulties encountered in preparing transgenic plants to silence sequences homologous to targeted sequences against phytopathogenic fungi (Mascia et al., 2014). Field trials of HIGS are limited due to exposure of plants to a variety of biotic and abiotic factors (Weiberg et al., 2015). There are some difficulties in terms of commercialization of HIGS. These; The precise selection of target sequences without undesirable effects on non-host organisms, the difficulty of expressing transgenic as a stable in many crops, the assessment of safety aspects, and the fact that consumers do not prefer transgenic crops. However, in the near future, it is hoped that HIGS technology can be used to develop products that are highly resistant to fungal diseases to replace costly and environmentally harmful chemical processes (Nunes et al., 2012).

## 6. Conclusions

RNAi-based studies that began with the discovery of RNAi in the science world have revolutionized many areas. Initially, more studies to determine the function of a gene have caused different ideas to emerge over time. Scientists have raised new hopes, especially as regards plant protection in terms of a new way of struggling against pathogens that chemical struggles have been inadequate and resistance problems have emerged. Some of the work being done remains in the experimental phase and often results in unsuccessful results in field applications. The health effects of transgenic plants are still a matter of debate among scientists. Some scientists uphold that RNAi applications do not have a direct effect on the gene and that it affects only one gene expression. For this reason, they think that RNAi applications are environmentally friendly. We also believe that the identification of genes that play a role in the virulence and pathogenicity of plant pathogens, the identification of silencing nc-RNA constructs complementary to these genes and the increased work on applications where these constructs can be transferred more easily to plants will make these genes applicable in practice. However, what will be the adverse effects of RNAi on health and environment will be the work to be done on these issues over time.

**Acknowledgement:** This study was funded by Selcuk University-ÖYP Coordinatorship, Project Number: #2016-ÖYP-056.

## References

Aras, S., Soydam-Aydın, S., Fazlıoğlu, A., Cansaran-Duman, D., Büyük, İ., & Derici, K. (2015). Bitkilerde RNA interferans. *Türk Hijyen ve Deneysel Biyoloji Dergisi*, 72, 255-262.

Bashyal, B.M., & Aggarwal, R. (2011). *RNAi technology.* In RNA interference in fungi (pp. 327-334). *CRC Press*, USA.

Brown, T.A. (2015). Genomes 3. Bardakcı, F., Ülger, C., *Nobel Press*, Ankara, (pp. 371-374).

Chang, S.S., Zhang, Z. & Liu, Y. (2012). RNA interference patways in fungi: mechanisms and functions. *Annual Review Microbiology*, 66, 305-323.

Campbell, N. A., & Reece, J. B. (2010). Biology. Gündüz, E., Demirsoy, A., Türkan, İ., *Palme Yayıncılık*, Ankara, (pp.389-392).

Duan, C.G., Wang, C.H., & Guo, H.S. (2012). Application of RNA silencing to plant disease resistance. *Biomed Central Silence.*

Ghag, S.B., Shekhawat, U.K.S. & Ganapathi, T. R. (2014). Host-induced post-trasncriptional hairpin RNA-mediated gene silencing of vital fungal genes confers efficient resistance against *Fusarium* wilt in banana. *Plant Biotechnology Journal*, 12, 541-553.

Girard, I. J., Mcloughlin, A. G., Kievit, T. R., Fernando, D. W. G. & Belmonte, M. F. (2016). Integrating large-scale data and RNA technology to protect

crops from fungal pathogens. *Frontiers in Plant Science* 7, 1-3.

Goldoni, M., Azzalin, G., Macino, G. & Cogoni, C. (2004). Efficient gene silencing by expression of double stranded RNA in *Neurospora crassa*. *Fungal Genetics and Biology*, 41, 1016-1024.

Hilly, J.M. & Liu, Z. (2007). An overview of small RNAs, In: Bassett, C.L., Regulation of Gene Expression in Plants, Springer-Verlag, Berlin, 123-147.

Hutvagnerg, G. & Zamore, P.D. (2002). A micro-RNA in a multiple-turnover RNAi enzyme complex. *Science*, 297, 2056-2060.

Johansen, L.K. & Carrington, J.C. (2001). Silencing on the spot induction and suppression of RNA silencing in the *Agrobacterium*-mediated transient expression system. *Plant Physiology*, 126, 930-938.

Karthikeyan, A., Deivamani, M., Shobhana, V.G., Sudha, M. & Anandhan, T. (2013). RNA interference: evolutions and applications in plant disease management. *Archieves of Phytopathology and Plant Protection*, 1430-1441.

Klahre, U., Crete, P., Leuenberger, S.A., Iglesias,V. A. & Meins, F. (2002). High molecular weight RNAs and small interfering RNAs induce systemic post transcriptional gene silencing in plant. *Proceedings of the National Academy of the USA*, 99, 11981-11986.

Kumagai, M.H., Donson, J., Cioppa, G., Harvey, D., Hanley, K. & Grill, L.K. (1995). Cytoplasmic inhibition of carotenoid biosynthesis with virus-derived RNA. *Proceedings of the National Academy of Sciencesof the USA*, 92, 1679-1683.

Kusaba, M. (2004). RNA interference in crop plants. *Current Opinion in Biotechnology,* 15, 139-143.

Liu, H., Cottrell, T.R., Pierini, L.M., Goldman, W.E. & Doering, T.L. (2002). RNA interfence in the pathogenic fungus *Cryptococcus neoformans*. *Genetics*, 160, 463-470.

Lee, W. S., Rudd, J.J. & Kanyuka, K. (2015). Virus induced gene silencing (VIGS) for functional analysis 3of wheat genes involved in *Zymoseptoria tiritici* susceptibility and resistance. *Fungal Genetics and Biology* 79, 84-88.

Lee, W. S., Kim, E., Hammond-Kosack, K. E. & Kanyuka, K. (2012). *Barley stripe mosaic virus*- mediated tools for investigating gene function in cereal plants and their pathogens: virus-induced gene silencing, host mediated gene silencing, and virus mediated overexpression of heterologous protein. *Plant Physiology*, 160, 582-590.

Mascia, T., Nigro, F., Abdallah, A., Ferrara, M., Stradis, A. D., Faedda, R., Palukaitis, P., & Gallitelli, D. (2014). Gene silencing and gene expression in phytopathogenic fungi using a plant virüs vector. *Microbiology*, 111, 4291-4296.

Nguyen, Q. B., Kadotani, N.,Kasahara, S., Tosa, Y., Mayama, S., & Nakayashiki, H. (2008). Systematic functional analysis of calcium signalling proteins in the genome of the rice-blast fungus, *Magnoporthe oryzae*, using a high-throughput RNA-silencing system. *Mol. Microbiol.* 68, 1348-1365.

Nowara, D., Gay, A., Lacomme, C., Shaw, J., Ridout, C., Douchkov, D., Hensel, G., Kumlehn, J., & Schweizer, P. (2010). HIGS: host-induced gene silencing in the obligate biotrophic fungal pathogen *Blumeria graminis*. *Plant Cell*, 22, 3130-3141.

Nowotny, M., & Yang, W. (2009). Structural and functional modules in RNA interference. *Curr Opin Struct Biol*, 19, 286-293.

Nunes C.C., & Dean R.A. (2012). Host-induced gene silencing: a tool for understanding fungal host interaction and for developing novel disease control strategies. *Mol Plant Pathol* 13, 519–529.

Palmer, K.E. & Rybicki, E.P. (2001). Investigation of the potential of maize streak virüs to act as an infectious gene vector in maize plants. *Archives of Virology*, 146, 1089-1104.

Panwar, V., Callum, B., Jordan, Loewen, M., Fobert, P., Cartney, C., & Bakkeren, G. (2016). RNA silencing approaches for identifying pathogenicity and virulence elements towards engineering crop resistance to plant pathogenic fungi. *ResearchGate*.

Pawar, K. R. & Waghmare, S. G. (2016). Agroinfiltration- effective method of gene transfer. *Biotech Research.*

Senthil-Kumar M., & Mysore K.S. (2011). New dimensions for VIGS in plant functional genomics. *Trends Plant Sci* 16(12):656–665.

Song, M. S., & Rossi, J.J. (2017). Molecular mechanisms of dicer: endonuclease and enzymatic activity. *Biochemical Journal*, 10, 1603-1618.

Thakare, D., Zhang, J., Wing, R.A., Cotty, P.J., & Schmidt, M.A. (2017). Aflatoxin-free transgenic maize using host-induced gene silencing. *Science Advances*, 3.

Yin, C. & Hulbert, S. (2015). Host induced gene silencing (HIGS), a promising strategy for developing disease resistant crops. *Gene Technology*, 4:3.

Younis, A., Siddique, M. I., Kim, C. K., & Lim, K. B. (2014). RNA interference (RNAi) induced gene silencing: a promising approach of hi-tech plant breeding. *International Journal of Biological Sciences*, 10, 1150-1158.

Wani, S. H., Sanghera, G. S., & Singh, N.B. (2010). Biotechnology and plant disease control- role of RNA interference. *American Journal of Plant Sciences*, 55-68.

Weiberg, A., Wang, M., Lin, F.M., Zhang, Z., Kaloshian, I.,Huang, H.D., & Jin, H. (2013). Fungal small RNAs supress plant immunity by hijacking host RNA interference pathways. *Science*, 342, 118-123.

Weiberg, A., Bellinger, M., & Jin, H. (2015). Conversations between kingdoms: small RNAs. *Current Opinion in Biotechnology*, 32, 207-215.

Williams, M., Clark, G., Sathasivan, K. & Islam, A. S. (2004). RNA interference and its application in crop improvement.

Zhang, T., Jin, Yun., Zhao, J. H., Gao, F., Zhou, B. J., Fang, Y. Y., & Guo, H.S. (2016). Host-induced gene silencing of the target gene in fungal cells confers effective resistance to the cotton wilt disease pathogen *Verticillium dahliae*. *Molecular Plant* 9, 939-942.

# O-36 The Effect of Pre-treating Two Eggplant *(Solanum melongena* L.) Genotypes with Hydrogen peroxide, Nitric oxide, and Salycilic acid Under Salt Stress Conditions

G. Baysal Furtana[1], F. Öcal Özdamar[1], Ş. Ş. Ellialtıoğlu[2], R. Tıpırdamaz[3]

[1]Gazi University, Science Faculty, Biology Department, Teknikokullar, Ankara
[2]Ankara University, Agriculture Faculty, Horticulture Department, Dışkapı,Ankara
[3]Hacettepe University, Science Faculty, Biology Department, Beytepe, Ankara
e-mail: gokcenbaysal@gmail.com

**Abstract**

One of the methods used to reduce the harmful effects of salt on plants and to revert the loss of productivity, is to apply some chemicals externally on plants. In this study, the effects of $H_2O_2$, NO and SA pre-treatments on the salt stress of two eggplant *Solanum melongena* L. genotypes that have different tolerances [salt tolerant (Mardin) and salt sensitive (Artvin)] were investigated. Eggplant seedlings at the 4-5 leaf stage were sprayed on the leaves with 1 mM $H_2O_2$, 0.1 mM SNP (as a NO source), 0.1 mM SA, and their combinations. Forty-eight hours after application, the plants were exposed to 100 mM NaCl for 10 days. In both of the eggplant varieties, salinity increased proline and lipid peroxidation levels compared to the control, where more increases observed in the Artvin genotype. In pre-treated groups, the amount of proline increased compared to the salt stress applied group, but lipid peroxidation decreased. The lowest level of lipid peroxidation was observed when $H_2O_2$+NO+SA was applied to the Mardin genotype, while this case was observed in the Artvin genotype when only $H_2O_2$ was applied. It was determined that the amount of internal $H_2O_2$ increased in the groups treated with salt stress compared to the control groups, especially in the Artvin genotype. As a result, it was determined that pre-treatments with $H_2O_2$, NO and SA alone or in combinations were effective at varying tolerance rates on both of the eggplant genotypes for reducing the negative effects of salt stress.

**Keywords:** Hydrogen peroxide, Lipid peroxidation, Nitric oxide, Proline, Salicylic acid, Salt tolerance

## INTRODUCTION

Abiotic stress can be identified as an environmental factor which limits crops' productivity or destroys their biomass (Cramer et al., 2011). Salinity, which is a major abiotic stress that affects germination, growth, photosynthesis, water relation, nutrient imbalance, oxidative stress, and yield (Ashraf, 2004; Abari et al., 2011), is one of the major problems affecting about 62 million hectares (20%) of the world's irrigated lands (Qadir et al., 2014). Thus a remarkable number of investigations have concentrated on resolving salinity problem and developing new methods to overcome it. Addition of some chemical compounds (salicylic acid, jasmonic acids, calcium, nitric oxide, hydrogen peroxide) to the plant's growing media is one of the methods in prospect of being a solution for the osmotic and oxidative stresses caused by salt stress. Because these compounds [such as calcium, hydrogen peroxide ($H_2O_2$), abscisic acid, jasmonic acid, ethylene, salicylic acid, and nitric oxide (NO)] have been suggested to be signal molecules or messengers that are required for stimulating specific responses against various biotic and abiotic stresses (Senaratna et al., 2000; Simaei et al., 2011; Esim and Atici, 2014; Miura and Tada, 2014; Qiao et al., 2014; Mostofa et al., 2015)

Salicylic acid (SA, 2-hydroxybenzoic acid), which is naturally synthesized by plants, plays an important role as a

signal molecule for the regulation of physiological and biochemical processes (Saruhan et al., 2012) and defences and enhances the tolerance of plants to various adverse abiotic and biotic stress conditions (Senaratna et al., 2000; Simaei et al., 2011). Furthermore, the role of SA in inducing salt tolerance has been investigated in detail for various plants (Dolatabadian et al., 2009; Fayez and Bazaid, 2014; Qados, 2015).

Hydrogen peroxide($H_2O_2$), a form of reactive oxygen species, is continually synthesized through various sources including enzyme and non- enzyme pathways in plants. Recent studies have demonstrated that low concentration of $H_2O_2$ is a key signaling molecule in the signaling pathway, which may control many different physiological responses such as biotic and abiotic stress responses. (Mittler et al., 2004; Habibi, 2014). But at high concentrations, it causes lipid peroxidation, protein denaturation and DNA damage (Dat et al., 2000; Creissen and Mullineaux, 2002). In the past few years, research on function of $H_2O_2$ in several stress tolerance has obtained such as drought (Ashraf et al., 2015), salinity (Sathiyaraj et al., 2014; Mohamed et al., 2015), cold (Si et al., 2017) and high temperatures (Wu et al., 2015). Some researches proposed that $H_2O_2$ foliar application contributed to increased antioxidant enzyme activity, decreased lipid peroxidation (Gao et al., 2010; Gondim et al., 2012).

Nitric oxide (NO), is another important endogenous plant bioactive signaling molecule, may have a vital role in plant growth, development (Moreau et al., 2010; Molassiotis and Fotopoulos, 2011; Siddiqui et al., 2011; Manai et al., 2014; Kovacs et al., 2015; Mostofa et al., 2015) and response to various abiotic stresses such as cold (Diao et al., 2017), heat (Yu et al., 2015), salt (Liu et al., 2015), drought (Shan et al., 2015) and osmotic stress (Alavia et al., 2014). Further, NO is known as a strong inhibitor of lipid peroxidation and protein oxidation (Fancy et al., 2016).

Toxic or protective effects of SA, $H_2O_2$ and NO on plants are dependent on concentration, method of application, treatment duration, plant species, age at treatment, and plant organ examined used for pretreatment (Manai et al., 2014; Sewelam et al., 2016).

Various studies indicated that exogenous $H_2O_2$, SA, and NO applications (separately or together) have beneficial effects in alleviating salt-induced oxidative damage in various plant species (Khan et al., 2014; Mustofa, 2015). $H_2O_2$, SA, and NO are involved in regulating a number of physiological processes and plant responses to several environmental stresses (Esim and Atici, 2014; Miura and Tada, 2014; Qiao et al., 2014; Niu and Liao, 2016). Nevertheless there are few studies that examine spraying leaves with $H_2O_2$, NO and SA.

Eggplant (*Solanum melongena* L.), belongs to family Solanaceae, is an important crop for Turkey. According to the TUIK 2016 datas, Turkey holds the first place in eggplant production in Europe with a yield of 827,830 tons approximately in 30.000 hectares (TUIK 2016).

The aim of this study was to investigate the effects of $H_2O_2$, NO and SA pre-treatment individually or together on the salt stress of two eggplant *Solanum melongena* L. genotypes that have different tolerances [salt tolerant (Mardin) and salt sensitive (Artvin)].

## MATERIAL AND METHODS

Two eggplant (Solanum tuberosum L.) cultivars [salt tolerant Mardin and salt sensitive Artvin (Yaşar,2003)] were used as the plant material. They were grown under the controlled conditions (25+2 C temperature, 50-60% relative humidity, 16h light/8h dark photoperiod and 100 $\mu mol.m^{-2}s^{-1}$light intensity) in perlite culture. The seeds were irrigated with Hoagland nutrient solution. Eggplant seedlings at the 4-5 leaf stage were sprayed on the leaves with 1 mM $H_2O_2$, 0.1 mM SNP (as a NO source), 0.1 mM SA, and their combinations. Forty-eight hours after application, the plants were exposed to 100 mM NaCl for 10 days.

The proline content was determined by using the method of Bates et al. (1973). The proline content in the sample was expressed as $\mu mol.g^{-1}$ fresh weight.

$H_2O_2$ contents were estimated in leaf samples using the method of Velikova et al. (2000). Shoot samples were extracted with 5 ml of 0.1% trichloroacetic acid (TCA) and centrifuged at 12,000 × g for 15 min. Then 0.5 ml of supernatant was mixed with 0.5 ml of 10 mM phosphate buffer (pH 7.0) and 1 ml of 1 M potassium iodide and the absorbance was determined at 390 nm. The content of $H_2O_2$ was calculated using the extinction coefficient 0.28 mM $cm^{-1}$ and expressed as µmol/g FW.

Lipid peroxidation was determined by estimating the malondialdehyde (MDA) content in 1 g leaf fresh weight according to Lutts et al. (1996). The concentration of MDA was calculated from the absorbance at 532 nm (correction was done by subtracting the absorbance at 600 nm for unspecific turbitidity) by using extinction coefficient of 155 $mM^{-1}.cm^{-1}$.

The experiments were set up in a completely randomized design. All analyses were carried out with 3 replications. All statistical analyses were done with SPSS statistical programme. The results were subjected to analysis of variance (ANOVA). Means differing significantly were compared with least significant differences (LSD) at the 5% probability level.

**RESULTS AND DISCUSSION**

As one of the major abiotic stresses, salinity causes adverse effects on plant growth and productivity. Plants are stressed in salinity in these ways; low osmotic potential of soil solution (water stress), nutrient imbalance, toxic effects of specific ions mainly $Na^+$ and $Cl^-$ and combination of these factors (Ashraf, 1994; Marschner, 1995). Accumulation of osmolytes, such as proline, soluble proteins and soluble sugars, is another way to cope with osmotic stress provoked by salinity (Khan et al., 2012; Ahmad et al., 2016).

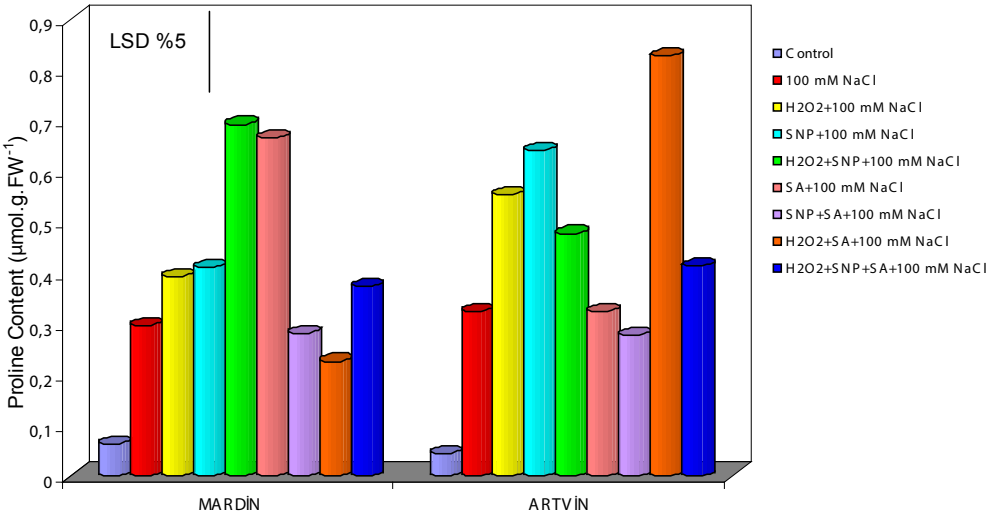



Figure 1: Effects of $H_2O_2$, SNP (NO donor) and SA pre treatments on proline contents of two eggplant cultivars' leaves.

In our study, salt treatment increased the level of proline 370 % in Mardin and 622 % in Artvin cultivars when compared with control. The proline contents changed between 0,063 and 0,693 µmol /g FW in Mardin, and 0,045 and 0,828 µmol/g FW in Artvin. For both of the cultivars, pre-treatments increased the proline accumulation in variable ratios with respect to the group which is under only salt stress. When compared to the only salt treated groups, it is found that the increase in proline contents were important ($p<0,05$) for Mardin at SA and $H_2O_2$+SNP pre-treatments (125% and 134%, respectively) and for Artvin at $H_2O_2$, SNP and $H_2O_2$+SA pre treatments (70%, 97% and 154 %, respectively).

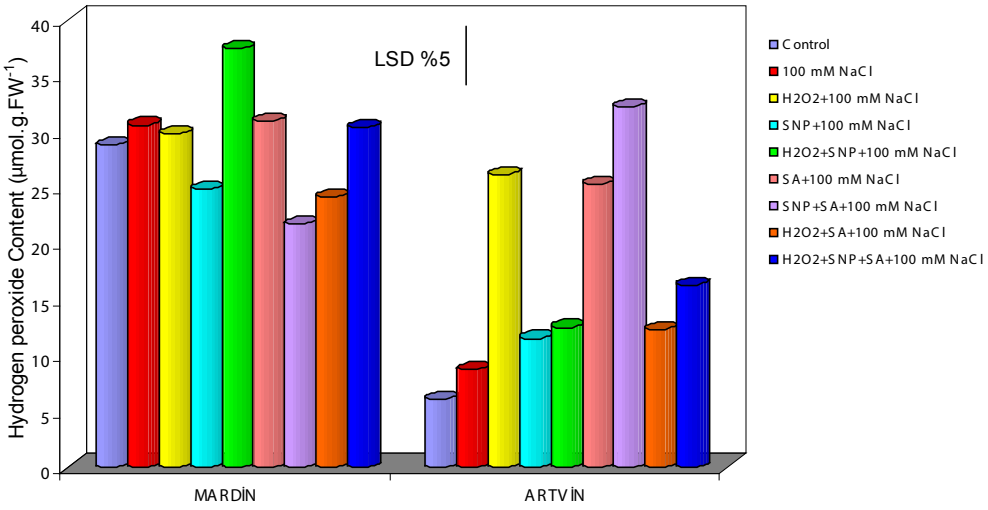



Figure 2: Effects of $H_2O_2$, SNP (NO donor) and SA pre treatments on $H_2O_2$ contents of two eggplant cultivars' leaves.

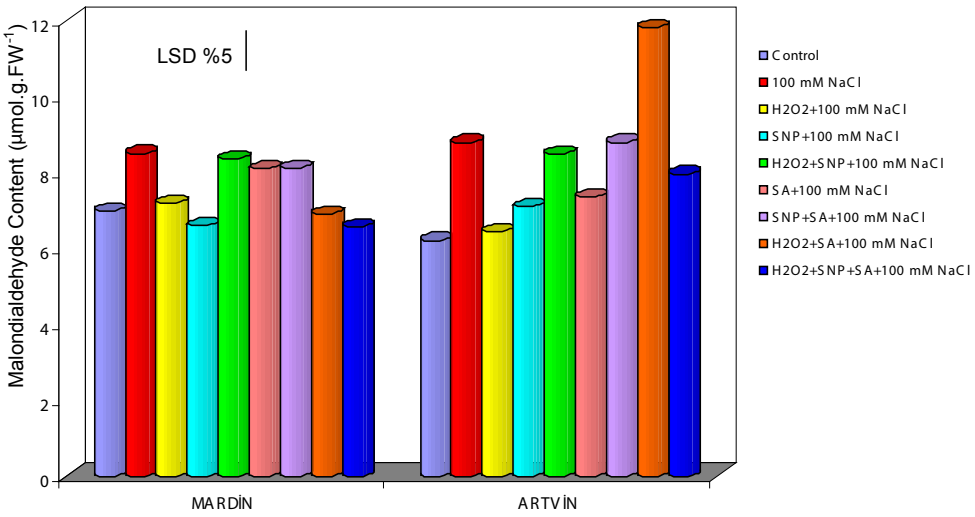



Figure 3: Effects of $H_2O_2$, SNP (NO donor) and SA pre treatments on MDA contents of two eggplant cultivars' leaves.

$H_2O_2$ content increases with the salinity stress even for both genotypes. With respect to the salt stress treatments, pre treatments -made single or together- cause generally decrease in $H_2O_2$ contents for Mardin and increase for Artvin. When compared to the only salt treated groups, it is found that $H_2O_2$+SNP pre-treatment for Mardin and $H_2O_2$+SA pre-treatment for Artvin have the highest $H_2O_2$ content.

Cellular membrane integrity evaluated by electrolyte leakage and lipid peroxidation, measured as MDA, appeared to be more reliable indices of salt tolerance (Lutts et al., 1996; Bor et al., 2003). In this study, It is observed that according to the control, salinity incerases lipid peroxidation (MDA amount) for both species whereas the increase for Artvin is higher. Lipid peroxidation is decreased in pre treatment groups with respect to the only salt treated group. When compared to the only salt treated groups, it is found that only SNP and $H_2O_2$+SNP+ SA pre-treatments for Mardin and only $H_2O_2$ pre-treatment for Artvin have the lowest MDA content.

Previous studies have shown that single or combined application of exogenous $H_2O_2$, NO and SA decreased $H_2O_2$ and MDA contents under abiotic stress conditions (Khan et al., 2012; Esim and Atıcı, 2015; Mostofa et al., 2015; Ahmad et al., 2016).

Results showed that pre-treatments with $H_2O_2$, NO and SA single or in combinations were variously effective on decreasing the negative effects of salinity for two different eggplant species which have different salinity tolerances.

## References


Abari, A. K., Nasr, M. H., Hojjati, M., & Bayat, D. (2011). Salt effects on seed germination and seedling emergence of two Acacia species. *African Journal of Plant Science*, 5, 52-56.

Ahmad, P., AbdelLatef, A. A., Hashem, A., AbdAllah, H.F., Gucel, S., & Tran L. (2016). Nitric oxide Mitigates Salt Stress by Regulating Levels of Osmolytes and Antioxidant Enzymes in Chickpea. *Frontiers in Plant Science*, 7, Article 347, 1-11.

Alavia, S. M. N., Arvinb, M. J., & Kalantaria, K. M. (2014). Salicylic acid and nitric oxide alleviate osmotic stress in wheat (Triticum aestivum L.) seedlings. *Journal of Plant Interactions,* 9(1), 683–688.

Ashraf, M. (1994). Breeding for salinity tolerance in plants. *Critical Reviews in Plant Science,* 13, 17-42.

Ashraf, M. (2004) Potential biochemical indicators of salinity tolerance in plants. *Plant Science*, 166, 3-16.

Ashraf, M. A., Rasheed, R., Hussain, I., Iqbal, M., Haider, M. Z., & Parveen, S. (2015). Hydrogen peroxide modulates antioxidant system and nutrient relation in maize (*Zea mays* L.) under water-deficit conditions. *Archives of Agronomy and Soil Science,* 61, 507–523.

Bates, M. L., Waldren, R. P., & Teare, J.D. (1973). Rapid determination of free proline for water stress studies. *Plant Soil,* 39, 205-207.

Bor, M., Özdemir, F., & Türkan, I. (2003). The effect of salt stress on lipid peroxidation and antioxidants in leaves of sugar beet *Beta vulgaris* L. and wild beet *Beta maritima* L. *Plant Science*,164, 77-84.

Cramer, G. R., Urano, K., Delrot, S., Pezzotti, M., & Shinozaki, K. (2011). Effects of abiotic stress on plants: a systems biology perspective. *BMC Plant Biology*, 11, 163, 1-14.

Creissen, G. P., & Mullineaux, P. M. (2002). The molecular biology of the ascorbate-glutathione cycle in higher plants. In: Inze´, D., Van Montagu, M. (Eds.), *Oxidative Stress in Plants* pp. (247-270), Taylor & Francis, UK.

Dat, J., Vandenabeele, S., Vranova, E., Van Montagu, M., Inze´, D., & Breusegem, F. (2000). Dual action of the active oxygen species during plant stress responses. *Cellular and Molecular Life Science*, 57, 779-795.

Diao, Q., Song, Y., Shi, D., & Qi, H. (2017). Interaction of Polyamines, Abscisic Acid, Nitric Oxide, and Hydrogen Peroxide under Chilling Stress in Tomato (*Lycopersicon esculentum* Mill.) Seedlings. *Frontiers in Plant Science*, 8, Article 203 1-16.

Dolatabadian, A., Sanavy, S. A. M. M., & Sharifi, M. (2009). Effect of salicylic acid and salt on wheat seed germination. *Acta Agriculturae Scandinavica Section B, Soil and Plant Science*, 59, 456-464.

Esim, N., & Atici, O. (2014). Nitric oxide improves chilling tolerance of maize by affecting apoplastic antioxidative enzymes in leaves. *Plant Growth Regulation*, 72, 29–38.

Esim, N., & Atici, O. (2015). Effects of exogenous nitric oxide and salicylic acid on chilling-induced oxidative stress in wheat (*Triticum aestivum*). *Frontiers in Life Science*, 8(2), 124-130.

Fancy, N. N., Bahlmann, A. K., & Loake, G. J. (2016). Nitric oxide function in plant abiotic stress. *Plant, Cell and Environment (Special Issue)*, 1-11.

Fayez, K. A., & Bazaid, S. A. (2014) Improving drought and salinity tolerance in barley by application of salicylic acid and potassium nitrate. *Journal of the Saudi Society of Agricultural Sciences,* 13, 45–55.

Gao, Y., Guo, Y., Lin, S., Fang, Y., & Bai, J. (2010). Hydrogen peroxide pretreatment alters the activity of antioxidant enzymes and protects chloroplast ultrastructure in heat-stressed cucumber leaves. *Scientia Horticulturae,* 126, 20-26.

Gondim, F. A., Gomes-Filho, E., Costa, J. H., Alencar, N. L. M., & Prisco, J. T. (2012). Catalase plays a key role in salt stress acclimation induced by hydrogen peroxide pretreatment in maize. *Plant Physiology and Biochemistry*, 56, 62-71.

Habibi, G. (2014). Hydrogen Peroxide ($H_2O_2$) Generation, Scavenging and Signaling in Plants, Chapter 19, P. Ahmad (Ed): *Oxidative Damage to Plants*. Elsevier Inc.

Khan, M. I. R., Asgher, M., & Khan, N. A., (2014). Alleviation of salt-induced photosynthesis and growth inhibition by salicylic acid involves glycinebetaine and ethylene in mungbean (Vigna radiata L.). *Plant Physiol Biochem*, 80, 67–74.

Khan, M. N., Siddiqui, M. H., Mohammad, F., & Naeem, M. (2012). Interactive role of nitric oxide and calcium chloride in enhancing tolerance to salt stress. *Nitric Oxide* 27, 210–218.

Kovacs, I., Durner, J., & Lindermayr, C. (2015). Crosstalk between nitric oxide and glutathione is required for nonexpressor of pathogenesis- related genes 1 (NPR1)-dependent defense signaling in *Arabidopsis thaliana*. *New Phytologist,* 208, 860–872.

Liu,W., Li, R. J., Han, T. T., Cai, W., Fu, Z. W., & Lu, Y. T. (2015). Salt stress reduces root meristem size by nitric oxide-mediated modulation of auxin accumulation and signaling in *Arabidopsis*. *Plant Physiology*, 168, 343–356.

Lutts, S., Kinet, J. M., & Bouharmont, J. (1996). Effects of salt stress on growth, mineral nutrition and proline accumulation in relation to osmotic adjustment in rice (*Oryza sativa* L.) cultivars differing in salinity tolerance. *Plant Growth Regulation*, 19, 207-218.

Manai, J., Kalai, T., Gouia, H., & Corpas, F. J. (2014). Exogenous nitric oxide (NO) ameliorates salinity-induced oxidative stress in tomato (*Solanum lycopersicum*) plants. *Journal of Soil Science and Plant Nutrition*, 14, 433–446.

Marschner, H. (1995). Mineral Nutrition of Higher Plants. Academic Press, London.

Mittler, R., Vanderauwera, S., Gollery, M., & Van Breusegem, F. (2004). Reactive oxygen gene network of plants. *Trends in Plant Science,* 9, 490-498.

Miura, K., & Tada, Y. (2014). Regulation of water, salinity, and cold stress responses by salicylic acid. *Frontiers Plant Science*, 5:4

Mohamed, H. E., Hemeida, A. E., & Mohamed, A. G. (2015). Role of hydrogen peroxide pretreatment on developing antioxidant capacity in the leaves of tomato plant (*Lycopersicon esculentum*) grown under saline stress. *International Journal of Advanced Research*., 3,878–879.

Molassiotis, A., & Fotopoulos,V. (2011). Oxidative and nitrosative signalingin plants: two branches in the same tree? *Plant Signaling & Behavior.* 6, 210–214.

Moreau, M., Lindermayr, C., Durner, J., & Klessig, D. F. (2010). NO synthesis and signaling in plants–where do we stand? *Physiologia Plantarum*, 138, 372–383.

Mostofa, M. G., Fujita, M., & Tran, L. S. P. (2015). Nitric oxide mediates hydrogen peroxide- and salicylic acid induced salt tolerance in rice (Oryza sativa L.) seedlings. *Plant Growth Regulation*, 77, 265–277

Niu, L., & Liao, W. (2016). Hydrogen Peroxide Signaling in Plant Development and Abiotic Responses: Crosstalk with Nitric Oxide and Calcium. *Frontiers in Plant Science*, 7, Article 230, 1-14.

Qadir, M.,Quillérou, E., Nangia, V., Singh, M., Murtaza, G., Thomas, R., Drechsel, P., & Noble, A. D. (2014). World losing 2,000 hectares of farm soil daily to salt damage: UN University, https://www.eurekalert.org/pub_releases/2014-10/tca-wl2102014.php

Qados, A. M. S. A. (2015). Effects of salicylic acid on growth, yield and chemical contents of pepper (*Capsicum annuum* L.) plants grown under salt stress conditions. *International Journal of Agriculture and Crop Sciences*, 8 (2), 107-113.

Qiao, W. H., Li, C. N., & Fan, L. M. (2014). Cross-talk between nitric oxide and hydrogen peroxide in plant responses to abiotic stresses. *Environmental and Experimental Botany*, 100, 84–93.

Saruhan, N., Saglam, A., & Kadioglu, A. (2012). Salicylic acid pretreatment induces drought tolerance and delays leaf rolling by inducing antioxidant systems in maize genotypes. *Acta Physiologiae Plantarum*, 34, 97–106.

Sathiyaraj, G., Srinivasan, S., Kim, Y. J., Lee, O. R., Parvin, S., & Balusamy, S. R. D. (2014). Acclimation of hydrogen peroxide enhances salt tolerance by activating defense-related proteins in *Panax ginseng* C. A. Meyer. *Molecular Biology Report*, 41, 3761–3771.

Senaratna, T., Touchell, D., Bunn, E., & Dixon, K. (2000). Acetyl salicylic acid (Aspirin) and salicylic acid induce multiple stres tolerance in bean and tomato plants. *Plant Growth Regulation*, 30, 157–161.

Sewelam, N., Kazan, K., & Schenk, P. M. (2016). Global Plant Stress Signaling: Reactive Oxygen Species at the Cross-Road**.** *Frontiers in Plant Science*, 7, Article 187, 1-21.

Shan, C., Yan, Z., & Liu, M. (2015). Nitric oxide participates in the regulation of the ascorbate-glutathione cycle by exogenous jasmonic acid in the leaves of wheat seedlings under drought stress. *Protoplasma* 252, 1397–1405.

Si, T., Wang, X., Wu, L., Zhao, C., Zhang, L., Huang, M., Cai, J., Zhou, Q., Dai, T., Zhu, J.K., & Jiang, D. (2017). Nitric Oxide and Hydrogen Peroxide Mediate Wounding-Induced Freezing Tolerance through Modifications in Photosystem and Antioxidant System in Wheat. *Frontiers in Plant Science*, 8, Article 1284, 1-17.

Siddiqui, M. H., Al-Whaibi, M. H., & Basalah, M. O. (2011). Role of nitric oxide in tolerance of plants to abiotic stress. *Protoplasma*, 248, 447–455.

Simaei, M., Khavarinejad, R. A., Saadatmand, S., Bernard, F., & Fahimi, H. (2011). Interactive effects of salicylic acid and nitric oxide on soybean plants under NaCl salinity. *Russian Journal of Plant Physiology*, 58, 783–790.

TUIK, (2016). Turkish Statistical Institute Statistical Data.

Velikova, V., Yordanov, I., & Edreva, A. (2000). Oxidative stress and some antioxidant system in acid rain treated bean plants: protective role of exogenous polyamines. *Plant Science*, 151, 59–66.

Wu, D., Chu, H. Y., Jia, L. X., Chen, K. M., & Zhao, L. Q. (2015). A feedback inhibition between nitric oxide and hydrogen peroxide in the heat shock pathway in arabidopsis seedlings. *Plant Growth Regulation*, 75,503–509.

Yaşar, F. (2003) Investigation of some antioxidant enzyme activities in eggplant genotypes grown under salt stress in vitro and in vivo. Ph.D. Thesis, Yuzuncu Yıl Univ. Fen Bil. Ens. (In Turkish) Van. 139 p.

Yu, Y., Yang, Z., Guo, K., Li, Z., Zhou, H., & Wei, Y. (2015). Oxidative damage induced by heat stress could be relieved by nitric oxide in *Trichoderma harzianum* LTR-2. *Currient Microbiology*, 70,618–622.

# O-47 EFFECT OF HUMAN FACTOR TO REALLOCATION PHASE OF LAND CONSOLIDATION

T. CAY[1] and E. ERTUNC[2]

[1,2]University Of Selcuk, Geomatics Engineering, Konya, Turkey.

**Abstract**

Land consolidation is one of the important devices provide productivity growth in agricultural production. Land consolidation not only gather divided lands, but also enhances agricultural, technical, social and cultural standards of landowners. Land consolidation projects consist of various phases. Land reallocation is the most important, complicated, time-consuming one of these phases. Land reallocation is a process which is time-consuming, high execution costly and causes a lot of disagreements between landowners. In block reallocation process of land consolidation studies; after road and irrigation network is passed, plots covered by road and irrigation networks (block) are placed locationally according to claimed amounts by considering soil graduation. Regular parcels are created grafically according to shape of the blocks after this placing and given to the landowners. Reallocation and creating new parcels should be made equally and fairly between employers. Otherwise there will be rejections, farmer satisfaction will not be provided and project will not be accepted. From this point of view it can be said that block reallocation is the most sensitive and care demanding process of land consolidation.

In this study, acquired results of block priority based reallocation method, which is applied by two different person, are compared. According to this comparison, effect of human factor to reallocation is studied.

Key Wordss: *Land Consolidation, Land Reallocation,* İnterview *Based Reallocation, Block Priority Reallocation*

## INTRODUCTION

Land, as one of the basic inputs of agriculture sector, is definitely an irreplaceable natural resource for humankind's maintaining his life, development of countries and providing welfare. Development of civilizations and life standards of people have been effected by land-human relation throughout history. In this two-way relationship, humankind has an important effect on the land too (Sönmez, 2012; Boztoprak an et al, 2015).

As it is not possible to increase agricultural lands in parallel with population growth, the solution is to find methods and techniques for increasing efficiency of existing limited agricultural lands. Although the necessity of using existed agricultural lands more efficiently is so clear, provisions in Inheritance Laws, shared and divided sales, construction of irrigation canals and roadworks cause small, divided, disordered agricultural lands and this situation causes loss of labour, capital and production and effects agricultural efficiency negatively.

Land consolidation can be defined as reconstruction and rearrangement of agricultural parcels in a planned way and considering ownership status of these parcels; land disruption can be decreased by presenting irrigation system and road network services by agricultural structures after the application ( Wang and Zhang, 2004; Yun et al., 2008; Pasakarnis and Maliene, 2010).

Land consolidation is one of the important devices which provides increase in agricultural production efficiency. Land consolidation does not only unite divided lands but also improve agricultural, technical, social and cultural standards of land owners. (Uyan, 2016; Cay and Uyan, 2013; Pasakarnis and Maliene, 2010). In this sense, land consolidation is not only limited with agricultural improvement but also contributes to development of natural resources and rural development (Li and et al, 2012). Land consolidation is most effective land management approach which solves the problem of sustaina-

ble rural development and agricultural development (Demetriou., 2010). Land consolidation is applied in 26 of 28 countries in European Union in different countries of the world such as China, India, Thailand, Moracco, Kenya, Australia.

In block reallocation stage of land consolidation studies; after road and irrigation network is built in project, remaining land pieces (block) around road and irrigation network, are spatially located according to claimed amounts considering soil graduation. After this locating regular parcels are created according to shape of he blocks and given to enterprise owners. Otherwise there will be objections for the project and farmer satisfaction will not be provided and project will not be accepted. From this point of view, it can be said that block reallocation is the most sensitive and care needed phase of land consolidation (İnceyol, 2014).

In this study, results of block priority based reallocation method, which are applied by two different person, are compared. According to this comparison, effect of human factor on reallocation is studied.

## MATERIAL AND METHOD

Key material of the study is Konya- Çumra-Üçhüyükler application area datas. Project is executed according to General Directorate of Agricultural Reform's (TRGM) 3083 numbered regulations of Agricultural Reform Law for Land Consolidation in Irrigation Areas. Block plans are prepared by TRGM. 17 blocks are created in block phase.

Konya City, Çumra District, Üçhüyükler Neighborhood, which is under continental climate effect, is chosen as research area (Figure 1).

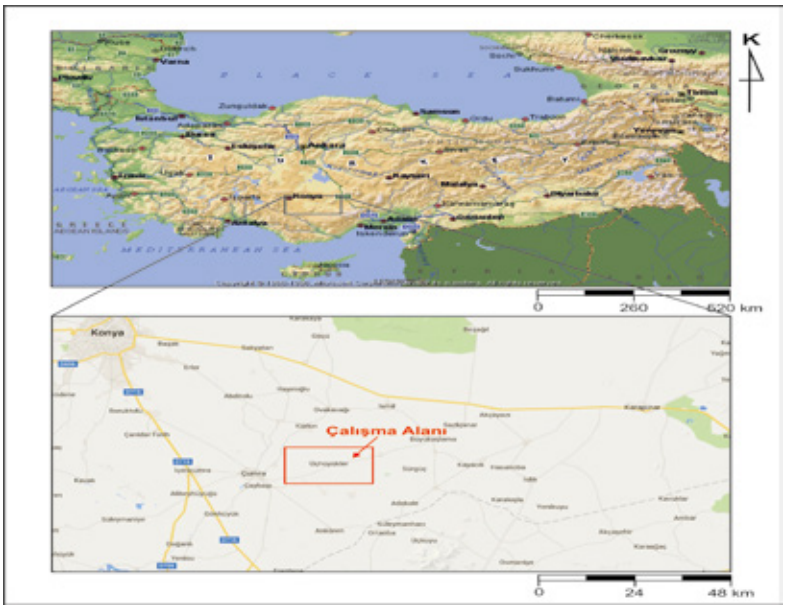



**Figure 1.** Study area Konya city Çumra district Üçhüyükler Neighborhood

Poject area of Üçhüyükler Neighborhood is 875,69 hectars, number of enterprises 275, cadastral parcel number is 265 (Figure 2) and 17 blocks. Total size of the cadastral parcels are 33 da.


**Figure 2.** Üçhüyükler Neighborhood cadastral situation

### Interview Based Reallocation Method

In planning process of Land Consolidation studies, farmers are asked for three choice in interview, for joining points or choosing block. This order of choice is considered while placing lands of the farmers to new blocks. This kind of block reallocation is called as "**interview based reallocation model**" .

### Block Priority Reallocation Model

Reallocation is executed according to the biggest owned parcel of enterprises in block priority reallocation model. In this method, the biggest parcels of enterprises and blocks of these parcels are determined. The land is given to enterprises from their biggest parcel's block during reallocation. If enterprise has a permanent facility, the land given to the enterprise is chosen from the block of this facility. Enterprises which can not fully fit to their biggest parcel according to occupancy rate of the block are placed to their biggest second or third parcel. Block reallocation continues until empty spots of blocks are zeroed. After that parcelation is made according to block reallocation result.

## RESULTS

### Parcel Numbers in Reallocation Models

Average size of new parcels after reallocation according to this model is 36948.96 $m^2$. Decreasing rate of new parcels after reallocation is 11% compared to old parcels. 224 new parcels are created according to 2nd block priority based reallocation results. Average parcel size is 39093.32 $m^2$. Decreasing rate of new parcels after reallocation is 15% according to old parcels. Parcel number is less in second block priority based reallocation result as seen in Table 1. There are also big differences in parcel sizes considering reallocation results of both block priority reallocation results. As it is understood from the table that there are differences between two different block reallocation results. The reason of this difference is approach of distributor people's approach on shared parcels. The person who makes 1st block priority based reallocation model, considers minimum agricultural land size as 0,5 hectar, which is cultivated agricultural lands, according to 5403 numbered Soil Conservation and Land Usage Law; separates shares in lands bigger than 0,5 hectars. In 2nd block priority based reallocation model, 0,3 hectar parcelling condition of greenhouse cultivation is considered and bigger shares than this size are separated.

Table 1. Parcel Numbers of Reallocation Models

| Parcel Size (da) | Cadastral State | Interview Based Model | Block Priority Based Model-1 | Block Priority Based Model-2 |
|---|---|---|---|---|
| | Number of Parcel | Number of Parcel | Number of Parcel | Number of Parcel |
| 0-5 | 32 | 25 | 15 | 11 |
| 5-10 | 37 | 20 | 19 | 30 |
| 10-20 | 42 | 48 | 55 | 49 |
| 20-30 | 38 | 43 | 36 | 33 |
| 30-40 | 44 | 28 | 28 | 25 |
| 40-50 | 20 | 22 | 28 | 20 |
| 50-60 | 16 | 23 | 18 | 16 |
| 60-80 | 16 | 14 | 14 | 11 |
| 80-100 | 9 | 8 | 12 | 15 |
| 100-120 | 6 | 7 | 7 | 7 |
| 120-150 | 2 | 5 | 4 | 4 |
| 150+ | 3 | 0 | 1 | 3 |
| **Total** | **265** | **243** | **237** | **224** |
| **Consolidation Ratio(%)** | | **8** | **11** | **15** |

**Average parcel size of reallocation models**

As seen in Table 1, average parcel size has increased 12% according to 1st block based reallocation model result and 18% according to 2nd block priority reallocation model result. The reason of this difference is parcel numbers.

Table 2. Average Parcel Size of Reallocation Models

| The Average Size of Parcel | Area ($m^2$) | Increase Percentage (%) |
|---|---|---|
| Cadastral State | **33044.92** | - |
| Interview Based Model | **36063.64** | **%9** |
| Block Priority Based Model-1 | **36948.96** | **%12** |
| Block Priority Based Model-2 | **39093.32** | **%18** |

**Number of Shared Parcels in Reallocation Model**

Although there are decrease in both reallocation, 1st block based reallocation model is more successful in this subject. As it is understood from here, mood, experience, ability and such factors of person who executes reallocation effects the reallocation.

**Parcel numbers of enterprises in reallocation models**

Parcel numbers of the enterprises in Üçhüyük applicatin area are shown in Table 4. According to table, number of enterprises, which has one parcel before the application, is 202 (%73.5). This number is 256 ( %93.09) after consolidation according to 1st block priority based model, and 252(%91.64) according to 2nd block priority based model. Accordingly, 1st block based model is more successful with regards to parcel per enterprise.

Table 3. Number of Shared Parcels in Reallocation Models

| The Number of Share in Parcel | | | | |
|---|---|---|---|---|
| | Cadastral State | Interview Based Model | Block Priority Based Model-1 | Block Priority Based Model-2 |
| 1 | 201 | 220 | 208 | 190 |
| 2 | 34 | 8 | 15 | 15 |
| 3 | 14 | 4 | 6 | 6 |
| 4 | 6 | 6 | 4 | 7 |
| 5 | 2 | 1 | 1 | 3 |
| 6 | 3 | - | 1 | 2 |
| 7 | 1 | 2 | - | - |
| 8 | 1 | - | 1 | 1 |
| 9 | - | - | 1 | - |
| 10 | 1 | 1 | - | - |
| 11 | 1 | - | - | - |
| 13 | 1 | 1 | - | - |
| The number of jointly owned parcel | 64 | 23 | 29 | 34 |
| Total | 265 | 243 | 237 | 224 |

Table 4.Number of Parcel for Enterprises in Reallocation Models

| The Number of Parcel | Cadastral | | Interview Based Model | | Block Priority Based Model-1 | | Block Priority Based Model-2 | |
|---|---|---|---|---|---|---|---|---|
| | The Number of Enterprises | % | The Number of Enterprises | % | The Number of Enterprises | % | The Number of Enterprises | % |
| 1 | 202 | 73.5 | 249 | 90.6 | 256 | 93.09 | 252 | 91.64 |
| 2 | 40 | 14.6 | 19 | 6.9 | 17 | 6.18 | 18 | 6.54 |
| 3 | 17 | 6.2 | 6 | 2.2 | 2 | 0.73 | 5 | 1.82 |
| 4 | 8 | 2.9 | 1 | 0.3 | - | - | - | - |
| 5 | 5 | 1.8 | - | - | - | - | - | - |
| 6 | 2 | 0.7 | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | - | - | - | - |
| 9 | 1 | 0.3 | - | - | | | | |
| TOTAL | 275 | 100 | 275 | 100 | 275 | 100 | 275 | 100 |

**Aspect Ratio of Enterprise Parcels**

It will be proper to choose between values 1/4 - 1/5, considering aspect ratio‘s cultural technical services related factors in consolidation projects (Çevik and Tekinel, 1989). This rate can be between 1/2 - 1/7 in compulsory situations considering size of the land ( Banger and Şişman, 2001, Çay, 2013).

Aspect ratio rates of parcels in Üçhüyük application area are given in Table 5. According to Table 6, while aspect ratio rate of parcels between /4 - 1/5 gap was 3% before land consolidation, it has been 12,1% in interview based reallocation model, 13,2% in 1st block based model and 9% in 2nd block based model. While parcel aspect ratio rate between 1/2 - 1/7 gaps were 39%, after land consolidation it has been 61,2% in 1st block based model, 41% in 2nd block based model. It is seen that there is a 20% difference in both model after block based reallocation.

Table 5. Aspect Ratio Rates of Üçhüyük Enterprise Parcels

| THE WİDTH / LENGTH RATIOS OF THE ENTERPRİSE PARCELS BELONGING TO ÜÇHÜYÜKLER REGION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Width / Length Group | CADASTRAL | | | | INTERVIEW-BASED REALLOCATION MODEL | | | |
| | Width / Length Ratio | Width / Length Fraction | The Number of Parcels | % | Width / Length Ratio | Width / Length Fraction | The Number of Parcels | % |
| 0-0.05 | 0.045 | 0 | 1 | 1 | 0.045 | 0 | 1 | 1 |
| 0.05-0.07 | 0.064 | 0 | 7 | 3 | 0.065 | 0 | 7 | 3 |
| 0.07-0.10 | 0.089 | 0 | 17 | 6 | 0.085 | 0 | 10 | 4 |
| 0.10-0.12 | 0.111 | 1/9 | 16 | 6 | 0.109 | 1/9 | 7 | 3 |
| 0.12-0.14 | 0.127 | 1/8 | 9 | 3 | 0.130 | 1/8 | 6 | 2 |
| 0.14-0.16 | 0.150 | 1/7 | 6 | 2 | 0.150 | 1/7 | 16 | 6 |
| 0.16-0.18 | 0.175 | 1/6 | 6 | 2 | 0.171 | 1/6 | 12 | 5 |
| 0.18-0.20 | 0.191 | 1/5 | 8 | 3 | 0.188 | 1/5 | 2 | 1 |
| 0.20-0.25 | 0.226 | 2/9 | 7 | 3 | 0.226 | 2/9 | 30 | 12 |
| 0.25-0.30 | 0.274 | 2/7 | 12 | 4 | 0.272 | 2/7 | 28 | 11 |
| 0.30-0.35 | 0.325 | 1/3 | 21 | 8 | 0.322 | 1/3 | 15 | 6 |
| 0.35-0.40 | 0.374 | 3/8 | 13 | 5 | 0.373 | 3/8 | 18 | 7 |
| 0.40-0.45 | 0.429 | 3/7 | 14 | 5 | 0.425 | 3/7 | 14 | 6 |
| 0.45-0.50 | 0.472 | 1/2 | 18 | 7 | 0.478 | 1/2 | 17 | 7 |
| 0.50-0.60 | 0.543 | 5/9 | 28 | 11 | 0.554 | 5/9 | 21 | 9 |
| 0.60-0.70 | 0.654 | 2/3 | 35 | 13 | 0.665 | 2/3 | 14 | 6 |
| 0.70-0.80 | 0.725 | 3/4 | 20 | 8 | 0.743 | 3/4 | 14 | 6 |
| 0.80-0.90 | 0.850 | 6/7 | 16 | 6 | 0.843 | 6/7 | 10 | 4 |
| 0.90-1.00 | 0.944 | 1 | 11 | 4 | 0.955 | 1 | 1 | 1 |
| TOTAL | | | 265 | 100 | | | 243 | 100 |

| **Width / Length Group** | Block Priority Based Model-1 | | | | Block Priority Based Model-2 | | | |
|---|---|---|---|---|---|---|---|---|
| | **Width / Length Ratio** | **Width / Length Fraction** | **The Number of Parcels** | % | **Width / Length Ratio** | **Width / Length Fraction** | **The Number of Parcels** | % |
| 0-0.05 | 0.045 | 0 | - | - | 0.045 | 0 | 6 | 3 |
| 0.05-0.07 | 0.064 | 0 | - | - | 0.064 | 0 | 13 | 6 |
| 0.07-0.10 | 0.089 | 0 | - | - | 0.089 | 0 | 31 | 14 |
| 0.10-0.12 | 0.111 | 1/9 | 2 | 1 | 0.111 | 1/9 | 24 | 11 |
| 0.12-0.14 | 0.127 | 1/8 | 7 | 3 | 0.127 | 1/8 | 13 | 6 |
| 0.14-0.16 | 0.150 | 1/7 | 3 | 1 | 0.150 | 1/7 | 12 | 5 |
| 0.16-0.18 | 0.175 | 1/6 | 2 | 1 | 0.175 | 1/6 | 10 | 4 |
| 0.18-0.20 | 0.191 | 1/5 | 5 | 2 | 0.191 | 1/5 | 5 | 2 |
| 0.20-0.25 | 0.226 | 2/9 | 30 | 13 | 0.226 | 2/9 | 20 | 9 |
| 0.25-0.30 | 0.274 | 2/7 | 32 | 14 | 0.274 | 2/7 | 20 | 9 |
| 0.30-0.35 | 0.325 | 1/3 | 15 | 6 | 0.325 | 1/3 | 7 | 3 |
| 0.35-0.40 | 0.374 | 3/8 | 24 | 10 | 0.374 | 3/8 | 10 | 4 |
| 0.40-0.45 | 0.429 | 3/7 | 21 | 9 | 0.429 | 3/7 | 9 | 4 |
| 0.45-0.50 | 0.472 | 1/2 | 13 | 5 | 0.472 | 1/2 | 3 | 1 |
| 0.50-0.60 | 0.543 | 5/9 | 26 | 11 | 0.543 | 5/9 | 16 | 7 |
| 0.60-0.70 | 0.654 | 2/3 | 17 | 7 | 0.654 | 2/3 | 8 | 4 |
| 0.70-0.80 | 0.725 | 3/4 | 21 | 9 | 0.725 | 3/4 | 4 | 2 |
| 0.80-0.90 | 0.850 | 6/7 | 11 | 5 | 0.850 | 6/7 | 9 | 4 |
| 0.90-1.00 | 0.944 | 1 | 8 | 3 | 0.944 | 1 | 4 | 2 |
| TOTAL | | | 237 | 100 | | | 224 | 100 |

## Discussion

Decreasing rate of new parcels, which are created after 1st block based reallocation model, is 11% compared to old cadastral parcels. This rate is 15% in 2nd block based reallocation model. When we check average parcel size, while it was 3.30 hectars in cadastral situation, it has risen to 3,60 hectars in 1st block based reallocation and 3,90 hectars in 2nd block based reallocation model. While there was 64 shared parcels before land consolidation, this number has become 29,2 according to 1st block based reallocation and 34 according to 2nd block based reallocation. There has been a 5% difference in distance to village center as a result of both block based reallocation models. There is a 20% difference in aspect ratio of parcels after both reallocation models.

Block reallocation step of land consolidation studies is a process which effects the success of land consolidation directly. As it is seen from acquired results; factors such as mood, experience, ability of project operator effect reallocation. Reallocation process of land consolidation is a multi criteria problem in which humans also play an important role. So using computer supported systems in reallocation process of land consolidation will increase efficiency and also contribute in shortening time consumption.

## Acknowledgements

This paper has been prepared by benefiting from the inventions of the project whose number is 114Y608 which supported by TÜBİTAK.

In addition, This paper is supported by Selcuk University Coordinating Office Of Scientific Research, Project Nr. 17701170, "Effect Of Human Factor To Reallocation Phase Of Land Consolidation" for presentation at the The Eurasian Agriculture and Naturel Sciences Congress.

## Literature cited

Banger, G. and Şişman, A., (2001), Applying Operations Research Techniques in Rural Area Land Consolidations , The Magazine of Map and Cadastral Engineering , Ankara, 87, (82-98).

Boztoprak, T., Demir, O., Çoruhlu, Y.E., Nişancı, R., (2015), Selcuk Univ. J. Eng. Sci. Tech.v:3, n:3,2015.ISSN: 2147-9364 ( Elektronic)

Çay, T.,(2013), Land Management and Regulations, Dizgi Ofset, Konya, 342 pages

Cay, T., Uyan.,M., (2013). Evaluation of reallocation criteria in land consolidation studies using the Analytic Hierarchy Process ( AHP). Land Use Policy 30, 541-548.

İnceyol, Y., (2014), Genetical Algorithm Application in Land Arrangement Studies,Master's Thesis , Selçuk University Institute of Science and Technology, Konya.

İşcan, F., (2009), Fuzzy Logic Application in Land Arrangement Studies, Master's Thesis, Selçuk University, Institute of Science and Technology, Konya.

Li, I., Chen, Y., Gao, H. and Li, D., (2012), A Hybrid Registration Approach of Remote Sensing Images for Land Consolidation, Intelligent Automation and Soft Computing, Vol.18, No.8, 1121-1132.

Pasakarnis, G. and Maliene, V., (2010), Towards Sustainable Rural Development in Central and Eastern Europe: Applying Land Consolidation, Land Use Policy, 27, 545-549.

Sönmez, B.," Tenth Development Plan- Study Group Report on Sustainable Usage of Agricultural Lands , Ankara, 2012.

Uyan, M.,(2016) Determination of Agricultural soil index using geostatistical analysis and GIS on land consolidation projects: A case study in Konya/ Turkey, Computers and Electronics in Agriculture, 123 ( 2016) , 402-409.

Wang,W., Zhang, Y., (2004), Land consolidation and sustainable development. China Population, Resources and Enviroment, 14 (1): 13- 18.

# O-53 PHYSICAL AND CHEMICAL MODELING OF TOXIC ELECTRICAL INSULATING LIQUIDS DECOMPOSITION AND REDUCTION OF CHLORINE-CONTAINING SUBSTANCES CONCENTRATION IN THE GAS-PHASE

Zarlık MAYMEKOV[1], Damira SAMBAYEVA[2], Janarbek İZAKOV[1], Mirlan MOLDOBAYEV[1], Kubat KEMELOV[1]

[1] Kyrgyz Turkish Manas University, Faculty of Engineering, Environmental Engineering Department, Bishkek, Kyrgyzstan

[2]Institute of Mining and Mining Technologies named after academician U. Asanaliev, Bishkek, Kyrgyzstan

e-mail: z.maymekov@gmail.com; z.maymekov@mail.ru

**Abstract**

The paper noted the practical basics of using insulating liquids containing chlorinated toxic substances in industrial environments; respectively considered chlorinated biphenyls, and their technogenic load chlorine, as well as processes of their conversion to a medium of calcium oxide, oxygen and water; carried out physico-chemical modeling of the thermal degradation of monochlorinated biphenyls, in a wide range of changes in temperature in the environment of water and solids; set distribution spectra equilibrium compositions and concentrations of particles and chlorine component in the gas phase depending on the temperature; identified changes in the properties of the system on the basis of its calculation of the thermodynamic characteristics; the chemical bases particle recycling chlorinated and components based on calcium oxide.

**Keywords**: monochlorobiphenyl, physico-chemical modeling, decomposition, minimization.

## INTRODUCTION

Electrotechnical industry in some countries accumulated big amount of polychlorinated biphenyl contained and other chlorinated toxic wastes. Accordingly to these, various methods of utilization are used in detoxification processes, these methods based on removal of one halogen atom in molecules of persistent organic pollutants [1-10]. The most suitable method for destruction processes of organochlorine compounds is hydrothermal detoxification, but solubility of these substances in water is too low at ordinary temperatures, and ineffective without organic solvents. However, in subcritical conditions, the solubility of organic substances in water and consequently the availability of water for chemical reaction increases as well as reaction rate with increasing temperature. It gives effective hydrolytic decomposition of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF). Non-volatile metal oxides can be used in order to forming thermally stable low molecular chlorides in dechlorination processes. In this case, the most acceptable is calcium oxide, which is an available reagent. Taking into account the above circumstances, processes of conversion of chlorine-containing toxic organic substances ($C_{12}H_9Cl$) were investigated in calcium-water-oxygen oxide medium: at different temperatures and solid phase ratios.

## MATERIALS AND METHODS.

Using electrical insulating liquids containing toxic chlorine-containing substances (PCDD and PCDF) currently is unsolved environmanetal problem. Because practical aspects of research are expensive and dangerous, also chemical analysis of their possible decomposition products requires high-tech modern laboratories [8]. According to this, physico-chemical modeling method of thermal destruction of organochlorine substances were used by using data of their thermochemical properties. For experiment $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ system was considered. Here monochlorobiphenyl is toxic electrical insulating liquid. Calculation thermodinamical parameters of the system were made by models which can predict formation of gaseous substances. The equilibrium data of components in system where determined by finding the extremum of entropy [11, 12]. Database of thermodynamic properties of substances includes information on $C_{12}H_9Cl$, CaO, $H_2O$, $O_2$. System has following chemical composition (mol·kg$^{-1}$): C = 15.902; H = 39.681; Cl = 1.325; Ca = 4.458; O = 33.961. Concentration of gas phased components where determined by multifunctional gas analyzer Visit 01-L / LR.

## RESULTS AND DISCUSSIONS.

The processes of monochlorobiphenyl's conversion in calcium oxide, water and oxygen medium at different ratios of solid phase were studied (Tables 1-3). During the conversion of $C_{12}H_9Cl$ in CaO-$H_2O$-$O_2$ medium at 1:1:1:1 ratio of the starting materials (composition, mol·kg$^{-1}$: C = 15.902; H = 39.681; Cl = 1.325; Ca = 4.458; O = 33.961); temperature ranges from 298 to 998 K; pressure of 0.1 MPa. During calculation following components were formed in gas phase (equi-

librium concentrations, mol·kg$^{-1}$): **$H_2$**–0.17·10$^{-3}$ (298 K), 0.87 (598 K), 13.6 (998 K); **$H_2O$**–17.9 (298 K), 11.9 (598 K), 5.93 (998 K); **HCl**–0.13·10$^{-3}$ (298 K), 0.9·10$^{-2}$ (598 K), 0.3·10$^{-1}$ (998 K); **$C_{(C)}$**–8.79 (298 K), 3.28 (598 K); **$CH_4$**–0.97 (298 K), 3.5 (598 K), 0.12 (998 K); **CO**–0.26·10$^{-9}$ (298 K), 1.3·10$^{-2}$ (598 K), 7.33 (998 K); **$C_2H_6$**–0.45·10$^{-8}$ (298 K), 0.8·10$^{-5}$ (598 K), 0.27·10$^{-6}$ (998 K); **$CO_2$**–2.34 (298 K), 5.29 (598 K), 4.62 (998 K); **Cl**–0.1·10$^{-9}$ (998 K); **$CH_3Cl$**–0.63·10$^{-9}$ (598 K), 0.66·10$^{-8}$ (998 K); **$C_2H_4$**–0.74·10$^{-9}$ (598 K), 0.16·10$^{-6}$ (998 K); **$C_3H_8$**–0.13·10$^{-9}$ (598 K), 0.11·10$^{-11}$ (998 K); **$CH_2O$**–0.44·10$^{-9}$ (598 K), 0.17·10$^{-5}$ (998 K); **$CH_2O_2$**–0.77·10$^{-7}$ (598 K), 0.16·10$^{-5}$ (998 K); **$C_2H_4O_2$**–0.46·10$^{-9}$ (598 K), 0.2·10$^{-9}$ (998 K); **H**–0.44·10$^{-7}$ (998 K); **OH**–0.47·10$^{-10}$ (998 K); **$CH_3$**–0.75·10$^{-8}$ (998 K);**$C_2H_2$**–0.77·10$^{-9}$ (998 K); **$C_2H_5$**–0.14·10$^{-11}$(998K); **CHO**–0.33·10$^{-9}$ (998 K); **$CHO_2$**–0.29·10$^{-10}$ (998 K); **HClCO**–0.15·10$^{-10}$ (998 K); **$CaO_2H_2$**–0.42·10$^{-10}$ (998 K); **$CaCl_2$**–0.13·10$^{-5}$ (998 K); **CaOHCl**–0.36·10$^{-7}$ (998 K); **$CaCl_{2(C)}$**–0.66 (298 K); 0.65(598 K), 0.64 (998 K);**$CaCO_{3(C)}$**–3.79 (298 K); 3.8 (598 K), 3.81 (998 K) (table 1). According to this the concentration distribution of components and particles has a wide spectrum in the gas phase: H, $H_2$, OH, $H_2O$,$C_{(C)}$, CO, $CO_2$, $CH_2O$, $CH_2O_2$, $C_2H_4O_2$, CHO, $CHO_2$; $CH_4$, $C_2H_6$, $C_2H_4$, $C_3H_8$, $CH_3$, $C_2H_2$, $C_2H_5$; Cl, HCl, $CH_3Cl$, HClCO, CaOHCl, $CaCl_2$, $CaCl_{2(C)}$, $CaO_2H_2$, $CaCO_{3(C)}$, In tables 1-3 carbon, hydrogen, oxygen containing particles, oxy compounds, low - molecular hydrocarbons and their radicals, chlorine-containing particles and condensed components such as $CaCl_2$ (C) and $CaCO_3$ (C) were presented. Obtained data show that raising of temperature (298 to 998 K) increase concentrations (mol·kg$^{-1}$) of $H_2O$, HCl, $CO_2$, $CO_2$, $CH_3Cl$, $C_2H_4$, $C_2H_6$, $CH_2O$, $CH_2O_2$; and decrease concentrations (mol·kg$^{-1}$) of $H_2O$, C (C), $CH_4$, $C_3H_8$, $C_2H_4O_2$; and formed condensed phases (mol·kg$^{-1}$) of $CaCl_{2(C)}$, $CaCO_{3(C)}$. Concentrations of chlorine-containing components vary within (mol·kg$^{-1}$): HCl–0.13·10$^{-3}$ (298 K); Cl–0.1·10$^{-9}$ (998 K); $CH_3Cl$–0.63·10$^{-9}$ (598 K); 0.66·10$^{-8}$ (998 K); HClCO–0.15·10$^{-10}$ (998 K); $CaCl_2$–0.13·10$^{-5}$ (998 K); CaOHCl–0.36·10$^{-7}$ (998 K); $CaCl_{2(C)}$–0.66 (298-998 K), Chlorine-containing low-molecular particles were formed in conversion process (at higher temperatures, chlorine is redistributed). In this way $C_{12}H_9Cl$ decompose into low-molecular hydrocarbons during conversion. Chlorine reacts with calcium oxide, hydrogen and hydroxide and forms following compounds: HCl, $CH_3Cl$, HClCO, CaOHCl, $CaCl_2$, and condensed compounds: $CaCl_2$ (C), $CaCO_3$ (C). Condensed carbon C (C) is formed at temperatures of 298 K (8.79 mol·kg$^{-1}$), 598 K (3.28 mol·kg$^{-1}$), and at 998 K it is not detected. Water dissociates ($H_2O$-17.89 mol·kg$^{-1}$, 298 K, 11.96 mol·kg$^{-1}$, 598 K, 5.93 mol·kg$^{-1}$, 998 K), forming atomic hydrogen and hydroxide. The final product of conversion is carbon oxides: CO, $CO_2$, their concentrations increase (CO=0.01-7.34 mol·kg$^{-1}$, within 298-998 K).

The entropy of $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ system increases with increasing temperature, from 4.62 kJ·mol$^{-1}$ at 298 K to 7.97 kJ·mol$^{-1}$ at 998 K; The total enthalpy has a similar values: -10427 J·mol$^{-1}$ at 298 K; -9959 J·mol$^{-1}$ at 598 K and -8109 J·mol$^{-1}$ at 998 K. The internal energy changes in following values (J·mol$^{-1}$): U = -10427 (298 K); U = -10013 (598 K); U = -8294 (998 K); Heat capacity at constant pressure: Cp = 1.16 (298K); Cp = 1.42 (598K); Cp = 1.69 (998K). Thermal conductivity: Lt = 0.025 (298 K), Lt = 0.063 (598 K), Lt = 0.17 (998 K). Prandtl number (Pr) of gas phase: 0.68; 0.64; 0.46 within the temperature range of the system: 298-998 K.

Equilibrium parameters of $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (1:1:1:1) system: composition, (mol·kg$^{-1}$): C-15.902; H-39.681; Cl-1.325; Ca-4.458; O-33.961; at P=0.1 MPa, **T=998 K**; v=2.62995; S=7.97058; I=-8109.64; U=-8294.07; M=36.1528; Cp=1.6928; k=1.18438; Cp'=2.74211; k'=1.15369; Ap=0.0012127; Bv=0.0011953; Gt=0.0000106; MMg=17.2513; Rg=481.956; Cpg=2.12849; kg=1.29271; Cp'g=4.04505; k'g=1.20779; Mu=0.0000374; Lt=0.170886; Lt'=0.291351; Pr=0.465929; Pr'=0.519352; A=546.863; z=0.453223; Equilibrium concentrations of main components in gas phase (mol·kg$^{-1}$): $H_2$=13.636; $H_2O$=5.9352; HCl=0.03504; CO=7.3392; $CO_2$=4.6238; $CH_4$=0.12607; $CaCl_2$(c)=0.64506; $CaCO_3$(c)=3.8129 (table 1).

With an increase of concentration of solid phase in system: $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (**1:3:1:1**), P=0.1 MPa, composition, mol·kg$^{-1}$: C-10.601; H-26.454; Cl-0.883; Ca-8.916; O-28.584; Equilibrium parameters at **P=0.1 MPa, T=998 K**; v=1.43488; S=5.21262; I=-9666.81; U=-9767.43; M=26.2084; Cp=1.52198; k=1.10432; Cp'=16.02; k'=1.30249; Ap=0.005773; Bv=0.0046916; Gt=0.0000128; MMg=11.8707; Rg=700.411; Cpg=2.89965; kg=1.31848; Cp'g=8.26273; k'g=1.22735; Mu=0.0000353; Lt=0.227726; Lt'=2.5575; Pr=0.449357; Pr'=0.114016; A=389.721; z=0.794727; Equilibrium concentrations (mol·kg$^{-1}$): H=0.2884e-7; $H_2$=10.374; OH=0.1486e-10; $H_2O$=2.4586; Cl=0.2827e-10; HCl=0.01093; CO=3.1678; $CO_2$=1,0866; $CH_3$=0,9914e-8; $CH_4$=0,19435; $C_2H_2$=0,1250e-8; $C_2H_4$=0,3756e-6; $C_2H_5$=0,3726e-11; $C_2H_6$=0.6351e-6; $C_3H_8$=0.7396e-11; CHO=0.1683e-9; $CHO_2$=0.8112e-11; $CH_2O$=0.1079e-5; $CH_2O_2$=0.5504e-6; $C_2H_4O_2$=0.1329e-9; $CH_3Cl$=0.4213e-8; HClCO=0.3772e-11; CaO(c)=2.3271; $CaO_2H_2$=0.4041e-10; $CaCl_2$(c)=0.43625; $CaCl_2$=0.7197e-6; CaOHCl=0.2666e-7; $CaCO_3$(c)=6.1526 (table 2).

With initial composition of the system: $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (**1:5:1:1**), P=0.1 MPa, composition, mol·kg$^{-1}$: C-7.951; H-19.840; Cl-0.663; Ca-11.145; O-25.896; T=298-998 K; P=0.1 MPa; Equilibrium parameters at **P=0.1 MPa, T=998 K**; v=1.07616; S=4.34483; I=-9924.42; U=-9999.88; M=24.1142; Cp=1.37933; k=1.08481; Cp'=12.2528; k'=1.29488; Ap=0.005773; Bv=0.0046916; Gt=0.0000128; MMg=11.8707; Rg=700.411; Cpg=2.89965; kg=1.31848; Cp'g=8.26273; k'g=1.22735; Mu=0.0000353; Lt=0.227726; Lt'=3.33409; Pr=0.449357; Pr'=0.0874588; A=336.521; z=0.846045; Equilibrium concentrations (mol·kg$^{-1}$): H=0.2163e-7; $H_2$=7.7806; OH=0.1115e-10; $H_2O$=1.844; Cl=0.2120e-10; HCl=0.0082; CO=2.3758; $CO_2$=0.81496; $CH_3$=0.7436e-8; $CH_4$=0.14576; $C_2H_2$=0.9379e-9; $C_2H_4$=0.2817e-6; $C_2H_5$=0.2795e-11 (fig 2 and table 3). $C_2H_6$=0.4764e-6; $C_3H_8$=0.5547e-11; CHO=0.1262e-9; $CHO_2$=0.6084e-11; $CH_2O$=0.8096e-6; $CH_2O_2$=0.4128e-6; $C_2H_4O_2$=0.9965e-10; $CH_3Cl$=0.3160e-8; HClCO=0.2829e-11; CaO(c)=6.2033; $CaO_2H_2$=0.3030e-10; $CaCl_2$(c)=0.32719; $CaCl_2$=0.5398e-6; CaOHCl=0.1999e-7; $CaCO_3$(c)=4.6144 (table 3).

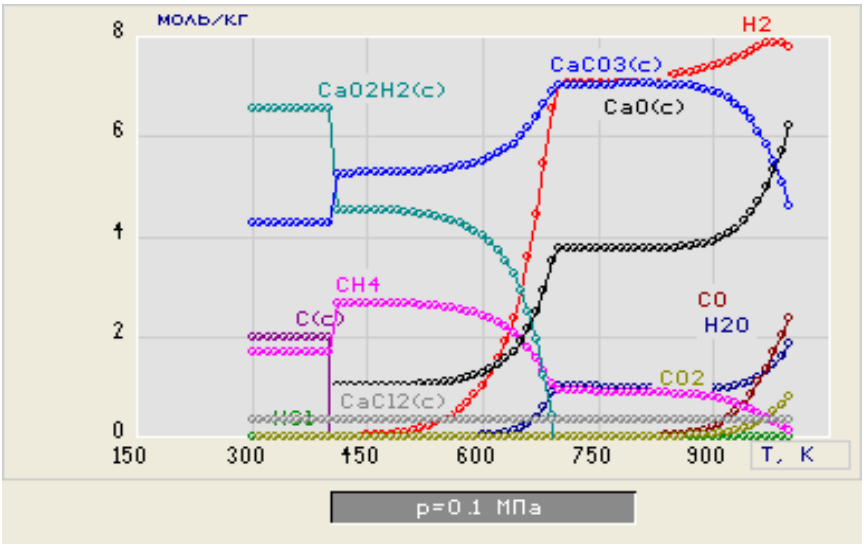



Fig.2. Distribution of the main components in the system (mol·kg$^{-1}$): $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (**1:5:1:1**), at P=0.1 MPa, T=298-998 K

Results showed that in the range of 300-450 K monochlorobiphenyl were oxidized in the gas-liquid medium ($H_2O$-$O_2$) and products of reactions (not aromatic chlorinated hydrocarbons, table 1-3, fig. 2) reacted with calcium oxide. As the result $CaO_2H_2$ (c), $CaCl_2$ (c), $CaCO_3$ (c), $CO_2$ and graphite C (c) were formed. Besides HCl, $CH_4$ and $H_2$ formed too. Concentration of condensed calcium hydroxide $CaO_2H_2$ (c) within 300-400 K is constant (about 6-6.5 mol·kg$^{-1}$), then at 450K it decreases to 4.2 mol·kg$^{-1}$; at 450-600 K is 4 mol·kg$^{-1}$, and at 600-700 K sharply decreases. At 650 K isolines of $CaO_2H_2$ (c) and $CaCO_3$ (c) intersect, which indicates sharp increase concentration of condensed calcium oxide $CaO_{(c)}$ (mol·kg$^{-1}$): 1e-30 (298-498K); 0.99 (698 K); 4.68 (898K); 5.63 (998 K).

**Table 1. Distribution of chlorine-containing components in system (mol·kg$^{-1}$): $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (1:1:1:1) at P=0.1 MPa, T=298-998** K

| **T** | **$H_2$** | **$H_2O$** | **Cl** | **HCl** | **C(c)** | **CO** | **$CO_2$** |
|---|---|---|---|---|---|---|---|
| **298** | 0.000169 | 17.8902 | 1.93e-22 | 0.000133 | 8.7894 | 2.12e-10 | 2.3421 |
| **498** | 0.156021 | 13.5237 | 4.03e-22 | 0.004157 | 4.50272 | 0.000366 | 4.52212 |
| **598** | 0.871797 | 11.9557 | 2.41e-18 | 0.009652 | 3.28888 | 0.013278 | 5.29555 |
| **998** | 13.6355 | 5.93523 | 1.07e-10 | 0.03504 | 1e-30 | 7.33917 | 4.6238 |
| **T** | **$CH_4$** | **$CH_3Cl$** | **$C_2H_5Cl$** | **HClCO** | **$CaCl_2$(c)** | **$CaCO_3$(c)** | |
| **298** | 0.975005 | 3.56e-16 | 6.63e-21 | 1.93e-22 | 0.662518 | 3.79545 | |
| **498** | 3.07928 | 4.02e-11 | 4.18e-15 | 1.53e-18 | 0.660503 | 3.79746 | |
| **598** | 3.50402 | 6.36e-10 | 9.54e-14 | 5.65e-16 | 0.657756 | 3.80021 | |
| **998** | 0.12607 | 6.66e-09 | 1.5e-13 | 1.53e-11 | 0.64506 | 3.8129 | |

**Table 2. Distribution of chlorine-containing components in system (mol·kg$^{-1}$): $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (1:3:1:1) at P=0.1 MPa, T=298-998** K

| **T** | **$H_2$** | **$H_2O$** | **Cl** | **HCl** | **CO** | **$CO_2$** | **$CH_4$** |
|---|---|---|---|---|---|---|---|
| **298** | 0.039962 | 4.60455 | 1.93e-22 | 2.31e-10 | 2.27e-18 | 2.73e-11 | 3.56984 |
| **498** | 2.21167 | 4.06162 | 1.93e-22 | 1.47e-06 | 7.24e-09 | 1.9e-06 | 3.02691 |
| **698** | 5.83563 | 3.14983 | 1e-17 | 0.000284 | 0.001015 | 0.005267 | 2.12066 |
| **898** | 8.97626 | 1.89517 | 4.94e-13 | 0.003839 | 0.635864 | 0.312508 | 1.17678 |
| **998** | 10.3742 | 2.45861 | 2.83e-11 | 0.010933 | 3.16776 | 1.08661 | 0.194346 |
| **T** | **$CH_3Cl$** | **$C_2H_5Cl$** | **HClCO** | **CaO(c)** | **$CaO_2H_2$(c)** | **$CaCl_2$(c)** | **$CaCO_3$(c)** |
| **298** | 1.93e-22 | 1.93e-22 | 1.93e-22 | 1e-30 | 1.44274 | 0.441726 | 7.03147 |
| **498** | 9.88e-16 | 7.13e-21 | 1.93e-22 | 1e-30 | 0.899821 | 0.44172 | 7.57439 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **698** | 2.12e-11 | 1.22e-15 | 7.15e-18 | 1e-30 | 1e-30 | 0.441579 | 8.47435 |
| **898** | 3.11e-09 | 4.79e-13 | 2.14e-13 | 1e-30 | 1e-30 | 0.439801 | 8.47613 |
| **998** | 4.21e-09 | 1.92e-13 | 3.77e-12 | 2.3271 | 1e-30 | 0.436254 | 6.15258 |

**Table 3. Distribution of chlorine-containing components in system (mol·kg$^{-1}$): $C_{12}H_9Cl$-CaO-$H_2O$-$O_2$ (1:5:1:1) at P=0.1 MPa, T=298-998** K

| T | $H_2$ | $H_2O$ | Cl | HCl | C(c) | CO | $CO_2$ | $CH_4$ |
|---|---|---|---|---|---|---|---|---|
| 298 | 6.28e-05 | 1.4e-09 | 1.93e-22 | 7.05e-20 | 1.99414 | 3.56e-21 | 8.33e-21 | 1.68779 |
| 498 | 0.105134 | 0.000267 | 1.93e-22 | 9.71e-11 | 1e-30 | 3.44e-10 | 1.25e-10 | 2.65858 |
| 698 | 7.04204 | 1.02946 | 5.62e-19 | 1.95e-05 | 1e-30 | 5.39e- 05 | 7.58e-05 | 0.924347 |
| 898 | 7.39305 | 0.95324 | 1.44e-13 | 0.001193 | 1e-30 | 0.1998 | 0.05997 | 0.786647 |
| 998 | 7.78062 | 1.84396 | 2.12e-11 | 0.008199 | 1e-30 | 2.37582 | 0.81496 | 0.145759 |
| T | **$CH_3Cl$** | **$C_2H_5Cl$** | **HClCO** | **CaO(c)** | **$CaO_2H_2$(c)** | **$CaCl_2$(c)** | **$CaCO_3$(c)** | |
| 298 | 1.93e-22 | 1.93e-22 | 1.93e-22 | 1e-30 | 6.54456 | 0.331295 | 4.26905 | |
| 498 | 1.2e-18 | 1.93e-22 | 1.93e-22 | 1.02361 | 4.49763 | 0.331291 | 5.29239 | |
| 698 | 5.25e-13 | 1.09e-17 | 3.22e-20 | 3.78713 | 1.29e-26 | 0.331281 | 7.0265 | |
| 898 | 7.85e-10 | 9.8e-14 | 2.89e-14 | 3.90967 | 1e-30 | 0.330694 | 6.90455 | |
| 998 | 3.16e-09 | 1.44e-13 | 2.83e-12 | 6.20329 | 1e-30 | 0.32719 | 4.61443 | |

The formation of calcium hydroxide based on water and calcium oxide. The reaction takes place at relatively low temperatures. At 450 K condensed phases were formed as $CaCO_3$(c), CaO (c) based on calcium hydroxide; At 700 K $CaCO_3$ (c) is 7 mol·kg$^{-1}$, and CaO (c) is about 4mol·kg$^{-1}$; Concentration of methane is gradually changed: at 300 K 1.8 mole / kg, then at 420 K, it increases to 2.7 mol·kg$^{-1}$, then decreases from 420 K to 700 K to 1 mol·kg$^{-1}$, and remains relatively constant within 700-900 K; at 1000 K and above it is zero. Such changes of the methane concentration is active participation in the processes of formation of molecular hydrogen ($H_2$) at 700 K 7 mol·kg$^{-1}$ and at 1000 K molecular hydrogen ($H_2$) reaches up to 8 mol·kg$^{-1}$. As well as carbon monoxide, where it's concentration at 1000 K is 2.2 mol·kg$^{-1}$. The concentration of carbon dioxide is low (at 1000 K is 0.6 mol·kg$^{-1}$) because of its participation in the formation of $CaCO_3$ (c). It should be noted that, within 900 K, calcium carbonate begins to decompose again into CaO and $CO_2$, therefore concentrations of calcium oxide and carbon dioxide begin to increase gradually (above 900 K, fig. 2), which is very important for more complete utilization of chlorine-containing substances and low-molecular chlorinated hydrocarbons (Cl, HCl, $CH_3Cl$, HClCO, CaOHCl, $CaCl_2$, $CaCl_{2(C)}$) It should be noted that the binding of sublimated chlorine from the gas phase as HCl, $CaCl_{2(C)}$ begins rather at low temperatures (Fig. 2). Thereby, at dechlorination process of monochlorobiphenyl with CaO at 500-900 K following compounds: $H_2$, $H_2O$, Cl, HCl, CO, $CH_4$, $CH_3Cl$, HClCO were formed.

Gases, formed during thermal destruction of monochlorobiphenyl (above 900 **K**), passing through boiling CaO secondary interact with it, and it's contributes to additional decrease in total release of polychlorinated aromatic compounds. Exept hydrolytic and chemisorption mechanisms of dechlorination (degradation), there are oxidation-reduction mechanism, and due to presence of hydrogen-methane and carbon-oxide compounds it has occured in gas phase (mol·kg$^{-1}$): $H_2$-0.41 (498K), 4.74 (898 ), $CH_4$-1.19 (298 K), 1.09 (498 K), 0.34 (698 K), C (s) 3.91 (298 K), 0.52 (498 K), CO-0.15 (698 K), 2.71 (998 K.). Reaction products of this schemes were following compounds (mol·kg$^{-1}$): $CaCl_2$ (c) - 0.72 (298-998 K), HCl- 0.01 (998 K) and more oxidized $CO_2$-0.61 (998 K) (Fig. 2).

Formation of molecular chlorine products during conversion of monochlorobiphenyl in CaO-$H_2O$-$O_2$ medium was not found. Hydrolytic dechlorination of monochlorobiphenyl realated to oxidation-reduction process due to the presence of the hydrogen-oxygen active mixture in the gas phase. Calcium oxide, water and oxygen are an effective mixture, and **c**an be used as dechlorinating reagent for polychlorinated biphenyls.

## CONCLUSION

1. The physicochemical basis of formation and decomposition of polychlorinated biphenyls (polychlorobiphenyls) in anthropogenic environment were investigated.Separate inventory data, practical ways of using electrical insulating liquids were listed. As well as ecological problems such a reduction of concentration of chlorine-containing toxic organic substances in the natural environment were studied.
2. Physicochemical modeling of monochlorobiphenyl's thermodestruction in wide range of temperature in a $C1_2H_9Cl$-CaO-$H_2O$-$O_2$ system were suggested. The equilibrium concentrations of chlorine-containing toxic organic substances were calculated and energy parameters of monochlorodiphenyl's decomposition were determined.
3. Conversion of chlorine-containing toxic organic substances in calcium oxide-water-oxygen medium($C_{12}H_9Cl$) showed that at 300-400°C calcium oxide reacts with non-aromatic chlorinated hydrocarbons and forms $CaO_2H_2$(c), $CaCl_2$(c),

$CaCO_3$(c ), $CaCl_2$, CaClOH, $CO_2$ and $C_{(c)}$. Formation of $H_2$, $H_2O$, Cl, HCl, CO, $CH_4$, $CH_3C$ and HClCO was observed during dechlorination with CaO at 500-900 K .

4. Formation of molecular chlorine products was not found during the conversion of monochlorobiphenyl in CaO-$H_2O$-$O_2$ medium. Hydrolytic dechlorination of monochlorobiphenyl is due to the oxidation-reduction process by presence of hydrogen-oxygen active mixture in the gas phase. Calcium oxide, water and oxygen are an effective mixture, and can use as dechlorinating reagent for polychlorinated biphenyls.

## REFERENCES


1. Klyuev N.A., Shelepchikov A.A. (2001) Problemyi zagryazneniya okruzhayuschey sredyi polihlorirovannyimidibenzo-p-dioksinami i dioksinop-odobnyimi veschestvami . Dioksinyi-supertoksikantyi XXI veka (6) 543p.
2. Klyuev N.A. (1996) Kontrol superekotoksikantov v okruzhayuschey srede i istochniki ih poyavleniya. ZhAH. (51) 163-172p.
3. Schepinov S.A. (1995) Dioksinyi i tehnologicheskie problemyi ozdorovleniya okruzhayuschey sredyi. Nauka i tehnologiya: Rossiya i mir (3) 33-72p.
4. Richter B.E., Ezzell J.L., Knowles D.E., Hoefler F., Mattulat A.K.R., Scheutwinkel M., Waddell D.S., Gobran T., Khurana V. (1997) Extraction of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans from Environmental Samples Using Accelerated Solvent Extraction (ASE).Chemosphere (34, Iss.5-7). 975-987 P.
5. Kuharchik T.I., Kakareka S.V., Tsyitik P.V. (2003) Polihlorirovannyie bifenilyi v elektrooborudovanii. Minsk, 27p.
6. Quab U., Fermann M.W., Bröker G. (2000) Steps towards a European dioxin emission inventory . Chemosphere. (V.40, Iss.9-11) 1125-1129 p.
7. Su M.-C., Christensen E.R. (1997) Apportionment of sources of polychlorinated dibenzo-p-dioxins and dibenzofurans by a chemical mass balance model. Water Res. (V.31, Iss.12) 2935-2948p.
8. Mayorova A.V.(2010) Issledovanie obrazovaniya i povedeniya vrednyih organicheskih soedineniy i formirovaniya gazovyih vyibrosov pri utilizat-sii PHB i tehnicheskih smesey na ih osnove. -Avtoreferat dis.nasois.uch.step.kand.him.nauk. –Ekaterinburg. 24p.
9. Dzhumaev I.A.,Pechenyuk O.I., Ilyazov M.K. (2011) Upravlenie polihlorirovannyimi difenilami v Kyirgyizskoy Respublike. Sbornik statey, Bish-kek, 256 p.
10. Gorbunova T.I., Saloutin V.I., Chupahin O.N. Himicheskie metodyi prevrascheniy polihlorbifenilov.-Uspehi himii 79(6), 2010. -S.565-586.
11. Trusov B.G. (1995) Modelirovanie himicheskih i fazovyih ravnovesiy pri vyisokih temperaturah (ASTRA. 4/RS). Moskva, 43p.
12. Sinyarev G.B., Vatolin N.A., Trusov B.G., Moiseev G.K.(1982) Primenenie EVM dlya termodinamicheskih raschetov metallurgicheskih protsess-ov - Moskva: Nauka. 64p.

# O-64 Economic Performance of Robotic Milking

Aykut ÖRS[1], Cennet OĞUZ[2]

[1]Agriculture and Rural Development Institute Konya Provincial Coordination Unit, Konya, Turkey; [2]Selçuk University, Faculty of Agriculture, Department of Agricultural Economics, Konya, Turkey

**Abstract**

Usage of robotic milking systems is increasing more and more to decrease labor input and to enhance life quality of dairy farmers. Over 35.000 milking robots are operational on dairy farms around the world today, heading by West Europe, United States of America, Canada and Australia. According to a study on 2016, there are 54 milking robots in 21 farms in Turkey. Its adaptation rate in Turkey is slow because usage of robotic milking systems (RMS) is new and there is not enough information about economic performance of robotic milking systems against conventional milking systems (CMS). In this paper, literature about economics of robotic milking was reviewed to compare with conventional milking systems. Data of investment cost, labor input, energy consumption, feed cost, milking frequency, milk yield and net income criteria's from 33 studies on 13 different countries between 1998-2017 were compiled as a table. According to the table, comparison was done for each criteria by years and recommendations for future were done.

**Keywords**: Comparison, economic performance, robotic milking systems

# Süt Sağım Robotlarının Ekonomik Performansı

Özet

Süt sağım robotlarının; süt çiftliklerinde iş gücü ihtiyacını azaltmak ve çiftçilerin yaşam kalitesini arttırmak amacıyla başta batı Avrupa, Amerika Birleşik Devletleri, Kanada ve Avustralya olmak üzere kullanımı her geçen gün artmaktadır. Bugün dünya genelinde 35.000'nin üzerinde süt sağım robotu kullanıldığı tahmin edilmektedir. 2016 yılında gerçekleştirilen bir çalışmada Türkiye'de 21 çiftlikte kurulu toplam 54 adet süt sağım robotu kullanıldığı tespit edilmiştir. Bu teknolojinin kullanımının yeni olması; süt sağım robotlarının, diğer otomatik sağım sistemlerine göre ekonomik performansının işletmeciler tarafından tam olarak bilinmemesi nedeniyle süt sağım robotları yavaş benimsenmektedir. Bu çalışmada, süt sağım robotlarının ekonomik performansı ile mevcutta kullanılan otomatik sağım sistemlerinin karşılaştırılması amacıyla; bu konuda gerçekleştirilen yerli ve yabancı literatür taranmıştır. Tarama sonucunda 13 farklı ülkede, 1998-2017 yılları arasında gerçekleştirilen, 33 adet çalışmada yer alan süt sağım robotları kullanılan çiftliklerin yatırım maliyeti, işgücü ihtiyacı, enerji tüketimi, yem tüketim miktarı, sağım sıklığı, ineklerin verimliliği ve işletme geliri verileri bir tabloda derlenmiştir. Derlenen bu bilgiler yardımıyla süt sağım robotu kullanan işletmeler ile kullanmayan işletmelerin ekonomik performansı yıllar itibariyle ve yukarıda sayılan kriterler çerçevesinde karşılaştırılmış ve ileriye yönelik öneriler sunulmuştur.

**Anahtar Kelimeler:** Karşılaştırma, ekonomik performans, robot süt sağım sistemleri

## INTRODUCTION

The most remarkable technological innovation in the dairy sector in recent years is undoubtedly robotic milking systems (RMS). Dairy farmers are interesting RMS but they have not enough information about economic performance of RMS against conventional milking systems (CMS). For this purpose, RMS and CMS were compared in this study according to investment cost, labor input, energy consumption, feed cost, milking frequency, milk yield and net income criteria's. As a result of study, economic and social effects on farm were assessed and recommendations for future were done. Compiling results of previous studies on economic performance of RMS can be beneficial for dairy farmer to decide having this technology and for researchers to guide their future studies.

## MATERIALS AND METHODS

During this study, literature about economic compression of RMS and CMS was reviewed and the data presented in this paper was collected from 33 studies carried out in 13 different countries from 1998 to 2017. Data of investment cost, labor input, energy consumption, feed cost, milking frequency, milk yield and net income were compiled as a table for both RMS and CMS from these studies.

To interpret data's, percentage changes were calculated. The percentage change or percent change is defined as a way of expressing any change in a given variable. It denotes the change in the old value and the new one. In mathematics, the concept of percent change is used to describe the relationship between the old value of a variable and the new value of the same variable. Positive values indicate a percentage increase whereas negative values indicate percentage decrease. After data's were compiled, percentage changes between RMS and CMS were calculated by following formula ($V_1$: Value of RMS; $V_2$: Value of CMS);

$$\text{The percentage change} = \frac{V_1 - V_2}{V_2} * 100$$

The mean and standard deviation were calculated by using calculated percentage changes. Normal distribution function calculated, normal distribution curve drawn and values out of normal distribution defined by using z-score. To define normal distribution range, the z-score value in probability of 40% (0.3997) was used which is 1,28 in z-score table. By using following formula, positive and negative range values defined (z: z-score (Standard Score), x: the value to be standardized; μ: the mean; σ: the standard deviation).

$$z = \frac{x - \mu}{\sigma}$$

## RESULTS AND DISCUSSION

### Milk yield

In 15 of the 33 studies, which have been carried out between 2003 and 2015, results of milk yield for both RMS and CMS were presented. Milk yield percentage change was calculated and presented in Table 1. When Table 1 was examined, in only one of these studies milk yield percentage showed a decrease and in only one of them no difference was observed. In other 13 studies, it has been determined that the milk yield is higher in dairy farms using RMS than in dairy farms using CMS.

When the average of all results is taken, it is seen that the dairy farms using RMS obtained 14,66% higher milk yield than dairy farms using CMS. By calculating the mean and standard deviation, The value 98% can be regarded as an exception because it is out of the normal distribution (Figure 1). If we exclude this exceptional value, we can say that using RMS in dairy farms increased milk yield by an average of 8,66% when compared with CMS.

Table 1. The percentage change of milk yield

| Referance No | Year | Country | Milk Yield Change (%) |
|---|---|---|---|
| 8 | 2003 | Canada | 2,00 |
| 9 | 2003 | Canada | 0,00 |
| 29 | 2003 | USA | 5,00 |
| 14 | 2004 | Holland | 6,95 |
| 38 | 2004 | Holland | 2,00 |
| 23 | 2005 | Denmark | 17,71 |
| 12 | 2007 | Finland | 24,10 |
| 27 | 2008 | Canada | 4,00 |
| 13 | 2010 | Finland | 98,57 |
| 26 | 2011 | USA | 23,47 |
| 36 | 2012 | Ireland | -5,00 |
| 34 | 2013 | USA | 10,00 |
| 3 | 2014 | Poland | 12,28 |
| 37 | 2014 | Norway | 9,46 |
| 31 | 2015 | USA | 9,31 |
| | | Mean | 14,66 |

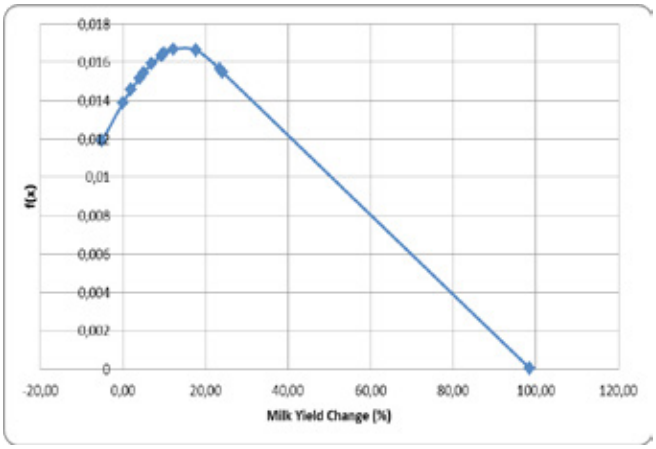



Figure 1. Normal distribution curve of milk yield

## Investment costs

In 9 of the 33 studies, which have been carried out between 1998 and 2015, results of investment costs for both RMS and CMS were presented. Investment cost percentage change was calculated and presented in Table 2. All percentage change values are positive in Table 2. This means that RMS investment cost is higher than CMS investment cost.

Table 2. The percentage change of investment costs

| Referance No | Year | Country | Investment Costs Change (%) |
|---|---|---|---|
| 24 | 1998 | USA | 83,88 |
| 8 | 2003 | Canada | 66,67 |
| 38 | 2004 | Holland | 150,33 |
| 19 | 2005 | Finland | 309,68 |
| 27 | 2008 | Canada | 8,70 |
| 32 | 2010 | Holland | 25,85 |
| 28 | 2011 | Canada | 76,00 |
| 37 | 2014 | Norway | 35,21 |
| 22 | 2015 | Ireland | 21,06 |
| | | Mean | 86,38 |

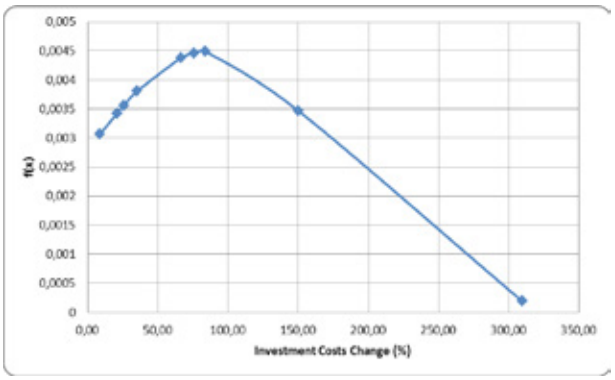



Figure 2. Normal distribution curve of investment costs

When the average of all results is taken, it is seen that the dairy farms using RMS have 86,38% higher investment costs than dairy farms using CMS. As it seen in Table 2, an increase of 309% in the study carried out in 2005. By calculating the mean and standard deviation, it can be regarded as an exception because it is out of the normal distribution (Figure 2). If we exclude this exceptional value, we can say that investing RMS in dairy farms costs higher by an average of 58,46% when compared with CMS.

## Labor input

In 16 of the 33 studies, which have been carried out between 2002 and 2015, results of labor input for both RMS and CMS were presented. Labor input percentage change was calculated and presented in Table 3. When Table 3 was examined, in only one of these studies observed an increase. In other 15 studies, it has been determined that the labor cost is lower in dairy farms using RMS than in dairy farms using CMS.

Table 3. The percentage change of labor input

| Referance No | Year | Country | Labor Input Change (%) |
|---|---|---|---|
| 20 | 2002 | Belgium, Denmark, Germany, Holland | -29,00 |
| 9 | 2003 | Canada | -68,91 |
| 38 | 2004 | Holland | -23,83 |
| 19 | 2005 | Finland | -37,61 |
| 23 | 2005 | Denmark | -43,40 |
| 12 | 2007 | Finland | -30,00 |
| 27 | 2008 | Canada | -40,00 |
| 18 | 2010 | Holland | -25,00 |
| 32 | 2010 | Holland | -3,92 |
| 26 | 2011 | USA | -23,97 |
| 28 | 2011 | Canada | -30,00 |
| 5 | 2012 | Spain | 29,26 |
| 34 | 2013 | USA | -66,67 |
| 37 | 2014 | Norway | -9,35 |
| 22 | 2015 | Ireland | -36,80 |
| 31 | 2015 | USA | -29,00 |
| | | Mean | -21,72 |

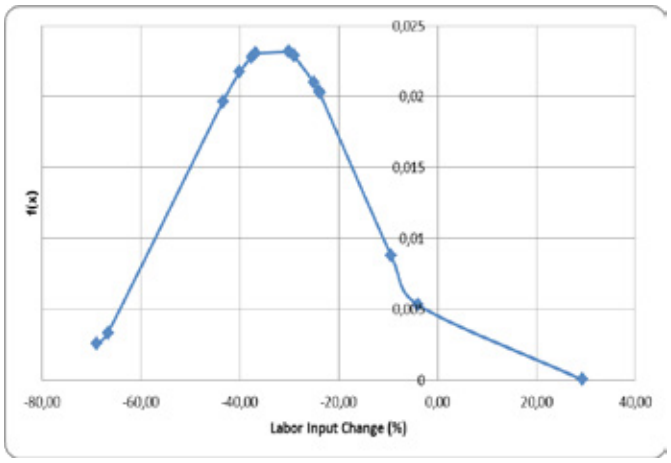



Figure 3. Normal distribution curve of labor input

When the average of all results is taken, it is seen that the dairy farms using RMS have 21,72% lower labor costs than dairy farms using CMS. By calculating the mean and standard deviation, the values -68,91%, -66,67% and 29,26% can be regarded as an exception because they are out of the normal distribution (Figure 3). If we exclude this exceptional values, we can say that labor input for RMS in dairy farms costs lower by an average of 27,84% when compared with CMS.

## Energy consumption

In 5 of the 33 studies, which have been carried out between 2004 and 2015, results of energy consumption for both RMS and CMS were presented. Energy consumption percentage change was calculated and presented in Table 4. When Table 4 was examined, energy consumption percentage change was observed positive in all studies. It has been determined that the energy consumption is higher in dairy farms using RMS than in dairy farms using CMS.

Table 4. The percentage change of energy consumption

| Referance No | Year | Country | Energy Consumption Change (%) |
|---|---|---|---|
| 4 | 2004 | Holland | 42,00 |
| 32 | 2010 | Holland | 30,00 |
| 36 | 2012 | Ireland | 37,98 |
| 11 | 2015 | USA | 10,95 |
| 22 | 2015 | Ireland | 72,35 |
| | | Mean | 38,66 |

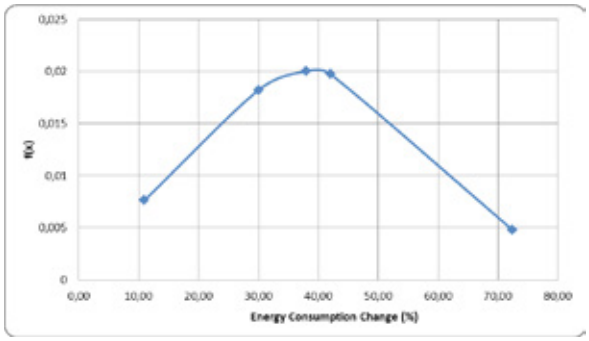



Figure 4. Normal distribution curve of energy consumption

When the average of all results is taken, it is seen that the dairy farms using RMS have 38,66% higher energy consumption than dairy farms using CMS. By calculating the mean and standard deviation, the values 10,95% and 72,35% can be regarded as an exception because they are out of the normal distribution (Figure 4). If we exclude this exceptional values, we can say that energy consumption RMS in dairy farms is higher by an average of 36,66% when compared with CMS.

## Feed cost

In 5 of the 33 studies, which have been carried out between 2003 and 2015, results of feed cost for both RMS and CMS were presented. Feed cost percentage change was calculated and presented in Table 5. When Table 5 was examined, in all studies feed cost percentage change is not greater than %6.

Table 5. The percentage change of feed cost

| Referance No | Year | Country | Feed Cost Change (%) |
|---|---|---|---|
| 2 | 2003 | Holland | -5,11 |
| 29 | 2003 | USA | 3,00 |
| 32 | 2010 | Holland | 0,00 |
| 30 | 2012 | USA | 0,28 |
| 31 | 2015 | USA | 2,04 |
| | | Mean | 0,04 |

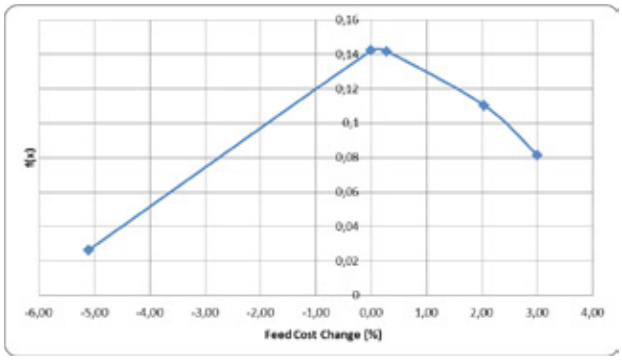



Figure 5. Normal distribution curve of feed cost

When the average of all results is taken, it is seen that dairy farms using RMS have 0,04% higher feed cost than dairy farms using CMS. By calculating the mean and standard deviation, the value -5,11% can be regarded as an exception because it is out of the normal distribution (Figure 5). If we exclude this exceptional value, we can say that feed cost of dairy farms using RMS is higher by an average of 1,33% when compared with CMS. This value of percentage change is so small to say there is a differences. So we can say that feed cost of dairy farms using RMS is similar with feed cost of dairy farms using CMS

**Milking Frequency**

In 13 of the 33 studies, which have been carried out between 2000 and 2016, results of milking frequency for both RMS and CMS were presented. Milking frequency for CMS was assumed 2 times in all studies. Milking frequency percentage change was calculated and presented in Table 6. When Table 6 was examined, in only one of these studies milking frequency percentage change showed a decrease. In other 12 studies, it has been determined that the milking frequency is higher in dairy farms using RMS than in dairy farms using CMS.

Table 6. The percentage change of milking frequency

| Referance No | Year | Country | Milking Frequency Change (%) |
|---|---|---|---|
| 1 | 2000 | Germany | 41,00 |
| 7 | 2001 | Holland | 15,00 |
| 25 | 2004 | USA, Canada | 30,00 |
| 33 | 2004 | Japan | 35,00 |
| 23 | 2005 | Denmark | 27,50 |
| 27 | 2008 | Canada | 32,50 |
| 18 | 2010 | Holland | 37,50 |
| 5 | 2012 | Spain | 34,50 |
| 30 | 2012 | USA | 40,00 |
| 36 | 2012 | Ireland | -6,50 |
| 11 | 2015 | USA | 40,00 |
| 31 | 2015 | USA | 40,00 |
| 10 | 2016 | Turkey | 30,00 |
| | | Mean | 30,50 |

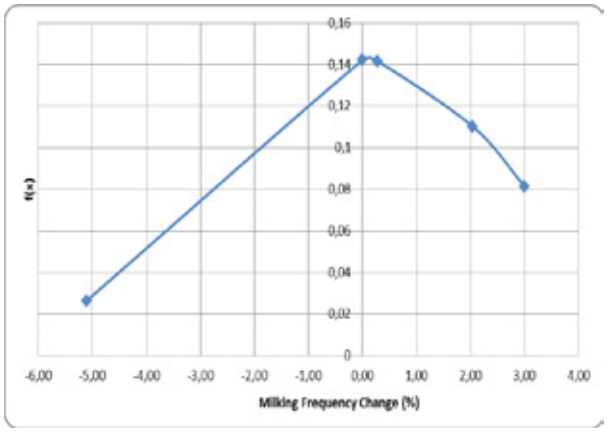



Figure 6. Normal distribution curve of milking frequency

When the average of all results is taken, it is seen that the dairy farms using RMS have 30,50% higher milking frequency than dairy farms using CMS. Milking frequency is an average of 2,61 in dairy farms using RMS. By calculating the mean and standard deviation, the value -6,50% can be regarded as an exception because it is out of the normal distribution (Figure 6). If we exclude this exceptional value, we can say that milking frequency of RMS in dairy farms is higher by an average of 33,58% and milking frequency is an average of 2,67 when compared with CMS.

**Net income**

In 7 of the 33 studies, which have been carried out between 2005 and 2015, results of net income for both RMS and CMS were presented. Net income percentage change was calculated and presented in Table 7. When Table 7 was examined, in only one of these studies showed an increase and in only one of them no difference was observed. In other 5 studies, it has been determined that net income is lower in dairy farms using RMS than in dairy farms using CMS.

Table 7. The percentage change of net income

| Referance No | Year | Country | Net Income Change (%) |
|---|---|---|---|
| 2 | 2003 | Holland | -9,30 |
| 38 | 2004 | Holland | 0,08 |
| 23 | 2005 | Denmark | 30,90 |
| 32 | 2010 | Holland | -2,26 |
| 37 | 2014 | Norway | -22,08 |
| 22 | 2015 | Ireland | -30,18 |
| 31 | 2015 | USA | -19,57 |
| | | **Mean** | -7,49 |

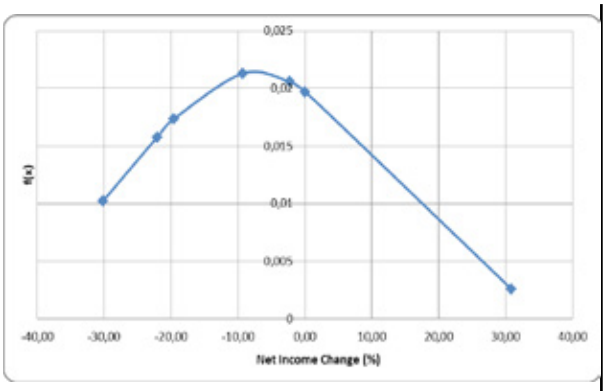



Figure 7. Normal distribution curve of net income

When the average of all results is taken, it is seen that the dairy farms using RMS have 7,49% lower net income than dairy farms using CMS. By calculating the mean and standard deviation, the value 30,90% can be regarded as an exception because it is out of the normal distribution (Figure 7). If we exclude this exceptional value, we can say that net income of RMS in dairy farms is lower by an average of 13,89% when compared with CMS.

## CONCLUSION

In the result of study, it can be said that dairy farms using RMS have advantage of milk yield 8,66%, labor input 27,84% and milking frequency 33,58% (with an average of 2,67 milking), while have disadvantage of investment costs 58,46%, energy consumption 36,66% and net income 13,89%. And no differences in feed cost between RMS and CMS.

Despite disadvantages in net income, the use of RMS in the world is increasing day by day. The most important reason for this is the social effect of RMS. Preferred social benefits are: raising the quality of life by spending more time with the family and freeing up time for other activities; less physical work for farmers who are old or have health problems; raising the opportunity to attract and protect skillful staff; a choice for innovators who want to try new ideas; possibility to enlargement of herd (more efficient use of the existing workforce) without having to get a new employee.

## REFERENCES


1. Artmann, R. (2004). System capacity of single box AMS and effect on the milk performance. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.474-475).
2. Bijl, R., S.R. Kooistra, H. Hogeveen (2007). The profitability of automatic milking on Dutch dairy farms. *Journal of Dairy Science,* 90, 239-248.
3. Bogucki, M., Sawa, A., Neja, W. (2014). Effect of changing the cow milking system on daily yield and cytological quality of milk. *Acta Scientiarum Polonorum Zootechnica*, 13 (4), 17–26.
4. Bos, K. (2004). Energy consumption on farms with an AM-System. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.75-76).
5. Castro, A., Pereira, J.M., Amiama, C., J. Bueno (2012). Estimating efficiency in automatic milking systems. *J. Dairy Sci.,* 95, 929-936.
6. Dolecheck, K., Bewley, J. (2013). Pre-investment considerations for precision dairy farming Technologies, University of Kentucky, USA.

7. Dooren, H.J.C., Bos C.H., Biewenga, G. (2004). Strategies to improve the capacity of an automatic milking system, *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.517).

8. Engel, P.D., Hyde, J. (2003). A real options analysis of automatic milking systems. *Agricultural and Resource Economics Review,* 32/2, 282-294.

9. Fisher, J.W., Rodenburg, J., MvKnight, D.R. (2003). Robotic milking systems for dairy cows in Ontario: economics, milk quality, nutritional enticers. University of Guelph, https://atrium.lib.uoguelph.ca/xmlui/ handle/10214/1759?show=full

10. Gonulol, E. (2016). Evaluating of robotic milking performance in Turkey, *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS),* 7(1), 31- 34.

11. Haan, M. (2015). A survey of robotic milking systems in PA", *Penn State Nutrition Conference, Pennsylvania, USA, 11 November 2015.*

12. Heikkilä, A.M., Vanninen, L., Manninen, E. (2010). Economics of small-scale dairy farms having robotic milking. *Proceedings of the first North American conference on precision dairy management, Toronto, Canada, 2–5 March 2010*.

13. Heikkilä, A.M., Myyrä, S., Pietola, K. (2012). Effects of economic factors on adoption of robotics and consequences of automation for productivity growth of dairy farms. *Factor Markets Working Paper No. 32*, Belgium.

14. Hogeveen, H., Heemskerk, K., Mathijs, E. (2004). Motivations of Dutch farmers to invest in an automatic milking system or a conventional milking parlour. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.56-61).

15. Jago, J., Eastwood, C., Kerrisk, K., Yule, I. (2012). Precision dairy farming in Australasia: adoption, risks and opportunities, *Proceedings of the 5th Australasian Dairy Science Symposium, Melbourne, Australia, 13-15 Novamber 2012* (pp.123-135).

16. Jensen, T. (2004). Expectations of automatic milking and the realized socio-economic effects. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.78-82).

17. Knijn, H., Taweel, H., et.al. (2013). Smart dairy farming program in the Netherlands. *Proceedings of the precision dairy conference and expo - a conference on precision dairy technologies, Minnesota, USA, 26-27 June 2013* (pp.141-142). University of Minnesota.

18. Koning, C.J.A.M. (2010). Automatic milking – common practice on dairy farms. *Proceedings of the first North American conference on precision dairy management, Toronto, Canada, 2–5 March 2010*.

19. Latvala, T., Pyykkönen, P. (2005). Profitability of and reasons for adopting automatic milking systems. *XI$^{th}$ congress of the European association of agricultural economists, Copenhagen, Denmark, 24-27 August 2005*. European Association of Agricultural Economists.

20. Mathijs, E. (2004). Socio-economic aspects of automatic milking, automatic milking system or a conventional milking parlour. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.46-55).

21. Mundan, D, Selçuk, H., Orçin, K., Karakafa, E., Akdağ, F. (2014). Modern süt siğiri işletmelerinde robotlu sağim sistemlerinin ekonomik açidan değerlendirilmesi. *Harran Üniversitesi Veterinerlik Fak*ültesi *Dergisi*, 3(1), 42-48.

22. O'Brien, B.,Foley, C., Shortall, J., Shalloo, L. (2015). An economic appraisal of automatic and conventional milking within a grass based seasonal milk production system. *7. European conference on precision livestock farming, Milan, Italy, 15-18 September 2015.*

23. Oudshoorna, F.W., Kristensena, T., Zijppb, A.J., Boerb, I.J.M. (2012). Sustainability evaluation of automatic and conventional milking systems on organic dairy farms in Denmark, NJAS - *Wageningen Journal of Life Sciences,* 59, (pp.25– 33).

24. Reinemann, DJ (1998). Prospects for robotic milking in Wisconsin. *Proceedings of the Arlington Dairy Days, Arlington, USA, December 1998.*

25. Reinemann D.J., Vorst, Y., Jong, W., Finnema, A. (2004). Survey of automatic milking systems management practices in North America. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.508).

26. Reneau, J. (2012). Does precision matter?. The University of Minnesota, http://www.extension.umn.edu/ agriculture/dairy/facilities/ does-precision-matter/

27. Rodenburg, J. (2008). Robotic milking systems: are they the way of the future?. *WCDS Advances in Dairy Technology,* 20, 35-54.

28. Rodenburg, J. (2011). Time for technology - robotic milking gets more affordable every year. http://www.dairylogix.com

29. Rotz, C.A. (2003). Whole farm impacts of automatic milking systems. *Advances in Dairy Technology,* 15, 355.

30. Salfer, J., Endres, M. (2013). Characteristics of robotic dairy farms. University of Minnesota Study. extension.psu.edu.

31. Salfer, J., Endres, M., Lazarus, W., Minegishi, K., Berning, B. (2017). Dairy robotic milking systems – what are the economics?. Extension. org, http://articles.extension.org/pages/ 73995/dairy-robotic-milking-systems-what-are-the-economics.

32. Steeneveld, W., Tauer, L.W., Hogeveen, H., Lansink A.G.J.D.M.O (2013). Economic comparison of farms with an automatic milking system and a conventional milking system. *Proceedings of the precision dairy conference and expo - a conference on precision dairy technologies, Minnesota, USA, 26-27 June 2013* (pp.51-52). University of Minnesota.

33. Tokida, M., Morita, S., Komiya, M., Kida, T. (2004). A study of practical use of automatic milking system in Japan. *Automatic milking: a better understanding. Conference Proceedings, Lelystad, Netherlands, March 2004* (pp.516).

34. Tranel, L.F., Schulte, K.M. (2013). The economics of robotic milking systems. *Proceedings of the precision dairy conference and expo - a conference on precision dairy technologies, Minnesota, USA, 26-27 June 2013* (pp.49-50). University of Minnesota.

35. Türkyılmaz, M.K. (2005). Süt sığırcılık işletmelerinde sağım robotu kullanımı, *Erciyes Üniversitesi Veterinerik Fak*ültesi Dergisi, 2(1), 61-64.

36. Upton, J., O'Brein, B. (2013). Analysis of energy consumption in robotic milking. *6th European Conference on Precision Livestock Farming, Leuven, Belgium, 10-12 September 2013* (pp.465-470).

37. Vasseljen, J. (2016). Milking robots in Norwegian dairy industry. *Proceedings of 24th Pacioli Workshop: FADN in a changing environment, Pristina, Kosovo, 28-28 September 2016* (pp.34-37).

38. Wade K.M., Asseldonk, M.A.P.M., Berentsen, P.B.M., Ouweltjes, W., Hogeveen, H. (2004). Economic efficiency of automatic milking systems with specific emphasis on increases in milk production. Food and Agriculture Organization. http://agris.fao.org.

# O-67 Sivas Ekolojik Koşullarında Bazı Yem Bezelyesi Genotiplerinin Agro Morfolojik Özellikleri ve Külleme Hastalığına(Erysiphe polygoni) Karşı Reaksiyonları

V. Yörük[1], T. Karaköy[2] , A. Demirbaş[3] and Y. Yanar[4]

[1]Cumhuriyet Üniversitesi Sivas Meslek Yüksekokulu, Bitkisel ve Hayvansal Üretim Bölümü, Sivas, Türkiye;[2]Cumhuriyet Üniversitesi Sivas Meslek Yüksekokulu,Bitkisel ve Hayvansal Üretim Bölümü, Sivas, Türkiye;[3]Cumhuriyet Üniversitesi Sivas Meslek Yüksekokulu, Bitkisel ve Hayvansal Üretim Bölümü,Sivas, Türkiye;[4]Gazi Osman Paşa Üniversitesi, Ziraat Fakültesi, Bitki Koruma Bölümü, Tokat, Türkiye.

## ÖZET

Ülkemiz birçok kültür bitkisi yönünden zengin genetik kaynaklara sahip olup, bunlardan birisi de bezelyedir. Türkiye orijinli yem bezelyesi gen kaynakları üzerinde yurt içi ve yurt dışı kaynaklı bazı araştırmalar yapılmış olmakla birlikte, bu kaynakların farklı araştırmalar ile agronomik ve kalite özellikleri açısından incelenmesi ve ıslah programlarında değerlendirilmesi önem taşımaktadır. Bundan dolayı bu çalışmanın temel konusu, ülkemizin farklı bölgelerinden toplanmış olan yem bezelyesi genotiplerinden tek bitki seçimi yapılarak saflaştırılmış olan hatlar üzerinde erkencilik, kalite, yüksek ot ve tohum verimi, külleme hastalığına dayanıklılık gibi özellikleri yönünden değerlendirmek, üstün olan hatların belirlenerek, bunların yem bezelyesi çeşit geliştirme programlarında kullanmak, Sivas ekolojik koşullarına uygun yeni çeşitlerin ıslah edilmesini sağlamaktır. Araştırmada, 4 adet ticari bezelye çeşidi ve ülkemizin farklı bölgelerinden toplanmış olan 60 adet yem bezelyesi genotipinde bazı önemli agro-morfolojik bitkisel karakterler ve bu genotiplerin külleme hastalığına karşı dayanıklılık düzeyleri incelenmiştir. Tüm yem bezelyesi genotipleri Sivas ekolojik koşullarında, Cumhuriyet Üniversitesi, Sivas Meslek Yüksekokulu, Bitkisel ve Hayvansal Üretim Bölümü araştırma ve deneme alanında yetiştirilmiştir. İncelen agro-morfolojik özellikler ve külleme hastalığına karşı dayanıklılık bakımından yüksek düzeyde varyasyon saptanmıştır. Çiçeklenme gün sayısı (60-83.3 gün), bitki boyu (41-128.7 cm), ilk bakla yüksekliği (16.7-73.3 cm), bitkide kardeş sayısı (1-2), bitkide bakla sayısı (1.3-12.3), baklada tane sayısı (3.3-8.0), bitkide tane sayısı (6.7-38.7), yeşil ot verimi (694.7-1585.0 kg/da), kuru ot verimi (198.2-466.3 kg/da), biyolojik verim (8.6-53.7 g/m$^2$), tane verimi (112.3-508.6 kg/da) ve külleme hastalığına dayanıklılık (0-10) gibi bazı özellikler incelenmiştir.

**Anahtar Kelimeler:** Yabani Bezelye, Agro-Morfolojik Özellikler, Külleme, Mantar

## ABSTRACT

Turkey has rich genetic sources by means of crop speciesandone of those is foragepeas. Although, severalinvestigations has beenconducted on theTurkishforagepeageneticresources, there is furtherneedtoconductmoreresearch on thesegeneticresourcestoevaluateagronomicperformanceandqualitytraits. Forthisreasonthe main objective of thisresearch is tofindthepromisingforagepealinesandtousetheselinestodevelopearlyfloweringwithhigherforage, grainyieldpotential, betterqualityandpowderymildewdiseaseresistancethatareappropriateforthe Sivasecologicalconditions.Weresearchedsomeimportantagronomicandmorphologicalplantcharacters of 4 commercialforagepeaand 60foragepeagenotypescollectedfromdifferentregions in Turkey. Allforagepeagenotypesweregrownunder SivasRegionconditions at CumhuriyetUniversity, Vocational School of Sivas, Department of

CropandAnimalProductionresearcharea in Sivas-Turkey. High germplasmvariabilitywasobservedforagro-morphologicaltraitsandpowderymildewdiseaseresistance. Therewashighdiversityamongthelandracesforflowering time (60-83.3days), plantheight (41-128.7 cm), firstnodheight (16.7-73.3 cm), number of branch (1-2), number of thepodsperplant (1.3-12.3), number of theseedperpod (3.3-8.0), number of theseedperplant (6.7-38.7), forageyield (694.7-1585.0 kg/da), hay yield (198.2-466.3 kg/da), biologicalyield (8.6-53.7 g/m$^2$), grainyield (112.3-508.6 kg/da) andpowderymildewdiseaseresistance (0-10). Accordingtoresults of thisstudysomediversegenotypescould be usedforsomeforagepeabreedingprogramsaimedhighforageyield,yieldcomponentsandpowderymildewdiseaseresistance.

**Keywords:** ForagePea, Agro-morphologicalTraits, PowderyMildewDisease, Fungi

## 1. GİRİŞ

Baklagiller grubu içerisinde yer alan bezelye; *Leguminosae* (baklagiller) takımında, *Papillionaceae* (kelebek çiçekliler) familyasının çok önemli türlerinin yer aldığı *Viceae* alt familyasına bağlı *Pisum* genusunun bir türüdür (Şehirali, 1998).Bezelye, yaklaşık M.Ö 8000'li yıllarda ilk defa kültüre alınmış, ancak orijininin Akdeniz havzası olduğu ve bu bitkinin Anadolu'nun ve Akdeniz'in yarı kurak alanlarında (yağışı 350-550mm) baklagil yem bitkisi olarak yayılış gösterdiği bilinmektedir (Anonymous, 2001).Bezelye'nin orijin merkezinin birinci derecede Doğu Akdeniz, İran, Kafkasya, Afganistan ve Tibet'e kadar uzanan bölgeler, ikinci derecede de Güney Batı Arabistan üzerinden Etiyopya ve Kuzey Afrika'ya kadar uzanan bölgeler olduğu belirtilmiştir (Govorov, 1937; Davies, 1976 ; Hagedorn, 1984). Shoemaker (1953), Etiyopya'yı; Watts (1954), Etiyopya, Akdeniz kıyıları, Güney Batı Asya'yı, Höslin (1964), Akdeniz ülkelerini ve Etiyopya'nın bezelyenin gen merkezi olduğunu rapor etmişlerdir. Son yıllarda tarımı yapılan bezelyeler *Pisumsativum*L. adı altında toplanmaktadır. Bu türün alt türü olan *Pisum sativum ssp. Sativum L.* yemeklik bezelye ve bahçe bezelyesi adı altında yeşil veya kuru daneleri için yetiştirilmektedir. Tarla bezelyesi veya yem bezelyesi olarak tanınan *arvense* ise daha kısıtlı ölçülerde ot ve dane üretimi amacı ile kullanılmaktadır (Açıkgöz, 2001).Serin ve ılıman iklim bitkisi olan bezelye (*Pisum Sativum* ssp. *Sativum* L)'nin tarımı, ılıman kuşağın hemen her yöresinde yapılmakla birlikte daha çok gelişmiş ülkelerde yaygınlaşmıştır.

Bezelye, konserve ve dondurulmuş gıda olarak işlenme kapasitesi açısından domatesin arkasından dünya genelinde en fazla üretilen üründür. Bunun yanında, bezelye kabuğu çıkarılmış kırması ve unu ise gıda sanayisinde kullanıldığı gibi, özellikle sap ve samanı hayvan beslenmesinde değerlendirilmektedir. Yem bezelyesi toprak ve iklim şartları ile uygulanan kültürel faktörlere bağlı olarak 250-1000 kg/da kuru ot üretmektedir. Açıkgöz ve Çelik (1986) Bursa'nın kıraç koşullarında yetiştirilebilecek en iyi tek yıllık baklagilleri belirlemek için yaptıkları araştırmada yem bezelyesinin adi fiğden sonra en verimli bitki olduğunu bulmuşlardır. Bu bitki daha çok tohumu için yetiştirilmekte olup, tohum verimi de oldukça yüksektir. Yem bezelyesinde tohum veriminin Bursa şartlarında 320 kg/da'a(Uzun ve ark., 2005), Diyarbakır şartlarında 246 kg/da'a(Sayar, 2007) çıktığı ifade edilmektedir. Yem bezelyesi otu çiftlik hayvanları için besleyici bir kaba yemdir. Nitekim, çiçeklenme döneminde %16.13 ham protein ve %8.39 ham kül ihtiva ettiği, tohum alındıktan sonra kalan samanda ise bu oranların sırasıyla %8.94 ve 5.92 olduğu belirlenmiştir (Deniz, 1967). Tane yem olarak enerji değeri oldukça yüksektir. Açıkgöz (2001)'ün bildirdiğine göre, tohumda %26.5 ham protein, %1.7 ham yağ, %7.3 ham selüloz ve %59.8 azotsuz öz madde bulunmaktadır. Protein ve lysine bakımından zengin olan yem bezelyesi tohumları Batı Avrupa ülkelerinde hayvan yemlerinde soyanın yerine kullanılmaktadır. Yem bezelyesinin tahıllarla karışım halinde mera bitkisi veya silaj olarak kullanımı da yaygındır.

Bezelye kuru taneleri A ve B vitaminleri bakımından zengindir. Kuru tanelerinde % 23 ham protein ve % 54 karbonhidrat içermektedir (Şehirali,1988). Kuru bezelyenin proteini lysin, leucin ve isoleucine aminoasitleri yönünden zengin olması nedeniyle insan beslenmesinde ayrıca önem göstermektedir. Diğer taraftan kuru taneler yeşil tanelere göre daha uzun süre bozulmadan saklanabilmektedir.

Bezelye nematod, fungus, bakteri, virüs ve böcek zararına karşı çok hassas olan bitkilerin başında gelmektedir. Otuzdan fazla fungus türü bezelye bitkisinde zararlara yol açabilmektedir. Bu hastalıklardan külleme (*Erysiphepisi*D.C), bezelye bitkisinin yaprak, gövde ve meyvelerinde enfeksiyon oluşturmaktadır. Külleme hastalığına neden olan fungus,e-kolojik koşulların uygun olması, hastalığın kontrol edilememesi durumunda önemli verim kayıplarına yol açmaktadır (Reiling, 1984). Hastalığa neden olan fungus etmeni obligat parazittir. Hastalık; verim, bitki başına bakla sayısı, bakladaki tohum sayısı, bitki boyu, bakla uzunluğu, baklada tohum sayısı gibi önemli verim komponentleri üzerinde olumsuz etkilerinden dolayı, önemli verim ve kalite kayıplarına neden olabilmektedir (Gritton ve Ebert 1975).Külleme hastalığına neden olan fungus, Ascomycetes sınıfı, Erysiphales takımı, Erysiphaceae familyasındandır. Fungus, Leguminosea ailesinden birçok bitki türünde yaşamını sürdürebilmektedir (Reiling 1984, Cook ve Fox 1992, Braun, 1995), fakat yalnızca bezelye türünde külleme hastalığına neden olmaktadır. Reiling (1984) göre;fungusun sadece belirli bir formu bezelye bitkilerinde hastalığa yol açarken, Braun (1995) göre ise;*Lathyrus, Lupinus, Trigonella*ve *Vicia* türlerinde hastalığa neden olan fungus, bezelyede de hastalığa yol açabilmektedir. Bitkinin tüm vejetatif aksamı hastalığa karşı duyarlıdır ve etmen organizma kışlık sporlar olarak kleistothesiumlar içerisindeki askosporlar ve konidiosporlar ile enfeksiyona yol açabilmektedir. Ekolojik koşullar, sporlarının çimlenme, gelişme ve hastalığın oluşumunda oldukça etkilidir. 10- 30 $^{o}$C'lik sıcaklıklarda konidiosporlar çimlenebilmektedirler, fakat çimlenme için en uygun hava sıcaklığı 20 $^{o}$C dolaylarındadır (Singh ve Singh, 1988).

Çalışmanın amacı, ülkemizin yerli bezelye genetik kaynakları kullanılarak elde edilmiş olan çeşit adaylarının, önemli agronomik ve kalite özelliklerinin belirlenmesi, adaptasyon yeteneklerinin ölçülmesi, bu özelliklerinin külleme hastalığı ile ilişkilerinin ortaya konulması ve külleme hastalığına karşı reaksiyonlarının ortaya konulmasıdır.

## 2. MATERYAL VE YÖNTEM

### 2.1. Materyal

Çalışmada, ICARDA (International Center for Agricultural Research in the Dry Areas)'dan temin edilen, ülkemizin farklı bölgelerinden toplanmış olan toplam 250 adet bezelye popülasyonundan, 2008-2012 yılları arasında yapılan çalışmalar neticesinde tek bitki seçimi yapılarak saflaştırılan toplam 60 adet yem bezelyesi hattı ile Türkiye'de ticari olarak yetiştirilen 4 adet yem bezelyesi (Gölyazı, Ulubatlı, Ürünlü, Kirazlı) çeşidinden oluşan, toplam 64 adet bezelye hattı ve çeşidi materyal olarak kullanılmıştır. Araştırmada kullanılan materyallere ait bilgiler Çizelge 1.'de verilmiştir.

Çizelge 1. Araştırmada kullanılacak yem bezelyesi hatları ile ticari çeşitlerine ait bilgiler.

| No | Geliştirilen Hat Sayısı | Orijin |
|---|---|---|
| 1 | 2 | Adıyaman-1988 |
| 2 | 1 | Balıkesir-1995/10 |
| 3 | 2 | Bursa-1995/10 |
| 4 | 1 | Çanakkale-1995/10 |
| 5 | 1 | Denizli-1980/09 |
| 6 | 1 | Edirne-1995/10 |
| 7 | 2 | Elazığ-1980/09 |
| 8 | 2 | İstanbul-1980/09 |
| 9 | 1 | Kars-1980/09 |
| 10 | 2 | Kastamonu-1980/09 |
| 11 | 2 | Kırklareli-1995/10 |
| 12 | 2 | Malatya-1980/09 |
| 13 | 2 | Manisa-1980/09 |
| 14 | 2 | Sakarya-1980/09 |
| 15 | 2 | Tekirdağ-1995/10 |
| 16 | 3 | Tokat-1985/07 |
| 17 | 1 | Afyon-1997/10 |
| 18 | 2 | Bingöl-1997/10 |

| | | |
|---|---|---|
| 19 | 2 | Diyarbakır-1997/10 |
| 20 | 3 | Kars-2003/01 |
| 21 | 2 | Konya-1997/10 |
| 22 | 1 | Manisa-1995/10 |
| 23 | 2 | Tekirdağ-1995/10 |
| 24 | 2 | Karaman-2003/01 |
| 25 | 2 | K. Maraş-2003/01 |
| 26 | 1 | Isparta-2003/01 |
| 27 | 1 | Burdur-2003/01 |
| 28 | 1 | Bolu-2003/01 |
| 29 | 2 | Van-2003/01 |
| 30 | 2 | Hakkari-2003/01 |
| 31 | 2 | Sivas-1985/07 |
| 32 | 1 | Giresun-2003/01 |
| 33 | 2 | Sinop-2003/01 |
| 34 | 1 | Ordu -2003/01 |
| 35 | 2 | Şırnak-2003/01 |
| **Toplam** | **60** | |
| Ticari Çeşitler | | |
| 1 | Gölyazı | Uludağ Üniversitesi |
| 2 | Ulubatlı | Uludağ Üniversitesi |
| 3 | Ürünlü | Uludağ Üniversitesi |
| 4 | Kirazlı | Uludağ Üniversitesi |

## 2.2.Toprak Özellikleri

**Çalışma, Cumhuriyet Üniversitesi, Sivas Meslek Yüksekokulu, Bitkisel ve Hayvansal Üretim Bölümü, Araştırma Uygulama arazisinde yürütülmüştür. Deneme toprağının fiziksel ve kimyasal özellikleri Çizelge 3.3'de verilmiştir. Anılan çizelgede izlendiği gibi denemenin yürütüldüğü topraklar, siltli killi bünyeye sahip kireçli (%19.6) yarayışlı fosfor ($P_20_5$)** içeriği düşük (3.4 kg/da), hafif alkalin pH' ya sahip (7.28), organik madde içeriği düşük (%1.7), tuzsuz (0.33mmhos/cm), potasyum ($K_2O$) içerikleri yüksektir (93.59 kg/da).

## 2.3. Metod

### 2.3.1. Denemenin Kurulması ve Yürütülmesi

Bu araştırma, Cumhuriyet Üniversitesi, Sivas Meslek Yüksek Okulu, Bitkisel ve Hayvansal Üretim Bölümü araştırma deneme alanında2013/2014 yılı yetiştirme mevsiminde yürütülmüştür. Araştırma ile ilgili tarla denemesi 2014 yılı ilkbaharında, her bir bezelye hat ve çeşidine ait tohumlar 4 m uzunluğundaki 5 sıraya, sıra arası 50 cm, sıra üzeri 10 cm olacak şekilde, tesadüf blokları deneme desenine göre kurulmuştur. Deneme 3 tekrarlamalı olarak düzenlenmiştir. (Şekil 3.2. ve Şekil 3.3) Ekimler markörle çiziler açılarak elle yapılmıştır. Denemede toprak analizi sonuçlarına göre ekimden önce 3 kg/da N, 6 kg/da $P_2O_5$ gelecek şekilde gübreleme (18-46) formunda yapılmış ve çıkıştan itibaren yabancı ot mücadelesi elle yolma ve çapalama şeklinde yapılmıştır.

Her lokasyonda, incelenen agronomik özelliklerin tamamı ile gözlem-ölçümler ve hasat/harman işlemleri parsellerin baş ve son kısımlarından 0.5 m bırakılarak her parselde ortadaki üç sırada yapılmıştır.

### 2.3.2.Tarla koşullarında Hastalık Reaksiyonlarının Belirlenmesi

*Çalışmada kullanılan 60 adet bezelye hattı ve 4 ticari çeşidin tarla koşullarında külleme hastalığına reaksiyonlarını belirlemek amacıyla hatlara ait tohumlar yukarıda ekim, bakım ve hasat işlemleri kısmında belirtildiği şekilde* Cumhuriyet Üniversitesi, Sivas Meslek Yüksek Okulu, Bitkisel ve Hayvansal Üretim Bölümü araştırma deneme alanına ekimleri yapılmıştır. Deneme tesadüf bloklar deneme desenine göre üç tekerrürlü olarak kurulmuştur. Bloklarda her bir hat 30 bitkiden oluşan bir sıra ile temsil edilmiştir. Yine her bir blokta hastalık yayılmasını teşvik etmek için beş hattan sonra bir sıra hassas çeşit ekilmiştir. Külleme hastalığıyla bulaşık olan bitki materyalleri, Çukurova üniversitesi, Ziraat Fakültesi, Tarla bitkileri Bölümü tarafından yürütülmekte olan bezelye ıslah çalışmalarının yapıldığı alandan temin edilmiştir. Bitkiler V3 (üçüncü gerçek yaprakların gelişmesini tamamladığı devre) döneminde iken farklı kaynaklardan sağlanan *Erysiphepolygoni*sporları hassas çeşide ait bitkiler üzerine inokule edilerek çoğaltılmıştır. Buradan elde edilen sporlar %0.0025 tween-20 ve %0.1 su agarı solüsyonu içeren çözelti içerisine karıştırılarak hemasitometre yardımı ile spor yoğunluğu 4x100000 spor/ml olacak şekilde ayarlanmıştır. Bitkiler V3 döneminde iken hazırlanan fungusinokulumu basınçlı pülverizatörü yardımı ile bitkilere uygulanmıştır. İnokulasyondan 30 ve 45 gün sonra her sıranın ortasındaki 10 bitkide hastalık şiddeti Falloon ve ark.,1995 tarafından geliştirilen 0-10 (görsel skala) skalası (0= yaprakçıkta hiç leke yok, 1= Yaprakçık alanının %5'i lekeler ile kaplı, 2= Yaprakçık alanının %10'u lekeler ile kaplı, 3= Yaprakçık alanının %15'i lekeler ile kaplı, 4= Yaprakçık alanının %20'si lekeler ile kaplı, 5= Yaprakçık alanının %33'ü lekeler ile kaplı, 6= Yaprakçık alanının %46'sı lekeler ile kaplı, 7= Yaprakçık alanının %60'ı lekeler ile kaplı, 8= Yaprakçık alanının %73'ü lekeler ile kaplı, 9= Yaprakçık alanının %86'sı lekeler ile kaplı, 10= Yaprakçık alanının %100'ü lekeler ile kaplı) modifiye edilerek belirlenmiştir. Genotipler aldıkları skala de*ğerlerine göre, 0: immun,* 1-3 yüksek düzeyde dayanıklı, 4-5 tölarant ve 6-10 hassas olarak gruplandırılmıştır.

### 2.3.3. Verilerin Değerlendirilmesi

Araştırma ile ilgili tarla denemelerinden ve laboratuar analizinden elde edilen verilerin değerlendirilmesinde, özellikler arası ilişkiler ve diğer istatistiki hesaplamalar, MSTAT-C istatistik paket programı kullanılarak yapılmıştır. Elde edilen ortalamaların karşılaştırılması Duncan (%5) testine göre yapılm**ıştır.**

## 3. BULGULAR VE TARTIŞMA

| Genotip | Çiçeklenme Gün Sayısı (gün) | Olgunlaşma Süresi (gün) | Bitki Boyu (cm) | Bitkide Bakla Sayısı (adet) | Bitkide Tohum Sayısı (adet) | Kuru Ot Ham Protein (%) |
|---|---|---|---|---|---|---|
| Adıyaman-1988/1 | 74.3 L-M | 114 | 96.3 D-F | 7.0 F-I | 25.0 C | 14.6 G-N |
| Adıyaman-1988/2 | 69.3 S-U | 105 | 100.3 CD | 7.0 F-I | 18.3 E-H | 14.3 I-N |
| Balıkesir-1995/10 | 65.0 W-X | 100 | 58.7 V-Z | 5.7 H-K | 22.3 C-E | 15.2 E-M |
| Bursa-1995/10/1 | 68.7 T-V | 106 | 47.3 Z | 1.3 S | 6.7 P | 14.7 G-N |
| Bursa-1995/10/2 | 60.0 Z | 98 | 71.0 L-U | 2.7 O-S | 13.3 H-N | 15.9 A-G |
| Çanakkale-1995/10 | 73.3 M-O | 113 | 77.3 I-Q | 5.7 H-K | 22.3 C-E | 15.0 F-N |
| Denizli-1980/09 | 78.3 G-I | 116 | 61.7 T-Z | 2.0 Q-S | 6.7 P | 15.5 B-J |
| Edirne-1995/10 | 72.0 O-Q | 114 | 56.3 X-Z | 6.3 G-J | 12.3 I-O | 15.4 C-L |
| Elazığ-1980/09/1 | 62.3 Z | 99 | 60.0 U-Z | 5.0 J-M | 8.7 N-P | 16.3 A-F |
| Elazığ-1980/09/2 | 77.3 I-J | 117 | 63.3 R-Y | 6.3 G-J | 19.0 D-G | 17.0 A-C |
| İstanbul-1980/09/1 | 75.7 KL | 114 | 41.0 Z | 3.7 L-Q | 9.0 N-P | 17.0 AB |
| İstanbul-1980/09/1 | 63.7 XZ | 98 | 62.7 S-Z | 4.7 J-N | 12.0 J-P | 14.7 G-N |
| Kars-1980/09 | 77.7 I-J | 115 | 81.7 G-M | 5.0 J-M | 9.0 N-P | 14.0 L-P |
| Kastamonu-1980/09/1 | 73.7 MN | 116 | 70.3 L-V | 4.0 K-P | 15.0 G-M | 14.4 H-N |
| Kastamonu-1980/09/2 | 63.7 XZ | 103 | 57.7 W-Z | 3.7 L-Q | 18.0 E-H | 14.3 I-N |
| Kırklareli-1995/10/1 | 61.3 Z | 97 | 70.0 M-V | 4.7 J-N | 13.3 H-N | 14.2 J-O |
| Kırklareli-1995/10/2 | 60.7 Z | 99 | 72.0 K-T | 5.7 H-K | 8.7 N-P | 15.3 D-M |
| Malatya-1980/09/1 | 68.0 UV | 111 | 62.7 S-Z | 3.7 L-Q | 7.0 O-P | 13.6 N-Q |
| Malatya-1980/09/2 | 79.7 D-G | 117 | 110.0 BC | 2.0 Q-S | 8.0 N-P | 14.4 H-N |
| Manisa-1980/01/1 | 73.7 MN | 119 | 85.0 F-J | 4.7 J-N | 19.0 D-G | 14.6 G-N |
| Manisa-1980/01/2 | 67.3 V | 116 | 88.7 D-I | 7.3 E-H | 25.0 C | 12.8 O-R |
| Sakarya-1980/09/1 | 61.0 Z | 99 | 57.0 W-Z | 4.0 K-P | 8.7 N-P | 12.8 O-R |
| Sakarya-1980/09/2 | 64.7 W-Y | 98 | 45.0 Z | 2.0 Q-S | 9.7 M-P | 12.6 P-R |
| Tekirdağ-1995/10/1 | 73.7 MN | 112 | 75.0 J-R | 3.3 M-R | 8.3 N-P | 12.7 P-R |
| Tekirdağ-1995/10/2 | 69.7 R-T | 116 | 67.3 P-X | 2.3 P-S | 11.3 J-P | 12.5 Q-R |
| Tokat-1985/07/1 | 69.7 R-T | 118 | 47.7 Z | 1.3 S | 7.7 O-P | 12.4 Q-R |
| Tokat-1985/07/2 | 69.7 R-T | 115 | 82.0 G-L | 8.0 D-G | 20.0 C-G | 12.8 O-R |
| Tokat-1985/07/3 | 71.0 PR | 119 | 84.3 G-J | 2.7 O-S | 9.0 N-P | 12.0 R |
| Afyon-1997/10 | 69.7 R-T | 114 | 78.7 G-P | 5.3 I-L | 11.3 J-P | 13.6 N-Q |
| Bingöl-1997/10/1 | 76.7 J-K | 116 | 66.3 Q-X | 2.0 Q-S | 8.7 N-P | 14.0 M-P |
| Bingöl-1997/10/2 | 69.7 R-T | 111 | 85.3 E-J | 10.0 BC | 37.0 AB | 13.6 N-Q |
| Diyarbakır-1997/10/1 | 63.3 YZ | 98 | 112.0 BC | 6.33 G-J | 11.3 J-P | 14.8 G-N |
| Diyarbakır-1997/10/2 | 69.3 S-U | 110 | 76.0 J-Q | 4.7 J-N | 16.3 F-J | 14.7 G-N |
| Kars-2003/01/1 | 69.3 S-U | 108 | 97.0 DE | 4.7 J-N | 15.3 G-L | 16.5 A-E |
| Kars-2003/01/2 | 64.3 W-Z | 104 | 80.7 G-N | 6.3 G-J | 17.7 E-I | 15.5 C-K |
| Kars-2003/01/3 | 65.3 W | 103 | 83.3 G-K | 5.0 J-M | 18.0 E-H | 15.4 C-L |
| Konya-1997/10/1 | 78.3 G-I | 120 | 78.3 H-P | 3.0 N-S | 11.3 J-P | 15.2 E-M |
| Konya-1997/10/2 | 63.0 Z | 97 | 82.0 G-L | 2.3 P-S | 8.0 N-P | 15.8 A-H |
| Manisa-1995/10 | 65.7 W | 98 | 51.0 Z | 4.3 K-O | 15.0 G-M | 14.3 I-N |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tekirdağ-1995/10/1 | 75.7 KL | 116 | 113.0 B | 9.0 C-E | 21.7 C-F | 16.4 A-F |
| Tekirdağ-1995/10/2 | 73.7 MN | 112 | 53.0 Y-Z | 2.7 O-S | 8.3 N-P | 15.6 A-J |
| Karaman-2003/01/1 | 63.0 Z | 102 | 56.7 X-Z | 3.0 N-S | 11.7 J-P | 14.2 J-O |
| Karaman-2003/01/2 | 80.7 C-E | 118 | 59.7 U-Z | 2.7 O-S | 8.0 N-P | 14.1 K-P |
| K. Maraş-2003/01/1 | 81.7 BC | 120 | 68.7 O-W | 3.3 M-R | 9.0 N-P | 15.9 A-G |
| K. Maraş-2003/01/2 | 79.3 E-H | 111 | 81.0 G-N | 2.7 O-S | 12.3 I-O | 16.7 A-D |
| Isparta-2003/01 | 81.0 CD | 121 | 74.0 J-S | 3.0 N-S | 11.0 J-P | 16.7 A-D |
| Burdur-2003/01 | 70.7 Q-S | 109 | 71.3 L-U | 4.7 J-N | 16.0 G-K | 13.6 N-Q |
| Bolu-2003/01 | 78.7 F-I | 117 | 69.7 N-V | 3.3 M-R | 12.3 I-O | 14.4 I-N |
| Van-2003/01/1 | 82.7 AB | 124 | 52.3 Y-Z | 1.3 S | 9.3 N-P | 17.0 A |
| Van-2003/01/2 | 78.3 G-I | 122 | 89.3 D-H | 2.7 O-S | 10.0 L-P | 15.7 A-I |
| Hakkari-2003/01/1 | 80.3 C-E | 117 | 79.7 G-O | 3.7 L-Q | 15.0 G-M | 14.6 G-N |
| Hakkari-2003/01/2 | 82.7 AB | 119 | 69.7 N-V | 3.0 N-S | 8.7 N-P | 13.6 N-Q |
| Sivas-1985/07/1 | 83.3 A | 126 | 60.0 U-Z | 4.3 K-O | 20.3 C-G | 16.3 A-F |
| Sivas-1985/07/2 | 79.3 E-H | 121 | 88.7 D-I | 8.7C-F | 38.7 A | 14.0 M-P |
| Giresun-2003/01 | 72.3 N-P | 112 | 83.3 G-K | 10.0 BC | 38.3 A | 14.9 F-N |
| Sinop-2003/01/1 | 73.7 MN | 114 | 89.3 D-H | 3.7 L-Q | 12.0 J-P | 15.0 F-N |
| Sinop-2003/01/2 | 80.0 D-F | 121 | 98.0 D | 9.3 CD | 24.3 CD | 15.6 A-J |
| Ordu -2003/01 | 75.3 KL | 124 | 90.3 D-G | 7.3 E-H | 18.0 E-H | 16.9 AB |
| Şırnak-2003/01/1 | 70.0 R-T | 110 | 62.3S-Z | 2.0 Q-S | 9.3 N-P | 16.3 A-F |
| Şırnak-2003/01/2 | 74.3 LM | 119 | 68.7 O-W | 1.7 R-S | 7.3 O-P | 16.7 A-C |
| Gölyazı | 80.0 D-F | 122 | 79.3 G-O | 3.7 L-Q | 18.3 E-H | 15.5 C-K |
| Ulubatlı | 78.0 H-J | 120 | 85.0 F-J | 4.3 K-O | 10.7 K-P | 15.7 A-I |
| Ürünlü | 68.7 T-V | 111 | 128.7 A | 12.3 A | 32.3 B | 16.3 A-F |
| Kirazlı | 79.3 EH | 124 | 125.7 A | 11.3 AB | 25.3 C | 15.9 A-G |
| **ORTALAMA** | 72.2 | 112 | 75.6 | 4.7 | 14.9 | 14.9 |

| **Genotip** | **Yeşil Ot Verimi (kg/da)** | **Kuru Ot Verimi (kg/da)** | **Biyolojik Verim (gr/ m2)** | **Tane Verimi (kg/da)** | **1000 Tane Ağırlığı (g)** | **Tanede Ham Protein Oranı (%)** |
|---|---|---|---|---|---|---|
| Adıyaman-1988/1 | 1348.0 D-H | 357.9 E-K | 41.0 FG | 379.2 E-J | 143.0 R-V | 20.6 G-N |
| Adıyaman-1988/2 | 1565.0 A | 387.3 C-H | 43.8 EF | 335.2 K-M | 157.0 O-R | 20.4 I-N |
| Balıkesir-1995/10 | 957.3 S-Y | 245.1W-Z | 33.3 J-L | 336.8 KL | 68.0 Z | 21.2 E-M |
| Bursa-1995/10/1 | 793.0 YZ | 202.7 Z | 40.6 FG | 164.7 U | 116.0 Y-Z | 20.7 G-N |
| Bursa-1995/10/2 | 996.0 Q-X | 255.4 U-Z | 46.7 C-E | 205.2 S-U | 109.0 Z | 21.9 A-G |
| Çanakkale-1995/10 | 1350.0 D-H | 308.1 K-T | 31.8 J-M | 175.2 TU | 149.0 Q-U | 21.0 F-N |
| Denizli-1980/09 | 855.3 X-Z | 219.6 Z | 20.3 Q-W | 215.9 R-T | 218.0 D-F | 21.5 B-J |
| Edirne-1995/10 | 923.7 V-Z | 234.3 Y-Z | 12.0 | 200.0 S-U | 117.0 X-Z | 21.4 C |
| Elazığ-1980/09/1 | 1055.0 O-V | 272.3 R-Z | 34.3 I-L | 402.0 C-F | 92.0 Z | 22.3 A-F |
| Elazığ-1980/09/2 | 998.0 S-X | 253.6 U-Z | 13.0z | 322.7 L-N | 113.0Z | 22.7 A-D |
| İstanbul-1980/09/1 | 749.3 | 199.4 Z | 16.7 V-Z | 337.4 J-L | 160.0 O-R | 23.0 AB |
| İstanbul-1980/09/1 | 1030.0 P-W | 267.2 S-Z | 30.9 K-M | 365.3 F-K | 172.0 K-O | 20.7 G-N |
| Kars-1980/09 | 1296.0 F-J | 337.4 H-P | 20.4 Q-W | 345.6 I-L | 157.0 O-R | 20.0 L-Q |
| Kastamonu-1980/09/1 | 933.3 U-Z | 238.6 X-Z | 19.2 S-Y | 399.9 C-F | 172.0 K-O | 20.4 I-N |
| Kastamonu-1980/09/2 | 873.3 W-Z | 232.8 Z | 13.6 Z | 371.5 E-K | 94.0 Z | 20.3 I-N |
| Kırklareli-1995/10/1 | 997.0 Q-X | 257.5 T-Z | 18.9 T-Y | 319.9 L-O | 171.0 K-O | 20.2 J-O |
| Kırklareli-1995/10/2 | 1081.0 N-V | 275.7R-Z | 17.3 U-Z | 354.2 G-L | 222.0 C-F | 21.3 D-M |

| | | | | | | |
|---|---|---|---|---|---|---|
| Malatya-1980/09/1 | 969.0 R-X | 256.7 T-Z | 23.9 O-S | 385.9 E-I | 223.0 C-F | 19.6 N-R |
| Malatya-1980/09/2 | 1487.0 A-D | 376.4 D-I | 19.5 R-X | 292.5 N-Q | 167.0 L-P | 20.4 H-N |
| Manisa-1980/01/1 | 1262.0 F-M | 322.2 J-R | 13.4 Z | 508.6 A | 128.0 V-Z | 20.6 G-N |
| Manisa-1980/01/2 | 1234.0 G-N | 315.9 J-S | 16.1 W-Z | 288.2 NQ | 134.0U-X | 18.8 O-S |
| Sakarya-1980/09/1 | 945.7 T-Z | 246.8 V-Z | 9.5 Z | 112.3 V | 104.0 Z | 18.8 P-S |
| Sakarya-1980/09/2 | 694.7 Z | 198.2 Z | 8.8Z | 251.2 QR | 133.0 U-Y | 18.6 Q-S |
| Tekirdağ-1995/10/1 | 1117. L-S | 220.2 Z | 17.9 U-Z | 338.7 J-L | 163.0 M-Q | 18.7 Q-S |
| Tekirdağ-1995/10/2 | 969.0 R-X | 252.3 U-Z | 10.6 Z | 291.2 N-Q | 182.0 J-L | 18.5 R-S |
| Tokat-1985/07/1 | 788.3 Z | 203.6 Z | 27.6 M-O | 192.0 S-U | 186.0 I-K | 18.4 R-S |
| Tokat-1985/07/2 | 1092. N-U | 290.3 P-W | 22.7 P-T | 501.7 A | 224.0 C-E | 18.8 P-S |
| Tokat-1985/07/3 | 1290. F-K | 341.1 H-O | 12.7Z | 498.4 A | 209.0 E-G | 18.0 S |
| Afyon-1997/10 | 1179. I-P | 298.8 M-U | 35.6 H-J | 383.0 E-I | 95.0 Z | 19.6 N-R |
| Bingöl-1997/10/1 | 853.3 X-Z | 223.0 Z | 25.5 N-P | 270.4 PQ | 136.0 U-W | 20.0 M-Q |
| Bingöl-1997/10/2 | 1230. G-N | 315.7 J-S | 25.0 N-Q | 293.3 M-P | 75.0 Z | 19.6 N-R |
| Diyarbakır-1997/10/1 | 1468. A-E | 361.7 E-J | 20.9 P-V | 410.0C-E | 154.0 P-T | 20.8G-N |
| Diyarbakır-1997/10/2 | 970.3 R-X | 302.3 L-U | 14.6 YZ | 482.4 A | 179.0 J-M | 20.7 G-N |
| Kars-2003/01/1 | 1341.0 D-I | 349.3 G-M | 13.5 Z | 383.0 E-I | 133.0 U-X | 22.50A-E |
| Kars-2003/01/2 | 1055.0 O-V | 268.6 S-Z | 11.7 | 468.5 A-B | 103.0Z | 21.5 C-K |
| Kars-2003/01/3 | 1119.0 L-S | 286.0 P-X | 18.1 T-Z | 391.0 E-G | 257.0 A | 21.4 C-L |
| Konya-1997/10/1 | 1127.0 K-R | 285.7 Q-Y | 19.4 S-X | 437.7 B-D | 182.0 J-L | 21.2 E-M |
| Konya-1997/10/2 | 1154.0 J-Q | 339.0 H-O | 12.8 Z | 478.4 AB | 87.0 Z | 21.8 A-H |
| Manisa-1995/10 | 717.3 Z | 205.0 Z | 16.8 V-Z | 190.5 S-U | 62.0 Z | 20.3 I-N |
| Tekirdağ-1995/10/1 | 1585.0 A | 419.0 A-D | 31.7 J-M | 400.0 C-F | 207.0 F-H | 22.4 A-F |
| Tekirdağ-1995/10/2 | 739.7 | 209.3 Z | 21.6 P-U | 387.7 E-H | 184.0 I-K | 21.6 A-J |
| Karaman-2003/01/1 | 876.0 W-Z | 251.7 U-Z | 19.7 R-X | 405.4 C-F | 208.0 E-G | 20.2 J-P |
| Karaman-2003/01/2 | 868.3 W-Z | 235.7 X-Z | 32.1 J-M | 408.6 C-E | 179.0 J-M | 20.1 K-Q |
| K. Maraş-2003/01/1 | 1103.0 M-T | 297.7N-V | 53.7 A | 346.7 H-L | 209.0 E-G | 21.9 A-G |
| K. Maraş-2003/01/2 | 1306.0 E-J | 329.0 I-Q | 29.7 L-N | 340.3 J-L | 147.0 Q-U | 22.7 A-D |
| Isparta-2003/01 | 1210.0 H-O | 314.7 J-S | 13.3 Z | 487.4 A | 159.0 O-R | 22.7 A-D |
| Burdur-2003/01 | 1308.0 E-J | 349.3 G-M | 46.6 C-E | 439.0 BC | 200.0 G-I | 19.6 N-R |
| Bolu-2003/01 | 1172.0 J-P | 353.7 F-L | 11.9 Z | 193.4 S-U | 244.0 AB | 20.4 I-N |
| Van-2003/01/1 | 865.7 W-Z | 284.0 Q-Z | 8.6 Z | 400.6 C-F | 148.0 Q-U | 23.0 A |
| Van-2003/01/2 | 1423.0 A-F | 376.7 D-I | 10.3 Z | 384.8 E-I | 139.0 T-W | 21.7 A-I |
| Hakkari-2003/01/1 | 1363.0 C-H | 404.0 B-F | 46.0 DE | 290.7 N-Q | 231.0 B-D | 20.6 G-N |
| Hakkari-2003/01/2 | 1238.0 G-N | 445.3 AB | 49.9 A-D | 482.4 A | 139.0 S-W | 19.6 N-R |
| Sivas-1985/07/1 | 850.0 X-Z | 232.3 Z | 50.8 A-C | 195.3 S-U | 134.0 U-X | 22.3 A-F |
| Sivas-1985/07/2 | 1270.0 F-L | 340.3 H-O | 38.6 G-I | 198.3 S-U | 123.0 W-Z | 20.0 M-Q |
| Giresun-2003/01 | 1298.0 F-J | 396.7 B-G | 49.3 A-D | 375.1 E-K | 185.0 I-K | 20.9 F-N |
| Sinop-2003/01/1 | 1392.0 B-G | 433.3 A-C | 24.1 O-R | 409.9C-E | 162.0 N-Q | 21.0 F-N |
| Sinop-2003/01/2 | 1497.0 A-D | 427.3 A-D | 15.1 X-Z | 474.9 AB | 157.0 O-R | 21.6 A-J |
| Ordu -2003/01 | 1344.0 D-H | 381.0 D-H | 34.5 I-K | 278.1 O-Q | 156.0 O-S | 22.9 AB |
| Şırnak-2003/01/1 | 1049.0 O-V | 380.7 D-H | 17.7 U-Z | 287.9 N-Q | 185.0 I-K | 22.3 A-F |
| Şırnak-2003/01/2 | 974.7 R-X | 348.7 G-N | 48.1 B-E | 225.7 RS | 235.0 BC | 22.7 A-C |
| Gölyazı | 1098.0 M-T | 317.0 J-S | 30.7K-M | 392.3 E-G | 186.0 I-K | 21.5 C-K |
| Ulubatlı | 1291.0 F-K | 406.7 B-E | 52.4 AB | 375.4 E-K | 179.0 J-N | 21.7 A-I |
| Ürünlü | 1515.0 A-C | 393.0 C-G | 17.7 U-Z | 348.3 H-L | 182.0 J-L | 22.3 A-F |
| Kirazlı | 1535.0 AB | 466.3 A | 39.4 F-H | 396.3D-F | 190.0 H-J | 21.9 A-G |
| **ORTALAMA** | 1125.55 | 306.20 | 25.7 | 343.814 | 160.0 | 20.9 |

## 3.1.*Çiçeklenme* Gün Sayısı (gün)

Bu araştırmada elde edilen ***Çiçeklenmegünsayısına***ilişkin değerler, ülkemizde bezelye üzerine yapılan bazı çalışmalarla karşılaştırıldığında; Diyarbakır ekolojik koşullarında incelenen yem bezelyesi genotiplerinde yapılan kışlık ekimlerde %50 çiçeklenmeye kadar geçen sürenin 159 ile 175 gün arasında değiştiği bildirilmiştir (Sayar, 2007). Çiçeklenme gün sayısına ilişkin elde edilen değerlerin bizim değerlerimizden yüksek çıkmasının nedeni, kışlık ekim yapılması ve doğal

olarak vejetasyon süresinin daha uzun olmasından kaynaklanmaktadır.

### 3.2.Olgunlaşma Süresi (gün)

Araştırmada incelenen çeşitlerin, olgunlaşma süresi değerleri 97-126 gün arasında değişmiş, en yüksek olgunlaşma süresi değeri (126 gün) Sivas-1985/07/1yem bezelyesi genotipinden, en düşük değer (97 gün) ise Kırklareli-1995/10/1 ve Konya-1997/10/2 yem bezelyesi genotipinden elde edilmiştir. İklim verileri dikkate alındığında, bölgemizde vejetasyon süresinin oldukça kısa olduğu görülmektedir. Tarlayı erken terk etmesi, bölgede görülebilecekerken sonbahar donlarından ve külleme hastalığından kaçma bakımından erkenci çeşitler yetiştiricilik açısından büyük bir avantaj sağlamaktadır.

### 3.3.Bitki Boyu (cm)

En yüksek bitki boyu değeri (128.7 cm)Ürünlü yem bezelyesi çeşidinden, en düşük değer (41.0 cm) ise İstanbul-1980/09/1 yem bezelyesi genotipinden elde edilmiştir. Ortalama bitki boyu değerinin 75.6 cm olduğu görülmektedir.

Yeşil ot üretimi bakımından yetiştirilen yem bezelyesi genotiplerinin bol miktarda yeşil aksam üretmeleri arzu edilir. Bu nedenle erkenci, uzun boylu ve külleme hastalığına yakalanmayan yem bezelyesi genotipleri bölgemizde kaba yem üretimi bakımından son derece önem taşımaktadır.

Bu araştırmada elde edilen bitki boyuna ilişkin değerler, farklı morfolojik özelliklerde olduğu gibi bitki boyu değerlerinin de birbirinden farklılık göstermesi beklenen sonuçlardan birisidir. Farklı bezelye genotipleri üzerinde yapılan bir çok araştırmada, hem yıllar arasında hem de çeşit veya hatlar arasında benzer bulgular saptanmıştır.

### 3.4.Bitkide Bakla Sayısı (adet)

Araştırmada incelenen çeşitlerin, bitkide bakla sayısı değerleri 1.3-12.3 adet arasında değişmiş, en yüksek bitkide bakla sayısı değeri (12.3 adet)Ürünlü yem bezelyesi çeşidinden, en düşük değer (1.3 adet) ise Bursa-1995/10/1yem bezelyesi genotipinden elde edilmiştir. Ortalama bitkide bakla sayısı değerinin 4.7 adet olduğu görülmektedir. Bitkide bakla sayısı değerleri yeşil ot verimi kadar tohum üretimi açısından da önem taşımaktadır. Araştırmanın yürütüldüğü 2013-14 yetiştirme sezonunda gece gündüz sıcaklık farklarının yüksek seyretmesi çiçeklenme döneminde açan çiçeklerin büyük bir kısmının döllenmeden dökülmesine yol açmış bu durum bitki başına bakla sayısının düşmesine neden olmuştur. Elde edilen bu bulgular, önemli bir verim komponenti olan bitkide bakla sayısı yönünden eldeki materyalin önemli bir varyasyona sahip olduğunu göstermektedir.

### 3.5.Bitkide Tohum Sayısı (adet)

Araştırmada incelenen çeşitlerin, bitkide tane sayısı değerleri 6.7-38.7 adet arasında değişim göstermiş, en yüksek bitkide tane sayısı değeri (38.7 adet) Sivas-1985/07/2 yem bezelyesi genotipinden, en düşük değer (6.7 adet) ise Denizli-1980/09 yem bezelyesi genotipinden elde edilmiştir. Ortalama bitkide tane sayısı değerinin 14.9 adet olduğu görülmektedir.

### 3.6.Kuru Ot Ham Protein Oranı (%)

Kuru ot ham protein değerleri bakımından elde edilen veriler incelendiğinde, kuru ot ham protein değerlerinin % 12.0-17.0 arasında değiştiği, en yüksek kuru ot ham protein değerinin (% 17.0) Van-2003/01/1, Elazığ-1980/09/2 ve İstanbul-1980/09/1 yem bezelyesi genotiplerinden, en düşük değerin (% 12) ise Tokat-1985/07/3 yem bezelyesi genotipinden elde edildiği belirlenmiştir. Ortalama kuru ot ham protein değerinin %14.9 olduğugörülmektedir. Bitkilerdeki ham protein oranı çok sayıda bitkisel ve çevresel faktöre bağlı olarak değişkenlik gösterebilmektedir. Genel olarak daha fazla yapraklı ve sapları ince olan materyaller daha yüksek ham protein oranı içermektedir.

### 3.7.Yeşil Ot Verimi (kg/da)

Yeşil ot verimi değerleri bakımından elde edilen veriler incelendiğinde, yeşil ot verimi değerlerinin 694.7-1585.0 kg/da arasında değiştiği, en yüksek yeşil ot verimi değerinin (1585.0 kg/da) Tekirdağ-1995/10/1 yem bezelyesi genotipinden, en düşük değerin (694.7 kg/da) ise Sakarya-1980/09/2 yem bezelyesi genotipinden elde edildiği belirlenmiştir.

Ortalama yeşil ot verimi değerinin 1125.5 kg/da olduğu görülmektedir. Bölgemiz koşullarına uygun yüksek yeşil ot verimine sahip çeşitlerin yaygın olarak yetiştirilmesi ile Sivas ve yöresinde hayvancılık yapan işletmelerin en önemli sorunlarından olan yem açığının azaltılmasına katkı sağlamış olacaktır. Ayrıca, ilimiz büyük baş hayvan varlığı (339.843 adet) dikkate alındığında, yüksek ot verimine sahip, kaliteli yeni yem bezelyesi çeşitlerinin bölge hayvancılığı açısından önemi ortaya çıkmaktadır.

### 3.8.Kuru Ot Verimi (kg/da)

Araştırmada incelenen çeşitlerin, kuru ot verimi değerleri 198.2-466.3 kg/da arasında değişim göstermiş, en yüksek kuru ot verimi değeri (466.3 kg/da) Kirazlı yem bezelyesi çeşidinden, en düşük değer (198.2 kg/da) ise Sakarya-1980/09/2 yem bezelyesi genotipinden elde edilmiştir. Ortalama kuru ot verimi değerinin 306.2 kg/da olduğu görülmektedir. Yem bezelyesi genotiplerinin kuru ot verimleri arasında farklılıkların oluşması beklenen bir sonuçtur. Bu durum yem bezelyesi ile çalışan birçok araştırıcı tarafından da vurgulanmıştır.

### 3.9.Biyolojik Verim(g/m$^2$)

Biyolojik verimi değerleri bakımından elde edilen veriler incelendiğinde (Çizelge 4.26), biyolojik verim değerlerinin 8.6-53.7 g/m$^2$ arasında değiştiği, en yüksek biyolojik verimi değerinin (53.7g/m$^2$) K. Maraş-2003/01/1 yem bezelyesi genotipinden, en düşük değerin (8.6g/m$^2$) ise Van-2003/01/1 yem bezelyesi genotipinden elde edildiği belirlenmiştir. Ortalama biyolojik verim değerinin 25.7g/m$^2$olduğu görülmektedir.

### 3.10.Tane Verimi (kg/da)

Araştırmada incelenen çeşitlerin, tane verimi değerleri 112.3-508.6 kg/da arasında değişim göstermiş, en yüksek tane verimi değeri (508.6 kg/da) Manisa-1980/01/1yem bezelyesi genotipinden, en düşük değer (112.3 kg/da) ise Sakarya-1980/09/1 yem bezelyesi genotipinden elde edilmiştir. Tohum verimi gerek çevresel gerekse genetik faktörlerin karşılıklı etkileşimi sonucu değişkenlik gösterebilen kompleks bir özelliktir. Verim değerlerinin genotiplere göre değişiklik göstermesi; materyallerin genetik yapılarının farklı olmasından ve çevre faktörlerinden farklı düzeyde etkilenmelerinden kaynaklanmaktadır (Önder ve Ceyhan, 2001).

### 3.11. 1000 Tane Ağırlığı (g)

Araştırmada incelenen çeşitlerin, 1000 tane ağırlığı değerleri 62.0 -257.0 g arasında değişmiş, en yüksek 1000 tane ağırlığı değeri (257.0 g)Kars-2003/01/3 yem bezelyesi genotipinden, en düşük değer (62.0 g) ise Denizli-1980/09 yem bezelyesi genotipinden elde edilmiştir. Farklı ekolojilerde yetiştirilen yem bezelyesi genotiplerinin birçok bitkisel özelliğinde olduğu gibi tane ağırlıklarında da önemli farklılıkların olması beklenmektedir. Karadeniz Bölgesinden toplanan bezelyelerde çalışan Karayel ve Bozoğlu (2008) bezelyede tane boyutunun küçük taneli tiplerden iri taneli tiplere kadar büyük varyasyon gösterdiğini 1000tane ağırlıklarının 37 g ile 103 g arasında değiştiğini bildirmişlerdir.

### 3.12.Tanede Ham Protein Oranı (%)

Araştırmada incelenen çeşitlerin, tanede ham protein değerleri % 18.0-23.0arasında değişim göstermiş, en yüksek tanede ham protein değeri (% 23.0) Van-2003/01/1 ve İstanbul-1980/09/1 yem bezelyesi genotiplerinden, en düşük değer (%18.0) ise Tokat-1985/07/3 yem bezelyesi genotipinden elde edilmiştir. Ortalama tanede ham protein değerinin %20.9 olduğu görülmektedir. Yem bezelyesi tanelerinin yem olarak enerji değeri oldukça yüksektir. Açıkgöz (2001)'ün bildirdiğine göre, yem bezelyesi tohumlarında %26.5 ham protein bulunmaktadır. Protein ve lysine bakımından zengin olan yem bezelyesi tohumları Batı Avrupa ülkelerinde hayvan yemlerinde soyanın yerine kullanılmaktadır. Çalışmamızda elde edilen tohumda ham protein değerleri oldukça geniş bir varyasyon göstermekte olup, bu genotiplerin aynı zamanda tane yem olarak kullanabileceği fikrini uyandırmaktadır.

### 3.13.Bezelye Genotiplerinin Külleme Hastalığına Karşı Gösterdikleri Reaksiyon

Araştırmada ele alınan yem bezelyesi genotiplerinde, külleme hastalığına karşı gösterdikleri reaksiyona ait skala değerleri bakımından elde edilen veriler incelendiğinde Van-2003/01/1 (10), Van-2003/01/2 (10), Sinop-2003/01/2 (10), Sivas-1985/07/1 (10), Ordu-2003/01 (10), Çanakkale-1995/10 (9), Elazığ-1980/09/2 (9), Tokat-1985/07/1 (9), Tokat-1985/07/3 (9), Konya-1997/10/01 (9), Kahramanmaraş-2003/01/1 (9), Isparta-2003/01 (9), Hakkari-2003/01/1 (9), Hakkari-2003/01/2 (9), Denizli-1980/09 (8), Kars-1980/09 (8), Malatya-1980/09/2 (8), Manisa-1980/01/1 (8), Tekirdağ-1995/10/2 (8), Tokat-1985/07/2 (8), Bolu-2003/01 (8) ve Sivas-1985/07/2 (8) yem bezelyesi genotiplerinin 8, 9, 10 değerleri aldıkları ve külleme hastalığına karşı oldukça hassas oldukları belirlenmiştir.

Kırklareli-1995/10/1 (0), Kırklareli-1995/10/2 (0), Sakarya-1980/09/1 (0), Sakarya-1980/09/2 (0), Diyarbakır-1997/10/1 (0), Kars-2003/01/2 (0), Kars-2003/01/3 (0), Manisa-1995/10 (0), Karaman-2003/01/1 (0), Bursa-1995/10/2 (1), Elazığ-1980/09/01 (1), Kastamonu-1980/09/2 (1), Konya-1997/10/2 (1), Adıyaman-1988/2 (2), Balıkesir-1995/10 (2), Bingöl-1997/10/1 (2), Şırnak-2003/01/1 (2), Diyarbakır-1997/10/1 (3), Tekirdağ-1995/10/1 (3), İstanbul-1980/09/1 (4), Malatya-1980/09/1 (4), Kars-2003/01/1 (4), Kahramanmaraş-2003/01/2 (4), Burdur-2003/01 (4), Giresun-2003/01 (4) ve Sinop-2003/01/1 (4) yem bezelyesi genotiplerininskala değerlerini aldıkları belirlenmiştir. Çalışmada kontrol olarak kullanılan çeşitlerden, Kirazlı (8), Ulubatlı (6), Gölyazı (5) ve Ürünlü (1) değerlerine sahip olmuşlar, Kirazlı, Ulubatlı ve Gölyazı çeşitleri külleme hastalığından etkilenirken, Ürünlü çeşidi hastalığa dayanıklılık göstermiştir.

Azmat ve ark. (2012),yürüttükleri çalışmada *Erysiphepolygoni*DC'nin neden olduğu külleme hastalığının bezelye bitkisinin kalitesini ve verimini önemli ölçüde azalttığını bildirmişler. Küllemeye dayanıklı çeşitlerin geliştirilmesinin son derece önemli olduğunu, ekonomik ve çevreyle dost yöntemler kullanılarak hastalığın kontrol altına alınmasının son derece önemli olduğunu vurgulamışlardır. Farklı ülkelerden toplanan 146 bezelye genotipiküllemeye dayanıklılık/hassasiyet durumlarına göre test edilmiştir. 9057, 9370, 9375, 10609, 10612, 18293, 18412, 19598, 19611, 19616, 19727, 19750, 19782, 20126, 20152, 20171, It-96, 267, ve 380 numaralı bezelye genotiplerinin külleme hastalığına karşı toleranslı olduğu; It-96 ve 267 numaralı genotiplerin ise dayanıklı olduğu tespit edilmiştir. Hastalık değerleri ve gelişme periyodu arasındaki korelasyonun negatif olması, küllemeye karşı daha hassas tarama için bu parametrelerin aynı anda kullanılması gerektiğini belirtmişlerdir. Bezelye külleme hastalığının verim üzerine etkilerini inceleyen diğer bir çalışmada, külleme hastalığının ikiticari (Mingo-Mark ve Meteor) çeşidi tamamıyla enfekte ettiğini, beş adet hattın dayanıklı, bir tanesinin toleranslı, dört adet hattın da hassas olduğunu bildirmişlerdir. Dayanıklı hatlar arasında yer alan PS-310539 hattının tohum veriminin 1406 kg/ha olduğunu, bunu sırasıyla PS-810106 (1274 kg/da), PS-210377 (1203 kg/ha) ve PS-310396 (1164 kg/ha) hatlarının izlediğinikülleme hastalığına yakalanmayan bezelye genotiplerinin daha yüksek tane verimine sahip olduklarını belirtmişlerdir (Jan ve ark. 2007).

Tarnap Tarımsal Araştırma Enstitüsü, Peşaver, Pakistan'da 2009-2010 yetiştirme sezonunda, 8 bezelye hattının bazı agronomik özellikleri ve külleme hastalığına karşı reaksiyonlarını belirlemek amacıyla yürütülen diğer bir çalışmada,

8 bezelye hattından 4 adeti dayanıklı, 3 adeti orta düzeyde dayanıklı, 1 adeti de hassas olarak bulunmuştur. Külleme hastalığına dayanıklı yada toleranslı olan bezelye genotiplerinin, bitki başına bakla sayısı, baklada tane sayısı ve vejetatif olarak daha üşütün olduklarını belirlemişlerdir(Shahid ve ark. 2010).

Yapılan bir diğer çalışmada 60 farklı ülkeden toplanan toplam 701 tarla ve bahçe tipi bezelye genotipinin, doğal epidemi koşullarında külleme hastalığına karşı reaksiyonlarını incelenmiş, 3 yıl sürdürülen tarla çalışmalarının neticesinde 57 bezelye genotipi külleme hastalığına karşı dayanıklılık göstermiş ancak laboratuvar çalışmaları sonucunda 10 farklı ülkeden 14 adet bezelye genotipi*Eriysiphepisi*'nin en yaygın izolatlarına karşı dayanıklı olduğu belirlenmiştir. Külleme hastalığına karşı yeter düzeyde dayanıklılık gösteren bezelye genotiplerinin aynı zamanda agronomik olarak da üstünlük gösterdiklerini bildirmişlerdir (Rana ve ark. 2012). Bulgularımız araştırıcıların bulguları ile benzerlik göstermektedir.

Ayrıca, gözlemlerimiz neticesinde bezelye genotiplerinin külleme hastalığına karşı gösterdikleri reaksiyonun, genotiplerin erkenci yada geççi oluşlarına göre değişiklik gösterdiği, erkenci çeşitlerin hastalıktan kaçarak bir bakıma dayanıklılık gösterdikleri, geççi çeşitlerin ise hastalığa yakalandıkları saptanmıştır.

Çizelge 3. Genotiplerin Hastalık Düzeyi

| **Genotip** | **Hastalık Düzeyi (0-10)** | **Genotip** | **Hastalık Düzeyi (0-10)** |
|---|---|---|---|
| Adıyaman-1988/1 | 6 | Konya-1997/10/2 | 1 |
| Adıyaman-1988/2 | 2 | Manisa-1995/10 | 0 |
| Balıkesir-1995/10 | 2 | Tekirdağ-1995/10/1 | 3 |
| Bursa-1995/10/1 | 5 | Tekirdağ-1995/10/2 | 6 |
| Bursa-1995/10/2 | 1 | Karaman-2003/01/1 | 0 |
| Çanakkale-1995/10 | 9 | Karaman-2003/01/2 | 5 |
| Denizli-1980/09 | 8 | K. Maraş-2003/01/1 | 9 |
| Edirne-1995/10 | 7 | K. Maraş-2003/01/2 | 4 |
| Elazığ-1980/09/1 | 1 | Isparta-2003/01 | 9 |
| Elazığ-1980/09/2 | 9 | Burdur-2003/01 | 4 |
| İstanbul-1980/09/1 | 7 | Bolu-2003/01 | 8 |
| İstanbul-1980/09/1 | 4 | Van-2003/01/1 | 10 |
| Kars-1980/09 | 8 | Van-2003/01/2 | 10 |
| Kasta-monu-1980/09/1 | 6 | Hakkari-2003/01/1 | 9 |
| Kasta-monu-1980/09/2 | 1 | Hakkari-2003/01/2 | 9 |
| Kırklareli-1995/10/1 | 0 | Sivas-1985/07/1 | 10 |
| Kırklareli-1995/10/2 | 0 | Sivas-1985/07/2 | 8 |
| Malatya-1980/09/1 | 4 | Giresun-2003/01 | 4 |
| Malatya-1980/09/2 | 8 | Sinop-2003/01/1 | 4 |
| Manisa-1980/01/1 | 8 | Sinop-2003/01/2 | 10 |
| Manisa-1980/01/2 | 6 | Ordu -2003/01 | 10 |
| Sakarya-1980/09/1 | 0 | Şırnak-2003/01/1 | 2 |
| Sakarya-1980/09/2 | 0 | Şırnak-2003/01/2 | 7 |
| Tekirdağ-1995/10/1 | 5 | Gölyazı | 5 |
| Tekirdağ-1995/10/2 | 8 | Ulubatlı | 6 |
| Tokat-1985/07/1 | 9 | Ürünlü | 1 |
| Tokat-1985/07/2 | 8 | Kirazlı | 8 |
| Tokat-1985/07/3 | 9 | **ORTALAMA** | 5 |
| Afyon-1997/10 | 5 | | |

| | | | |
|---|---|---|---|
| Bingöl-1997/10/1 | 2 | | |
| Bingöl-1997/10/2 | 6 | | |
| Diyar-bakır-1997/10/1 | 0 | | |
| Diyar-bakır-1997/10/2 | 3 | | |
| Kars-2003/01/1 | 4 | | |

## 4. SONUÇ

Çalışmada, ICARDA (International Center for Agricultural Research in the Dry Areas)'dan temin edilen, ülkemizin farklı bölgelerinden toplanmış olan toplam 250 adet bezelye popülasyonundan, 2008-2012 yılları arasında yapılan çalışmalar neticesinde tek bitki seçimi yapılarak saflaştırılan toplam 60 adet yem bezelyesi hattı ile Türkiye'de ticari olarak yetiştirilen 4 adet yem bezelyesi (Gölyazı, Ulubatlı, Ürünlü, Kirazlı) çeşidinden oluşan, toplam 64 adet bezelye hattı ve çeşidi materyal olarak kullanılmıştır.Agro-morfolojik özellikler ve külleme hastalığına karşı oluşan reaksiyonlar incelenerek ortaya konulmuştur.

Çalışmada elde edilen başlıca sonuçlar ve öneriler aşağıda maddeler halinde verilmiştir.

1. Araştırma sonucunda ülkemizin farklı bölgelerinden toplanarak yapılan ıslah çalışmaları sonucunda saflaştırılan yem bezelyesi genotipleri arasında, incelenen özellikler yönünden önemli varyasyon saptanmıştır. Bu durum ileriki yıllarda sürdürülebilecek yem bezelyesi ıslahı programlarında, seleksiyon ve melezleme çalışmalarında eldeki materyalden yararlanılabileceğini ortaya koymaktadır.

2. Tüm genotip içerisinde, Adıyaman-1988/2 (1565.0 kg/da), Malatya-1980/09/2 (1487.0 kg/da), Sinop-2003/01/2 (1497.0 kg/da), Diyarbakır-1997/10/1 (1468.0 kg/da), Van-2003/01/2 (1423.0 kg/da), Sinop-2003/01/1 (1392.0 kg/da), Hakkari-2003/01/1 (1363.0 kg/da), Çanakkale-1995/10 (1350.0 kg/da), Adıyaman-1988/1 (1348 kg/da), Ordu-2003/01 (1344.0 kg/da), Kars-2003/01/1 (1341.0 kg/da), Burdur-2003/01 (1308 kg/da), Kahramanmaraş-2003/01/2 (1306 kg/da), Giresun-2003/01 (1298.0 kg/da) ve Kars-1980/09 (1296.0 kg/da) yem bezelyesi genotiplerinin 1000 kg/da üzerinde yeşil ot verimine sahip oldukları ve Sivas ili ekolojik koşullarında üzerinde durulması gereken genotipler oldukları belirlenmiştir.

3. Araştırmada kullanılan yem bezelyesi genotiplerinin kalite kriterleri bakımından geniş varyasyon gösterdikleri, Ordu-2003/01 (%22.9), Şırnak-2003/01/2 (%22.7), Kahramanmaraş-2003/01/2 (%22.7), Isparta-2003/01 (%22.7), Elazığ-1980/09/2 (%22.7), Kars-2003/01/1 (%22.5), Tekirdağ-1995/10/1 (%22.4), Sivas-1985/07/1 (%22.3), Elazığ-1980/09/1 (%22.3), Bursa-1995/10/2 (%21.9) ve Kahramanmaraş-2003/01/1 (%21.9) genotiplerinin yaklaşık %22 ve üzerinde tanede ham protein oranı değerlerine, Ordu-2003/01 (%16.9), Şırnak-2003/01/2 (% 16.7), Isparta-2003/01 (%16.7), Kahramanmaraş-2003/01/2 (%16.7), Kars-2003/01/1 (%16.5), Tekirdağ-1995/10/01 (%16.4), Şırnak-2003/01/1 (%16.3), Sivas-1985/07/1 (%16.3), Elazığ-1980/09/1 (%16.3), Bursa-1995/10/2 (%15.9), Kahramanmaraş-2003/01/1 (%15.9), Konya-1997/10/02 (%15.8), Van-2003/01/2 (%15.7), Tekirdağ-1995/10/2 (%15.6), Sinop-2003/01/2 (%15.6) ve Kars-2003/01/2 (15.5) yem bezelyesi genotiplerinin %15'in üzerinde kuru ot ham protein değerlerine sahip oldukları ve materyal olarak yem bezelyesi genotiplerinin ıslah çalışmalarında iç ve dış pazarın istekleri doğrultusunda çeşit geliştirilmesinde genetik kaynak olarak kullanılabileceği saptanmıştır.

4. Araştırmada kullanılan yem bezelyesi genotipleri külleme hastalığına karşı farklı düzeylerde reaksiyon göstermişler, Kırklareli-1995/10/1 (0), Kırklareli-1995/10/2, Sakarya-1980/09/1, Sakarya-1980/09/2, Diyarbakır-1997/10/1,

Kars-2003/01/2, Kars-2003/01/3, Manisa-1995/10, Karaman-2003/01/1, Bursa-1995/10/2, Elazığ-1980/09/01, Kastamonu-1980/09/2, Konya-1997/10/2, Adıyaman-1988/2, Balıkesir-1995/10, Bingöl-1997/10/1, Şırnak-2003/01/1, Diyarbakır-1997/10/1, Tekirdağ-1995/10/3 yem bezelyesi genotiplerinin külleme hastalığına dayanıklı oldukları belirlenmiştir. Bezelye genotiplerinin külleme hastalığına karşı gösterdikleri reaksiyon genotiplerin erkenci yadageççi oluşlarına göre değişiklik göstermiştir. Erkenci çeşitler hastalıktan kaçarak bir bakıma dayanıklılık göstermişler, geççi çeşitler ise hastalığa yakalanmışlardır.

5. Tüm bu sonuçların ışığı altında, ümitli görülen yem bezelyesi genotipleri seçilmiş olup, çeşit geliştirmeye yönelik olarak ıslah çalışmaları sürdürülmektedir.

Yem bezelyesi ve diğer birçok bitki için ülkemiz önemli genetik kaynaklara sahip olup, bu genetik kaynakların benzer yada daha büyük çalışmalarla değerlendirilmesi ve hızla ıslah programlarına entegre edilmesi gerekmektedir. Yem bezelyesi genotiplerinin Sivas ili ekolojik koşullarında gerek agro-morfolojik gerekse külleme hastalığına karşı reaksiyonlarının değerlendirilmesi amacını taşıyan bu çalışmaya benzer yeni çalışmalar devreye sokularak, disiplinler arası çalışmalarla ıslah programlarında kullanılarak biyotik ve abiyotik stres koşullarına dayanıklı, makineli hasada uygun, yüksek verimli ve kaliteli yeni çeşitler geliştirilerek üretime katılmalıdır.

## KAYNAKLAR


Açıkgöz, E. ve Çelik, N., (1986). Bursa kıraç koşullarında bazı önemli tek yıllık baklagil yem bitkilerinin kuru ot verimi ve kalitesi üzerinde ön araştırmalar. Uludağ Üniversitesi Ziraat Fakültesi Dergisi. 5: 47-53.

Açıkgöz, E.,(2001). Yem Bitkileri. Uludağ Üniv. Güçlendirme Vakfı Yay No: 182. Bursa.

Anonymous, (2001). A nuclear lamin is requiredforcytoplasmicorganizationandeggpolarityinDrosophila.Guillemin et al., 2001, Nat. Cell Biol. 3(9): 848—851.

Azmat, M.A.,Khan, A.A., Saeed, A., Ashraf, M. ve Niaz, S., (2012). ScreeningPeaGermplasmAgainstErysiphepolygoniforDiseaseSeverityandLatentPeriod. International Journal of Vegetable Science, 18:153–160.

Braun, U., (1995). The Powdery Mildews (Erysiphales) of Europe. Gustav Fischer Verlag, New York, N.Y. pp.337.

Cook, R.T.A. andFox, R.T.V., (1992). *Erysiphe pisi* var. *pisi*on fababeansandotheregumes in Britain. PlantPathology, 41: 506-512.

Davies, D. R., (1976). Peas, In: Simmonds N.W. (ed), volution of cropplants. Longman, London, pp. 172-174.

Deniz, O., (1967). Yem Bezelyesinin Ham ve Hazm olabilir Besin Maddeleriyle Kalsiyum, Fosfor ve Protein Değerleri, Ankara Çayır-Mer'a Yem bitkileri ve ZooteknikAraşt. Enst. Ayyıldız Matbaası A.Ş., Ankara, 91 s.

Gritton, E.T. and Ebert, R.D., (1975). Interaction of plantingdateandpowderymildew on peaplantperformance. J. Amer. Soc. Hort. Sci.,100: 137-142.

Govorov, L.I., (1937). PisumPp. 231-336 in N.I. Vavilovand E.V. Wulff, eds. Flora of CultivatedPlants. IV. GrainLeguminosae. StateAgricultural Publishing Company, Moscow, Leningrad.

Hagedorn, D. J., (1984). Compendium of peadisases. University of Wisconsin-Madison.

Höslin S.M., (1964). Gemüsebau. ErzeugungundAbsatz. BayerischerLandwirtschaftverlagGm BH, Munchen.

Jan, K.,Muhammad, A., Muhammad, S., (2007). Screening of Advanced PeaLinesForYieldAndResistanceAgainstPow-

deryMildew in KaghanValley (NWFP), Pakistan Sarhad J. Agric. Vol. 23, No. 2.

Karayel R. ve Bozoğlu, H., (2013), OMÜ Zir. Fak. Dergisi, 2008,23(1):32-38 J. of Fac. of Agric., OMU, 2008,23(1):32-38.

Önder, M., Ceyhan, E., (2001). Orta Anadolu Şartlarında Farklı Ekim Zamanlarında Ekilen Bezelye (Pisumsativum L.) Çeşitlerinde Tane Verimi ile Bazı Morfolojik Özellikler Arasındaki İlişkiler., S.Ü. Ziraat FakUltesi Dergisi Sayl:15 (25): 172- 183.

Rana, J.C.,Banyal, D.K., Sharma, K.D., Manish, K., Yadav, K., (2012).Screening of peagermplasmforresistancetopowderymildewReceived: 24 March 2012 / Accepted: 12 September 2012 / Publishedonline: 25 September 2012 _ SpringerScience+Business Media Dordrecht.

Reiling, T.P., (1984). PowderyMildew. InCompendium of PeaDiseases. Editedby D.J. Hagedorn. AmericanPhytopathologicalSociety. St. Paul,Minnesotapp: 21-22.

Sayar, M.S.,(2007). Diyarbakır ekolojik koşullarında bazı yem bezelyesi *(Pisumarvense*L.*)* hat ve çeşitlerinin verim ve verim öğelerinin belirlenmesi **üzer**ine bir araştırma, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü (Yayınlanmamış yüksek lisan tezi), Adana.

Sayar, M.S., Yücel C., Tekdal, S., Yasak, M.Ş., Yıldız, E., (2009). *"Diyarbakır Koşullarında Bazı Adi Fiğ (ViciaSativa L.) Hatlarının Verim Ve Verim Unsurlarının Belirlenmesi"*Türkiye VIII. Tarla Bitkileri Kongresi, 19-22 Ekim 2009, Hatay.

Shoemaker, J. S., (1953). Vegatablegrowing. John WileyandSonsInc., New York, ChapmanandHall Ltd., London.

Shaid, M.,Shah, S.F.A.,Ghufranulhaq, Ali, H., Istiagh, S., (2010). Resistance in peagermplasm / linestopowderymildewundernaturalconditionsMycopath8(2)**:** 77-80.

Singh, H.B. ve Singh, U.P., (1988). Powderymildew of pea (*Pisumsativum*L.). Int. J.

TropicalPlantDis., 6: 1-18.

Şehirali, S., (1988). YemeklikTaneBaklagillerDersKitabı. Ankara ÜniversitesiZir. Fak. Yayınları, No:224.

Uzun, A. and Açıkgöz E., (1998). Effect of sowingseasonandseeding rate on themorphologicaltraitsandyields in peacultivars of differingleaftypes. J. Agronomy andCropScience, 181: 215-222.

Watts, R. L.,andWatts G. S., (1954). The vegatable growing business. Orange Judd Publishing Co. Inc., New York.

# O-68 ANALYSIS OF FINANCIAL PERFORMANCE IN DAIRY ENTERPRISES; THE CASE STUDY OF KONYA, TURKEY*

**C. OGUZ[1], A. YENER[2]**

[1]Selcuk University, Faculty of Agriculture, Department of Agricultural Economics, Konya, Turkey, corresponding authors: coguz@selcuk.edu.tr

[2]Selcuk University, Faculty of Agriculture, Department of Agricultural Economics, Konya, Turkey

**ABSTRACT**

Sustainability and development of the dairy enterprises are dependent on competitiveness. Determination of the performance of the enterprises requires measurement and analyses of the financial performance of the enterprises. The ability of dairy enterprises to continue and grow is dependent on competiveness. It requires that the financial performance of the farm enterprises be measured and analyzed in order for the enterprises to be able to detect the competition power in a healthy manner. The aim of the study is to analyze the financial performance of the dairy enterprises in Konya province by determining the capital structure. Çumra, Karapınar and Ereğli districts constituted 15% of the number of bovine animals, were selected by using purpose sampling method. The number of dairy cattle in these enterprises constituted the main frame of the population the primary data collected from 125 dairy farm enterprises with questionnaire technique through stratified sampling method with 95% confidence interval and error margin of 5%. The capital structure of the enterprises surveyed in the research area was classified according to their functions and the average active capital of the enterprises was calculated as 845,330.84 $. 67.87 % of the active capital is composed of land capital, 31.70 % is composed of fixed enterprises capital and 0.43 % is variable working capital. The economic profitability level (EP) was determined as 6.90% and the financial profitability level (FP) indicated the success of the enterprise was calculated as 7.06%. The capital turnover rate, an important indicator in the success and comparison of the enterprises, is 27.68%. As a result, their development and competitiveness are slow, because they do not use enough business and investment capital.

**Keywords:** Dairy enterprises, financial performance analysis, Konya, Turkey

## 1. INTRODUCTION

Sustainability and development of the dairy enterprises are dependent on dependent on competitive power. The ability of an enterprise to determine its competitiveness in a healthy manner requires that its financial performance be measured and analyzed. Performing decision making, planning, control, audit and management functions effectively in the enterprises makes the financial analysis inevitable. For this reason, among the most important responsibilities of business managers is the measurement and analysis of financial performance. The capital made up of all the wealth elements allocated to production is an important factor of production as well as land, labor and entrepreneur.

Agricultural enterprises in Turkey are generally far away from the idea of financial performance analysis because they do not keep accounting records. However, livestock enterprises are supported by huge financial investments and it is beneficial to analyze the financial performances of the investments in this area and determine the competitiveness of the enterprise in a healthy way. Milk farming in Konya province is also very important in this respect and it constitutes 5.24% of Turkey's total number of animals and 5.48% of milk production (Oğuz and Yener, 2017). Measuring and analyzing financial performance is important in that an agricultural enterprise can examine its own situation and compare its competitiveness with other enterprisees. Among the main data needed to accurately assess the financial status of an agricultural enterprise is the need to make an inventory of every kind of capital allocated for the production, which is called the inventory (balance

sheet). Inventory is the identification, assessment and listing of the entity's financial assets, debts and claims at a specific period. The main data required for the assessment of the financial status of an agricultural enterprise can be summarized as total active capital, total passive capital, equity, total income, total expenses and net profit.

## 2. MATERIAL AND METHOD

The main material of the study was the primary data obtained from the surveys conducted with the agricultural enterprises engaged in dairy farming in Konya province. The main frame of the research is animal assets of dairy farming enterprises in Çumra, Karapinar and Ereğli districts, which constitute 15% of the number of animals in Konya. In this main frame, 125 enterprises have formed sample volume according to stratified sampling method among simple random sampling methods (Yamane, 1967). Capital used in enterprises requires a certain amount of expenses. Capital structures of the enterprises are examined based on the classification of the capital according to its functions (Açıl and Demirci 1984; İnan, 1994). For this purpose, entrepreneurs' active values, which are capital elements invested in their enterprises for the purpose of production, and the passive capital that shows their sources have been put forward.

## 3. RESEARCH FINDINGS AND DISCUSSION

### 3.1. Active and passive capital structure of surveyed enterprises

In agricultural enterprises, capital helps net revenues increase directly. In dairy enterprises in Konya province, the capital is categorised as active and passive capital according to the capital functions. Active capital is classified as farm capital and enterprise capital. Farm capital consists of land, land improvement, building, plant, hunting and fish capital. The enterprise capital is divided into two groups as fixed enterprise capital and revolving enterprise capital. Fixed enterprise capital consists of livestock capital, tool and machine capital; and the revolving capital consists of material capital and money capital (Oğuz and Bayramoğlu, 2017). The distribution of the capital elements that constitute the active capital is important in terms of effective business management. Thus, it is important to examine the the active capital that gives the enterprise capital according to its components. In a rationally operating enterprise, the distribution of active capital is expected to be 25% for farm capital, 25% for building capital, 25% for livestock capital, 10% for tools and machine capital, 10% for material and supply capital and 5% for money capital (Erkuş et al., 1995 ). However, limited cultivated agricultural land, moral loyalty to the land, rapid population growth and rise in demand for non-agricultural land increase land prices. Therefore, the share of agricultural land in active capital is high. Indeed, similar results have been obtained in previous studies (Bayramoğlu 2003, Altıntaş and Akçay 2007).

**Table 1.** Distrubution ($) and Ratios (%)of Active Capital in Enterprises surveyed

| Capital groups | | Enterprise Groups (Number) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0-50 | | 51-150 | | 151-+ | | Enterprise averages | |
| | | $ | % | $ | % | $ | % | $ | % |
| Farms Capital | Land | 206,051.94 | 71.7 | 494,287.44 | 67.57 | 1,058,098.59 | 68.32 | 395,921.13 | 69.00 |
| | Land improve capital | 4,029.73 | 1.4 | 15,664.38 | 2.14 | 27,089.20 | 1.75 | 10,333.80 | 1.80 |
| | Building | 72,079.91 | 25.08 | 206,871.76 | 28.28 | 422,077.46 | 27.25 | 155,056.34 | 27.02 |
| | plant | 5,212.86 | 1.81 | 14.730.82 | 2.01 | 41,414.32 | 2.67 | 12,450.49 | 2.17 |
| | Total | 287,374.44 | 100 | 731,554.39 | 100 | 1,548,679.58 | 100 | 573,761.76 | 100 |
| | | | 75.93 | | 67.87 | | 62.02 | | 67.87 |
| Fixed enterprises capital | Livestock | 70,070.42 | 78.67 | 270,397.52 | 78.93 | 829,407.28 | 88.45 | 222,090.28 | 82.88 |
| | Tools Machines | 18.994.28 | 21.33 | 72,161,32 | 21.07 | 108,252.93 | 11.55 | 45,868.10 | 17.12 |
| | Total | 89.064.70 | 100 | 342,558.84 | 100 | 937,660.21 | 100 | 267,958.38 | 100 |
| | | | 23.53 | | 31.78 | | 37.55 | | 31.7 |
| Revolving farm capital | Materials and Supplies Capital | 709.12 | 35.19 | 2,038,55 | 53.7 | 6,807.51 | 63.04 | 1,845.07 | 51.1 |
| | Money Capital | 1.306.4 | 64.81 | 1,757.79 | 46.3 | 3,990.61 | 36,96 | 1,765.63 | 48.9 |
| | Total | 2.015.36 | 100 | 3,796.33 | 100 | 10,798.12 | 100 | 3,610.70 | 100 |
| | | | 0.53 | | 0.35 | | 0.43 | | 0.43 |
| Total Farms Capital | | 91.080.06 | 24.07 | 346,355.17 | 32.13 | 948,458.33 | 37.98 | 271,569.08 | 32.13 |
| Total Active Capital | | 378.454.49 | 100 | 1,077,909.57 | 100 | 2,497,137.91 | 100 | 845,330.84 | 100 |

Another capital element that is calculated more than expected amount in the field of research is the tools and machine capital. In the enterprises surveyed, milking unit, cooling tank, feed mixer, tractor and other tools and machines used in vegetative production constituted this capital group. The following chart shows the active capital of dairy enterprises (Table 1). $ 845,330.84 of active capital has been identified per enterprise. 67.87% of this is the farm capital and 32.13% is the enterprise capital. As the enterprise width increases, active capital per enterprise increases. As can be seen in the table, the share of the farm capital in the active capital is much more than the share that should be in a normal enterprise. Besides, the rates of plant, land improvement, material and money capital are very low. This formation of active capital is considered as a situation that affects business success negatively (Erkuş 1979).

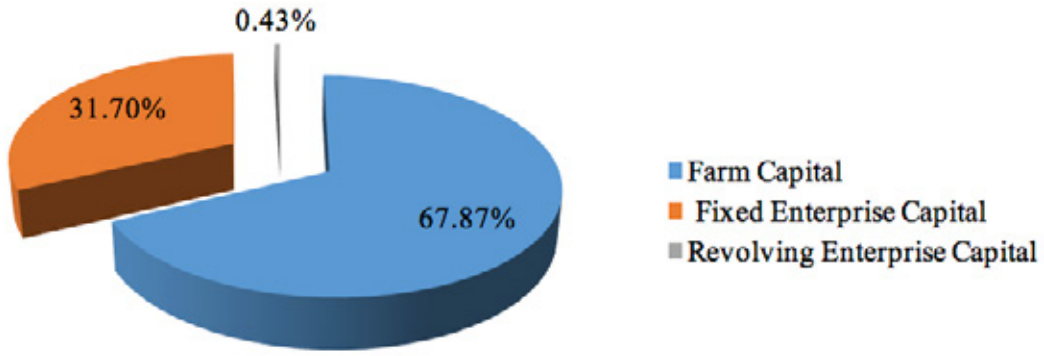



**Figure 1.** Proportional distribution of active capital in the enterprises surveyed (%)

67.87% of the active capital in the enterprises surveyed is farm capital, 31.70% is fixed enterprise capital and 0.43% is the revolving enterprise capital. The largest share of active capital is obtained from land (46.84%). This is followed by animal capital (26.27%), building capital (18.34%) and tool and machine capital (5.43%).

In the enterprises surveyed, passive capital is composed of foreign and equity capital used in enterprises. The land values held in the lease on the active capital of the enterprises surveyed are also included as debts. It has been determined that the enterprises surveyed have an average of $ 14,220.14 debts per business. Of these, 59.78% are animal production loans, 12.75% are private consumption loans, 12.37% are tool-machine loans, 11.04% are vegetative production loans and 4.06% are personal debts.

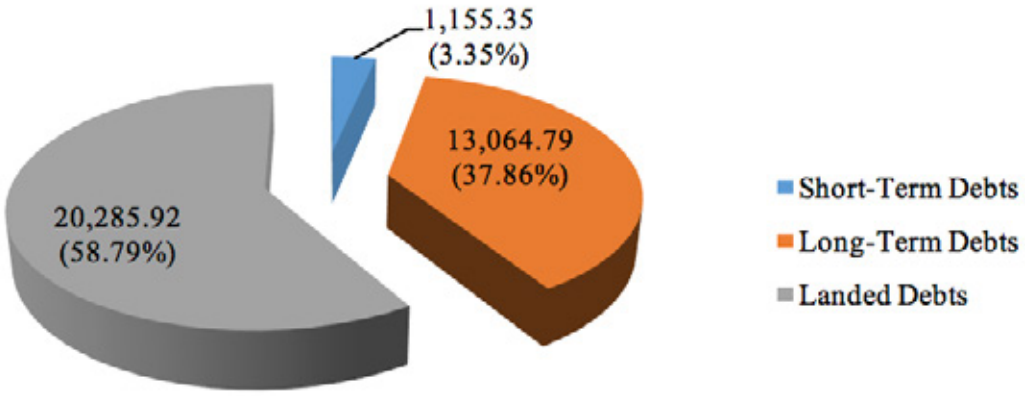



**Figure 2.** Proportional Distribution of Foreign Capital in the enterprises surveyed (%)

In the surveyed enterprises, of the debts per enterprise 58.79% are landed debts, 37.86% are long-term debts and 3.35% are short-term debts. The landed debts consist of the amount paid to the landowner for the leased land.

**Table 2**. Distribution and Ratios (%) of Passive Capital ($)in the surveyed enterprises

| | Enterprise groups (Number) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-50 | | 51-150 | | 151-+ | | Enterprise averages | |
| | $ | % | $ | % | $ | % | $ | % |
| Short-term debts | 1,222.61 | 0.32 | 1,113.32 | 0.10 | 938.97 | 0.04 | 1,155.35 | 0.14 |
| Long-term debt | 14,558.88 | 3.85 | 11,695.70 | 1.09 | 9,361.50 | 0.37 | 13,064.79 | 1.55 |
| Total | 15,781.49 | 4.17 | 12,809.03 | 1.19 | 10,300.47 | 0.41 | 14,220.14 | 1.68 |
| Landed debts | 16,336.56 | 4.32 | 21,599.33 | 2.00 | 35,915.49 | 1.44 | 20,285.92 | 2.40 |
| Total foreign capital | 32,118.06 | 8.49 | 34,408.36 | 3.19 | 46,215.96 | 1,85 | 34,506.06 | 4.08 |
| Equity | 346,336.44 | 91.51 | 1,043,501.20 | 96.81 | 2,450.921.95 | 98.15 | 810.824.79 | 95.92 |
| Total passive capital | 378,454.49 | 100 | 1,077,909.57 | 100 | 2,497,137.91 | 100 | 845,330.84 | 100 |

As can be seen in the table, the average passive capital per enterprise is 845,330.84 $. Passive capital differs according to enterprise groups. It has been determined as 378,454.49$ for enterprises with 0-50 animals, 1,077,909.57$ for enterprises with 51-150 animals, and 2,497,137.91$ for those with more than 150 animals.

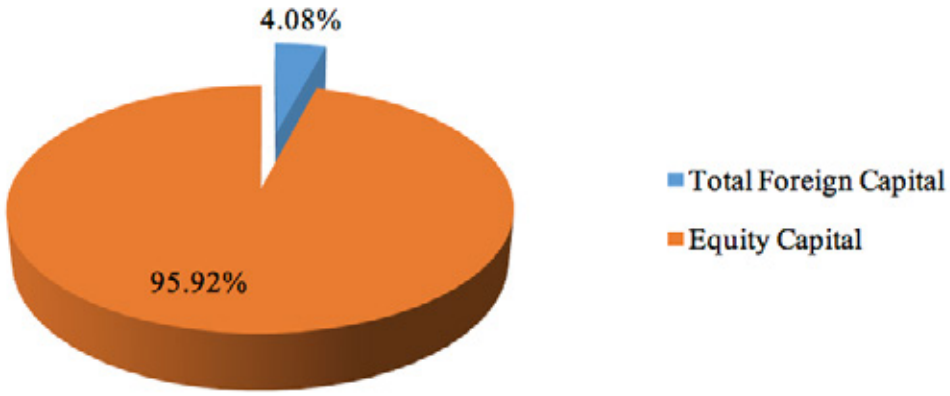



**Figure 3**. Proportional Distribution of Passive Capital (%)

95.92% of the passive capital ($ 845,330.84) constitutes equity capital and 4.08% constitutes foreign capital. Therefore, equity refers to the financial share of enterprise owners in the enterprise, or the amount of risk they have on the enterprise (Akgüç, 1995).

### 3.2. Net profit in the surveyed enterprises

Net profit is calculated by subtracting production costs from gross revenue. This is the basic indicator that measures the profitability of the business activity. The net profit for agricultural family enterprise shows the amount of resources that the family can use to meet expenses such as living expenses, taxes and capital investments. It is natural that the profit should be positive in order to talk about the improvement of the financial condition of the enterprise. If the profit is greater than zero, the revenue from the enterprise activity can be used for investment and growth purposes.

**Table 3.** Net Profit($)

| | Enterprise Groups (Number) | | | |
|---|---|---|---|---|
| | 0-50 | 51-150 | 151-+ | Enterprise average |
| | $ | $ | $ | $ |
| Gross product | 85,459.89 | 290,522.30 | 841,720.41 | 238,550.13 |
| Production costs | 92,934,.46 | 279,626.54 | 699,335.53 | 222,456.98 |
| Net profit | -7,474.57 | 10,895.76 | 142,384.88 | 16,093.15 |

Net profit per enterprise was found by subtracting production costs from gross revenue. Net profit per enterprise was determined as 16,093.15.

### 3.3. Financial performance analysis of Dairy Farming Enterprises

To measure the financial performance of an enterprise, it is necessary to find performance data and to calculate reference (standard) values. As reference values, often ratios are used rather than absolute financial indicators. Ratios are indicators that establish a relative relationship between two absolute performance indicators and compare one financial size to another. The advantage of relative values is that they destroy the diverting influence of the size of the enterprise on the indicator. Compared to the absolute indicators, these ratios make it possible to make more meaningful and direct comparisons between different size enterprises and thus to compare the financial performances of different enterprises in a more healthy way. The main ratios used to measure financial performance are examined in four main categories: liquidity, activity (efficiency), debt payability (leverage) and profitability.

### 3.3.1. Liquidity Ratios

Liquidity ratios are, in essence, the rates used to measure the extent to which an enterprise can meet its short-term debts and to determine whether the enterprise capital is sufficient. Here, the current ratio, which is one of the most widely used ratios in financial performance analysis, is obtained by dividing liquid assets into short term debts. It was found to be 3.13 in the surveyed enterprises. It shows the capacity of the enterprise to pay short term debts. If the current ratio exceeds one, it generally shows that they can pay their short-term debts on time. The capital turnover rate is calculated within activity (efficiency) ratios. It is calculated by dividing the gross production value by the total enterprise capital. It demonstrates how effectively the enterprise assets can produce output. The higher the rate, the better. The capital turnover rate of dairy farming enterprises in the research area is 27.68% in the average of the enterprises.

**Tablo 4.** The capital turnover rate (%)

| | Enterprise Groups (Number) | | | |
|---|---|---|---|---|
| | 0-50 | 51-150 | 151-+ | Enterprise Averages |
| Short-term debts | 1,222.61 | 1,113.32 | 938.97 | 1,155.35 |
| Revolving enterprises capital | 2,015.36 | 3,796.33 | 10,798.12 | 3,610.70 |
| Gross production value | 82,151.18 | 285,593.88 | 832,319.00 | 234,017.90 |
| Total farm capital | 378,454.49 | 1,077,909.57 | 2,497,137.91 | 845,330.84 |
| current rate | 1.64 | 3.41 | 11.5 | 3.13 |
| Capital turnover rate | 21.71 | 26.5 | 33.33 | 27.68 |

Debt payability ratio is calculated by dividing total debts into the active capital. It demonstrates the mobility of the enterprise and how much of the financial debt the enterprise can pay if all of the assets are sold. In other words, it is a rate that indicates how much of its assets an enterprise owes to its lenders or institutions. This rate was calculated as 4% in the research area. Profitability analyzes are calculated from financial and economic direction in dairy farming enterprises and the average financial profitability which shows the success of the enterprise is calculated as 7.06% and the economic profitability which shows the success of the enterprise is 6.90%. The financial and economic profitability of the enterprises surveyed is given in table 5.

**Table 5.** The financial and economic profitability

| | Enterprise Groups (Number) | | | |
|---|---|---|---|---|
| | 0-50 | 51-150 | 151-+ | Enterprise Average |
| Net Profit | -7,474,57 | 10,895.76 | 142,384.88 | 16,093.15 |
| Equity rant | 17,660,20 | 52,870.76 | 124,032.86 | 41,128.93 |
| Equity | 346,336,44 | 1,043,501.20 | 2,450,921.95 | 810,824.79 |
| Aktive Capital | 378,454,49 | 1,077,909.57 | 2,497,137.91 | 845,330.84 |
| Pure product | 11,448,15 | 64,791.24 | 267,241.77 | 58,359.69 |
| Financial profitability (FP) | 2.94 | 6.11 | 10.87 | 7.06 |
| Economic profitability (EP) | 3.02 | 6.01 | 10.7 | 6.9 |

Financial profitability (FP) measures the profitability of the equity capital owned by the enterprise and the economic profitability(EP) measures the profitability of the enterprise.

## 4. CONCLUSION

It can be said that dairy farming enterprises in Konya have managed the investment capital well. However, small enterprises are less able to pay their debts than large enterprises, and their financial (2.94) and economic (3.02) profitability is also low. Small enterprises are less likely to compete with larger enterprises. This is because the mobility of large enterprises is higher than that of small enterprises and their liquidity of being able to immediately close its debts in the case of the liquidation is higher (4%). Although the financial and economic liquidity of the enterprises is high in the research area, the share of own capital is 95.92%, the share of foreign capital is 4.08%, and the enterprises are hesitant to take risks. The fact that the risks and uncertainties in agricultural enterprises are already so high, input costs in animal husbandry enterprises are high and the market is unstable are considered to be a disadvantage and large enterprises can not compete in the market. As a result, operators need to better manage capital. It is necessary to evaluate the management and operational results as much as the management plans.

## References


Açıl, A. F., & Demirci, R. (1984). Tarım Ekonomisi Dersleri, Ankara Üniversitesi Ziraat Fakültesi Yayınları No:880, Ankara.

Akgüç, Ö. (1995). Mali Tablolar Analizi, 9. Baskı, İstanbul: Muhasebe Enstitüsü Yayını.

Altıntaş, G., & Akçay, Y. (2007). Tokat ili Erbaa ovasında tarım işletmelerinin ekonomik analizi ve işletmelerin başarısını etkileyen faktörlerin ortaya konulması. Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi, 24(2):33-42.

Erkuş, A. (1979). Ankara İli Yeni Mahalle İlçesinde Kontrollü Kredi Uygulaması Yapılan Tarım İşletmelerinin Planlanması Üzerine Bir Araştırma. Ankara Üniversitesi, Ziraat Fakültesi Yayınları, No:709, Bilimsel Araştırma Ve İncelemeler: 415, Ankara.

Erkuş, A., Bülbül, M., Kral T., Açıl, F. & Demirci R. (1995). Tarım Ekonomisi. ISBN 975-7185-01-9, Ankara. İnan, İ. H. (1994). Tarım Ekonomisi. Trakya Üniversitesi Tekirdağ Ziraat Fakültesi, Tekirdağ.

Bayramoğlu, Z. (2003). Konya ilinde süt sığırcılığı projesi (100x2) kapsamında yer alan işletmelerin ekonomik analizi. Selçuk Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Konya.

Oğuz, C., & Bayramoğlu, Z. (2015). Tarım Ekonomisi Kitabı. Atlas Akademi 2. Basım. ISBN:978-605-63373-3-8. Konya.

Oğuz, C., & Yener, A. (2017). Konya İli Süt İşletmelerinin Ekonomik Faaliyet Sonuçları ve Yenilikleri Benimseme Düzeyleri, Selçuk Üniversitesi Bilimsel Araştırma Projeleri Proje No: 15401020, Konya.

Yamane, T. (1967). Elementary Sampling Theory." Prentice-Hall Inc.Englewood Cliffs, New Jersey.

# O-69 KIRSAL KADINLARIN GIDA GÜVENLİĞİ KONUSUNDAKİ BİLİNÇ DÜZEYLERİ: HÜYÜK İLÇESİ ÖRNEĞİ KONYA, TÜRKİYE

**C. OĞUZ[1], N. MERAKLI[2]**

[1]Selçuk Üniversitesi, ZiraatFakültesi, TarımEkonomisiBölümü, Konya, Türkiye,

SorumluYazar: coguz@selcuk.edu.tr

[2]Selçuk Üniversitesi, ZiraatFakültesi, TarımEkonomisiBölümü, Konya, Türkiye

**ABSTRACT**

This research was conducted to determine the attitudes and behaviors of women living in rural areas on food safety in terms of producing, purchasing and using food. The main frame of the study is the women who have different income groups living in the Hüyük county of Konya province. The sample size determined as a 100 according to "Unclustered Simple Random Sampling Method Based on Main Mass Ratios". The data of the research were collected from the women using the survey technique as voluntarily and willingly. The tables were created and interpreted in the analysis of the data. Binary relationships were analyzed by "Chi-square test". According to the results of the research, 62% of the women are conscious of food safety and a high level of relationship between income and education levels of women and food safety consciousness levels is determined.

**Keywords:** Food safety, rural women, Konya

## 1. GİRİŞ

Beslenme ve gıda ihtiyacı bireylerin, toplumların, ülkelerin yaşamlarını ilgilendiren ve sosyolojik, kültürel, politik, ekonomik tüm faktörleri etkileyen temel gereksinimlerdir. İnsanın hem zihinsel hem de fiziksel olarak sağlıklı ve dengeli olması için gerekli en önemli unsurlardan biri beslenme ihtiyacının nicelik ve nitelik olarak yeterli derecede tatmin edilmesidir (Cevger ve ark, 2005).Toplumu oluşturan bireylerin büyüme, gelişme, fizyolojik ve ruhsal gelişimlerini sağlama ve yaşamlarını sürdürmeleri için yeterli ve dengeli beslenme önemli bir yer tutmaktadır. Sağlıklı nesillerin oluşması, sağlıklı ve güvenli gıdanın sağlanmasıyla mümkündür. Toplum varlığının korunması ve sağlık koşullarının geliştirilerek halkın sağlıklı ve kaliteli gıdalarla beslenmesinin temin edilmesi, gıdaların üretiminden tüketime kadar kontrol altında bulundurulması devletin temel görevlerinden biridir. Güvenli gıda konusu, sosyoekonomik gelişmelere bağlı olarak, az gelişmiş ülkeler kadar, gelişmiş ülkeleri de yakından ilgilendiren önemli bir konu haline gelmiştir. Dünyada iki türlü beslenme sorunu yaşanmaktadır. İlki ve en önemlisi yeterli gıdaya erişimdir. Diğeri ise vücudun ihtiyaç duyduğu sağlıklı ve güvenli besin kaynaklarının alınmasıdır. Yeterli gıdaya erişim gıda güvencesi kavramı altında yer almakta ve insanların yaşamlarını sürdürebilmeleri için, her zaman yeterli, güvenli, besin değeri yüksek gıdalara ulaşabilmeleri olarak tanımlanmakta ve "gıdanın elde edilmesi", "gıdaya ulaşma" ve "gıdanın kullanımı" kavramlarını içermektedir (FAO, 2003). İnsanların sürdürülebilir, güvenilir, uygun fiyatta, kaliteli, sağlıklı beslenme alışkanlığını geliştirecek gıdaları satın alma ve tüketme hakkına sahip olmalarının güvence altına alınması olarak ta tanımlanmaktadır(Boci, 2003).

Gıdaya ilişkin ikinci temel sorun gıda güvenliği ise; sağlıklı gıda üretimini sağlamak amacıyla gıdaların üretim, işleme, saklama, taşıma ve dağıtım aşamalarında gerekli kurallara uyulması ve önlemlerin alınması olarak tanımlanmakta ve sağlıklı, gıda kavramlarını içermektedir (DPT, 2001; Anonim, 2003). Gıdaya ilişkin riskler, gelişen teknolojiye bağlı çevre kirliliği, nüfus artışı, küreselleşme sürecinde değişen tüketim alışkanlıkları, eğitim ve gelir düzeyinin düşüklüğü, gıda üretim birimlerinde gerekli fiziki yatırımların yapılamaması, yetersiz mevzuat, denetim uygulamalarının eksikliği gibi nedenlerle artmaktadır. Gıda Güvenlik Sistemlerinin "çiftlikten sofraya" kadar gıda zincirinin her aşamasında uygulanması gerekliliği önemle vurgulanmaktadır. Türkiye'de kırsal alanda tarımsal faaliyetler büyük oranda küçük aile işletmeleri tarafından yapılmaktadır. Arazi miktarı 50 dekarın altında olan işletmelerin oranı %64'tür. Aile işletmelerinde ise gıdayı

üreten kesim genellikle kadınlardır.Kadınların gıda güvenliği ve çevresel konular ile ilgili önemi 1980'lerde başlamış olup kırsal kalkınma ve çevre yaklaşımları içerinde politika planlamalarına dahil edilmiştir(STGM, 2007). Tarım kesimindeki kadınların üretime katılım düzeyleri, ailenin sahip olduğu arazi ve hayvan varlığına, gelire ve ürün desenine göre değişmektedir. Ancak, özellikle 2000'li yıllardan sonra tarımda teknoloji kullanım düzeyi artıkça kadın tarımsal üretimden kopmakta ve çalışma potansiyeli ev kadınlığına yönelmektedir. Az topraklı ailelerde kadınlar mevsimlik işçilik başta olmak üzere bitkisel ve hayvansal üretimin her aşamasına katılmaktadır (Anonim, 2007).Üretimin hemen her aşamasında aktif olarak yer alan kadınlar, aynı zamanda evde gıda üretimi yapmakta ve gıda maddeleri satın alımında da belirleyici rol oynamaktadır. Dolayısıyla kadınların çiftlikten sofraya kadar uzanan gıda zincirinde önemli bir yere sahip olduğunu söylemek yanlış olmayacaktır. Kadınların bilinçli üretim ve tüketim davranışı ile gıda güvenliğinde temel olarak kabul edilen izlenebilirliğin ve sürdürülebilirliğin sağlanmasında önemli bir paya sahip oldukları ifade edilebilir. Kırsal kadınların gıda güvenliği konularındaki bilinç durumlarını ortaya koymayı amaçlayan bu çalışma son yıllarda büyük şehir belediyelerinin düzenlemiş olduğu gıda üretimi, korunması ve muhafazası ile ilgili kurs programlarına en fazla katılımın olduğu, Konya ili Hüyük ilçesinde yürütülmüştür.

## 2. MATERYAL VE YÖNTEM

Araştırmanın ana materyalini, Hüyük ilçesinde yaşayan kadınlarla anket tekniği kullanılarak gönüllülük ilkesine göre elde edilen veriler oluşturmuştur. Ayrıca, araştırmada, konuyla ilgili yerli ve yabancı makaleler, araştırmalar, projeler ve tezler gibi dokümanlardan elde edilen ikincil verilerden de yararlanılmıştır. Araştırmanın ana kitlesini Konya İli Hüyük İlçesinde yaşayan hane halkı oluşturmaktadır. Araştırmanın örnek hacmi, "Ana Kitle Oranlarına Dayalı Kümelendirilmemiş Basit Tesadüfi Örnekleme Yöntemi" ne göre, %95 güven aralığında %5 hata payı ile 100 hane olarak aşağıdaki formüle göre hesaplanmıştır.

$$n = \frac{Np(1-p)}{(N-1)\sigma_{p_x}^2 + p(1-p)}$$

Eşitlikte;

n=Örnek Hacmi

N=Popülasyon İşletme Sayısı

$\sigma_{p_x}^2$=Oranın Varyansı

p=0.5

Kırsal kadınların gıda ürünleri satın almada dikkat ettikleri özellikleri değerlendirmede, gıda güvenliği konusunda ve gıda tüketim alışkanlıklarına ilişkin görüşlerinin ölçülmesinde 5'li Likert tipi ölçek kullanılmıştır.

- ✓ Gıda güvenliğini bilme durumu ile eğitim arasındaki ilişki,
- ✓ Gıda ürünü üretme ile gelirleri arasındaki ilişki
- ✓ Gıda ürünü satın almada özellikler (kalite, tazelik, hijyen vb.) ile gelirleri arasındaki ilişki,
- ✓ Hane halkının aylık gıda harcaması ile gelirleri arasındaki ilişki, gerekli hipotezler oluşturularak khi-kare testi uygulanmış ve yorumlanmıştır.

## 3. ARAŞTIRMA BULGULARI

### 3.1. Kırsal Kadınların Demografik Özellikleri

Araştırma alanında öncelikli olarak ankete katılan kadınlara ait bazı demografik göstergeler incelenmiştir. Bu bölümde; kadınların yaş grupları, eğitim düzeyleri, medeni durumları ve meslekleri ile ilgili bulgular yer almaktadır.

**Tablo 1. Kadınların Yaş Gruplarına Göre Dağılımı**

| İşletme Gelir Grupları (TL) | YAŞ | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18-24 | | 25-34 | | 35-49 | | 50-64 | | 65+ | | Toplam | |
| | Sayı | Oran | Sayı | Oran | Sayı | Oran | Sayı | Oran | Sayı | Oran | Sayı | Oran |
| **0-1.000** | 2,00 | 25,00 | 3,00 | 37,50 | 1,00 | 12,50 | 1,00 | 12,50 | 1,00 | 12,50 | 8,00 | 100,00 |
| **1.001-2.000** | 2,00 | 8,00 | 10,00 | 40,00 | 7,00 | 28,00 | 3,00 | 12,00 | 3,00 | 12,00 | 25,00 | 100,00 |
| **2.001-3.000** | 4,00 | 8,90 | 20,00 | 44,44 | 15,00 | 33,33 | 6,00 | 13,33 | 0,00 | 0,00 | 45,00 | 100,00 |
| **3.001+** | 0,00 | 0,00 | 10,00 | 45,45 | 11,00 | 50,00 | 1,00 | 4,54 | 0,00 | 0,00 | 22,00 | 100,00 |
| **Ortalama** | 8,00 | 8,00 | 43,00 | 43,00 | 34,00 | 34,00 | 11,00 | 11,00 | 4,00 | 4,00 | 100,00 | 100,00 |

Araştırmaya katılan kadınların, %43'ü 25-34, %34'ü 35-49, %11'i 50- 64 yaş ve %4,'ü 65 yaş ve üzeri yaş aralığında yer almaktadır. Araştırmaya katılan kadınların çoğunluğu (%43) 25-34 yaş aralığında bulunmaktadır. Eğitim durumlarına göre %44'ü ortaokul %39'u ilkokul, %12'si lise,%3'ü okur-yazar durumunda ve %2'si ise üniversite mezunudur. Medeni durumu ise %89'u evli %11'i ise bekardır. Araştırmaya katılan kadınların büyük çoğunluğu (%67) ev hanımıdır.

**Tablo 2.** Kırsal Kadınların Gıda Güvenliği Konusundaki Bilgi Düzeyleri

| İşletme Gelir Grupları (TL) | Evet | | Hayır | | Toplam | |
|---|---|---|---|---|---|---|
| | Sayı | Oran | Sayı | Oran | Sayı | Oran |
| **0-1.000** | 6,00 | 75,00 | 2,00 | 25,00 | 8,00 | 100,00 |
| **1.001-2.000** | 13,00 | 52,00 | 12,00 | 48,00 | 25,00 | 100,00 |
| **2.001-3.000** | 30,00 | 66,67 | 15,00 | 33,33 | 45,00 | 100,00 |
| **3.001+** | 13,00 | 59,09 | 9,00 | 40,91 | 22,00 | 100,00 |
| **Ortalama** | 62,00 | 62,00 | 38,00 | 38,00 | 100,00 | 100,00 |

Araştırma alanında kadınların %62'si gıda güvenliği konusunda bilgi sahibi olduklarını ve bu konuda çeşitli eğitim ve kurs programlarına katıldıklarını ifade etmektedirler.Benzer bir çalışmada ise, kadınların % 43,9'u gıda güvenliği konusunda bilgilerinin olduğunu belirtmişlerdir (Özdemir,2009). Araştırmaya katılan kadınların gıda güvenliği konusunda bilgi edindikleri kaynaklar, aile, akraba arkadaşları, konferans, seminer panel olduğu tespit edilmiştir. Genel olarak incelendiğinde kadınların bilgi edindikleri kaynakların güvenirliliği çok düşüktür. Kırsal kadınların gıda güvenliği konusunda bilgi düzeyleri ile eğitim durumları arasında khi-kare analizi yapılmıştır.

**Tablo 3.Chi-SquareTests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| PearsonChi-Square | 15,003[a] | 4 | ,005 |
| LikelihoodRatio | 15,986 | 4 | ,003 |
| Linear-by-LinearAssociation | 12,401 | 1 | ,000 |
| N of ValidCases | 100 | | |
| $X^2$= 15,003 p<0,05 | | | |

Kadınların gıda güvenliği konusunda bilgilerinin olma durumu ile eğitim düzeyleri arasındaki khi-kare bağımsızlık testi anlamlı bulunmuştur. Eğitim düzeyi arttıkça kadınların gıda güvenliği konusunda bilgilerinin de arttığı söylenebilir. Ayrıca, araştırma alanında kadınların gıda ürünleri satın alırken dikkat ettikleri özellikler incelenmiştir (Tablo4).

**Tablo 4.Gıda Ürünleri Satın Almada Dikkat Edilen Özellikler**

| Özellikler | İşletme Gelir Grupları (TL) | | | | |
|---|---|---|---|---|---|
| | **0-1.000** | **1.001-2.000** | **2.001-3.000** | **3.001+** | İşletmeler Ortalaması |
| **Kalite** | 4,62 | 4,28 | 4,22 | 4,13 | 4,25 |
| **Tazelik** | 4,87 | 4,44 | 4,28 | 4,13 | 4,33 |
| **Tadı ve Lezzeti** | 4,87 | 4,40 | 4,44 | 4,13 | 4,40 |
| **Besin Değeri** | 4,25 | 3,68 | 3,62 | 3,18 | 3,59 |
| **Gıda Maddesinin İçindekileri** | 4,25 | 3,76 | 3,68 | 3,40 | 3,68 |
| **Fiyatı** | 3,75 | 4,60 | 4,40 | 4,00 | 4,31 |
| **Gıda Güvenliği** | 4,00 | 3,76 | 3,75 | 3,82 | 3,79 |
| **Gıdanın İşlenmesi ve Hijyeni** | 4,75 | 4,24 | 4,26 | 4,36 | 4,32 |
| **Marka ve Firma Sahibi** | 3,00 | 3,20 | 3,11 | 2,90 | 3,08 |
| Üretim ve Son Kullanma Tarihi | 4,50 | 4,56 | 4,51 | 4,31 | 4,48 |
| **Doğal Katkısız Ürün Olması** | 4,75 | 3,72 | 3,97 | 3,81 | 3,93 |
| **Ambalajın Şekli** | 3,87 | 3,04 | 2,84 | 2,50 | 2,90 |
| **Dış Etkilere Karşı Ürünü İyi Muhafaza Etmesi** | 4,50 | 3,84 | 3,86 | 3,45 | 3,82 |

Oldukça Önemli: 5 Önemli: 4 Fikrim Yok: 3 Az Önemli: 2 Hiç önemli Değil: 1

Gıda ürünleri satın alırken kadınların (%80'i ambalajlı ürünleri tercih etmektedirler.Araştırmaya katılan kadınların gıda ürünü satın alırken dikkat ettikleri özellikler 5'li likert ölçeği ile belirlenmiştir. Araştırma alanında 5'li ölçeklendirmeye göre üretim ve son kullanma tarihi (4,48/5), tadı ve lezzeti (4,40/5), tazelik (4,33/5), gıdanın işlenmesi ve hijyeni (4,32/5), fiyatı (4,31/5) ve kalite (4,25/5) kadınların dikkat ettikleri en önemli özellikler olup, ambalajın şekli(2,90/3) ise kadınların gıda ürünü satın almada çok fazla dikkat etmediği özellik olarak tespit edilmiştir.Genel olarak kadınların gıda ürünü satın almada her bir bilgiye önem verdikleri ve daha hassas davrandıkları görülmüştür.Benzer bir çalışmada, tüketicilerin gıda ürünü satın almada dikkat ettikleri özelliklerin en önemlisi %85,2 oranla hijyen olduğu saptanmıştır(Aygün,2007). Araştırmaya katılan kadınların gıda ürünü satın almada dikkat ettikleri özellikler ile gelir grupları arasında ilişki olup olmadığı Khi-kare ile test edilmiştir.

$X^2$= 43,356 p<0,01

Kadınların gıda ürünü satın almada dikkat ettikleri özellikler ile gelir grupları arasında anlamlı bir ilişki bulunmuştur.

**Tablo 5. Gıda Ürünü Üretme Durumu**

| İşletme Gelir Grupları (TL) | Evet | | Hayır | | Toplam | |
|---|---|---|---|---|---|---|
| | Sayı | Oran | Sayı | Oran | Sayı | Oran |
| **0-1.000** | 8,00 | 100,00 | 0,00 | 0,00 | 8,00 | 100,00 |
| **1.001-2.000** | 25,00 | 100,00 | 0,00 | 0,00 | 25,00 | 100,00 |
| **2.001-3.000** | 40,00 | 88,89 | 5,00 | 11,11 | 45,00 | 100,00 |
| **3.001+** | 16,00 | 72,73 | 6,00 | 27,27 | 22,00 | 100,00 |
| **Ortalama** | 89,00 | 89,00 | 11,00 | 11,00 | 100,00 | 100,00 |

Kırsal kadınların %89'u evde gıda üretmektedir (Tablo 5). Araştırmaya katılan kadınların gıda ürünü üretiminde bulunma durumu ile gelir grupları arasında ilişki olup olmadığı Khi-kare ile test edilmiştir.

$X^2$= 10,030 p<0,05

Kadınların gıda ürünü üretiminde bulunması ile gelir grupları arasında anlamlı bir ilişki bulunmuştur. Kadınların %19,88'i yoğurt, %6,53'ü ise erişte üretmektedirler. Yoğurt yapmalarındaki en önemli neden ise sağılabilir ineklerinin olması ve köyde imece usulünün olmasından kaynaklanmaktadır. Kadınlar evde üretilen gıda ürünlerinin tamamen güvenilir olduğunu vurgulamaktadırlar. Zira evde üretilen geleneksel gıdaların içerisindeki katkı maddelerinin daha az olduğunu, tuz, sirke ve baharat gibi doğal koruyucular dışında yapay koruyucular kullanmadıklarını ifade etmektedirler.

**Tablo 6. Hane Halkının Yaptığı Aylık Gıda Harcamaları**

| **İşletme Gelir Grupları (TL)** | **0-200** | | **201-400** | | **401-600** | | **601-800** | | **801+** | | **Toplam** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Sayı** | **Oran** | **Sayı** | **Oran** | **Sayı** | **Oran** | **Sayı** | **Oran** | **Sayı** | **Oran** | **Sayı** | **Oran** |
| **0-1.000** | 5,00 | 62,50 | 3,00 | 37,50 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 8,00 | 100,00 |
| **1.001-2.000** | 1,00 | 4,00 | 24,00 | 96,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 25,00 | 100,00 |
| **2.001-3.000** | 0,00 | 0,00 | 6,00 | 13,33 | 36,00 | 80,00 | 3,00 | 6,67 | 0,00 | 0,00 | 45,00 | 100,00 |
| **3.001+** | 0,00 | 0,00 | 0,00 | 0,00 | 16,00 | 72,72 | 6,00 | 27,27 | 0,00 | 0,00 | 22,00 | 100,00 |
| **Ortalama** | 6,00 | 6,00 | 33,00 | 33,00 | 52,00 | 52,00 | 9,00 | 9,00 | 0,00 | 0,00 | 100,00 | 100,00 |

Araştırma alanında hane halkının yaptığı gıda harcamalarının 401-600 TL arasında olduğu tespit edilmiştir. Araştırmaya katılan kadınların aylık gıda harcamaları ile gelir grupları arasında ilişki olup olmadığı Khi-kare ile test edilmiştir.

$X^2$=126,568 p<0,01

Hane halkının yaptığı gıda harcamaları ile gelir grupları arasında anlamlı bir ilişki bulunmuştur. Araştırma alanında gıda denetimi sağlanmış gıda ürünleri için kadınların %33'ü ekstra ücret ödeyebileceklerini belirtmişlerdir. Yine benzer bir çalışmada tüketicilerin %30'unun gıda denetimi sağlanmış gıda ürünlerine fazladan ödeme yapabilecekleri saptanmıştır (Onurlubaş,2015).

## 4. SONUÇ

Gıda güvenliği, özellikle 2000'li yılların yoğun çözüm arayışlarına neden olan konusu ve geleceğin önemli endişelerindendir. Kırsal alanda yaşayan kadınlar, bir yandan üretim diğer tüketim davranışları ile bu kavramın anahtar noktalarından birinde yer almaktadır. Konya İli Hüyük ilçesinde yaşayan kadınların, gıda üretimi ve tüketiminde ki tutum ve davranışları, gıda güvenliği açısından incelenen bu araştırmada önemli sonuçlara ulaşılmıştır.

Araştırmaya katılan kadınların %62'si gıda güvenliği konusunda bilgi sahibidirler. Nitekim kadınların gıda güvenliği konusundaki bilgi sahibi olmaları ile eğitim düzeyleri arasında anlamlı bir ilişki bulunmuştur. Kadınların eğitim seviyesi yükseldikçe gıda güvenliği konularında daha duyarlı olmaktadırlar. Araştırmaya katılan kadınların gıda güvenliği konusunda bilgi kaynaklarının birden fazla olduğu, bunların sırasıyla aile, akraba, TV, internet, radyo, konferans,panel,seminer gibi toplantıların etkili olduğu tespit edilmiştir. Araştırmaya katılan kadınların tamamına yakını evde geleneksel olarak gıda üretmektedirler. Araştırma alanında gelir arttıkça kadınların evde gıda üretimini arttırdıkları belirlenmiştir. İstatiksel olarak ta anlamlı bulunmuştur. Bu ürünlerden en fazla yoğurt en az ise erişte yaptıkları tespit edilmiştir. Kadınların önemli bir bölümü kendi ürettikleri ürünün tamamen güvenilir olduğunu ifade etmektedirler. Evde üretilen geleneksel gıdaların içerisindeki katkı maddelerinin daha az olması, tuz, sirke ve baharat gibi doğal koruyucular dışında yapay koruyucular içermemeleri vb. sebeplerinden kadınlar kendi ürettikleri gıdaları güvenilir bulmaktadır. Araştırma alanında kadınların gıda ürününü satın alırken en fazla ürünün son kullanma tarihi, tazelik, hijyen, fiyat, kalite gibi unsurlara dikkat ettikleri tespit edilmiştir. Sonuçta kırsal kadınların gıda ürünlerinin önemli bir bölümünü ev içerisinde üreterek toplam aile bütçesi içerisinde gıdaya ayrılan payın düşmesine katkıda bulundukları da tespit edilmiştir. Bununla birlikte araştırma alanında hane halkının geliri arttıkça gıda ürünlerine yapılan harcamanın arttığı ve kadınların %33'ünün denetimi sağlanmış gıda ürünleri için fazladan ödeme yapabilecekleri saptanmıştır. Sonuç olarak, kırsal alanda yaşayan kadınların, çevresel bozulmanın gıda güvenliğine yönelik tehditleri karşısında duyarlı olmaları gerekliliği dikkate alındığında, bu hedef kitleye gıda güvenliğine yönelik eğitimlerin artırılarak verilmesi yararlı olacaktır. Nitekim kadınlarına kendilerine verilen bilgileri uyguladıkları ve bu eğitimlere açık oldukları gözlemlenmiştir. Kırsal alanda yürütülen hem örgün hem de yaygın eğitimde çevre ve insan sağlığı konularına ağırlık verilmelidir. Gelirle birlikte çevre ve insan sağlığı bilincinin yükseldiği göz önünde tutularak, toplumda farkındalığı artıracak konuların ele alınarak tüm paydaşların burada yer almaları sağlanmalıdır.

## KAYNAKLAR


Anonim, (2003). "Ulusal gıda ve beslenme stratejisi çalışma grubu raporu", Yayın No: 2670, Mart. http://tarim.kalkinma.gov.tr/wp-content/uploads/2015/01/Ulusal_GidaveBeslenme_Eylem_PlaniTaslak-04-11-2014.pdfAnonim, (2007). II. Tarım Şurası, Kırsal Kalkınma Politikaları Komisyon Rap.,http://tarimsurasi.tarim.gov.tr/PDFLER/VIII.Komisyon.pdf.

Aygün, E. (2007). Ambalajın Tüketici Satın Alma Davranışı Üzerindeki Etkisi: Gıda Maddeleri Üzerinde Bir Araştırma. Yayınlanmamış Yüksek Lisans Tezi. Sakarya Üniversitesi, Sosyal Bilimler Enstitüsü, Üretim Yönetimi ve Pazarlama Anabilim Dalı. Sakarya.

Boci, A.T.(2003). Gıda güvenliği ve güvencesi. Türk Belediyecilik Sempozyumu (SABEM) www.sabem.saglik.gov.tr/kaynaklar/2989.pdf

Cevger Y, Yalçın C, Aral Y (2005): Türkiye'de hayvansal üretimde gıda güvencesi ve hayvancılık politikaları. 272- 284. Gıda Güvenliği ve Güvenirliği Sempozyumu, 20-22 Ekim 2005, Biyologlar Derneği, Tam Metinler Kitabı, Ankara.

DPT.(2001). Ulusal Gıda ve Beslenme Stratejisi Çalışma Grubu Raporu. DPT Müs.İktisadi Sektörler ve Koordinasyon Genel Müdürlüğü. Ankara.

FAO.(2003). FoodandAgricultureOrganization of the United Nations. TradeReformsandFood Security. Rome, sayfa: 25.

Onurlubaş, E., 2015. Tüketicilerin Gıda Güvenliği Konusunda Bilinç Düzeylerinin Ölçülmesi: Tokat İli Örneği.Gaziosmanpaşa Üniversitesi, Fen Bilimleri Enstitüsü, TarımEkonomisi AnabilimDalı.(doktora tezi),Ankara.

Özdemir, Z. (2009). Kadınların gıda güvenliği konusundaki bilgi, tutum ve davranışları, Gazi Üniversitesi, Eğitim Bilimleri Enstitüsü, Aile Ekonomisi Beslenme Anabilim Dalı, Yüksek Lisans Tezi, Ankara.

STGM, (2007). Toplumsal Cinsiyet ve Gıda Güvenliği, Gıda ve Tarım Örgütü, Toplumsal Cinsiyet Birimi, Sivil ToplumGeliştirmeMerkezi,http://www.stgm.org.tr/docs/1202397164Toplumsal%20Cinsiyet%20ve%20Gida%20 Guvenligi-Gida%20ve%20Tarim%20Orgutu.pdf

# O-70 Confectionary Pumpkin Farming and Economics in Turkey

**Musa Seymen[1], Hasan Arısoy[2], Atilla Dursun[3], Ünal Kal[4], Önder Türkmen[1]**

1: Selçuk University Faculty of Agriculture Department of Horticulture, Konya, Turkey
2: Selçuk University Faculty of Agriculture Department of Agricultural Economics, Konya, Turkey
3: Atatürk University Faculty of Agriculture Department of Horticulture, Erzurum, Turkey
4: Korkut Ata University Applied Science School of Kadirli Organic Farming Business Management Department, Osmaniye, Turkey

**Abstract**

Consuming the fruits of the pumpkin as a vegetable, the seeds are also consumed both in the production of edible oil and as appetizer. Confectionary pumpkin seeds are a highly valuable species with high content of unsaturated fatty acids, minerals, vitamins and 40-50% fat content. Turkey has 1.500.000 tons of crude oil production and the crude oil demand of the country is around 3.033.000 tons in 2014. According to data from the year 2015, the country spent 1.4 billion dollars on importing crude oil (Öztürk, 2016). On the other side, as in many parts of the world, there is a widespread appetizer culture in Turkey. It is foreseen that the consumption of appetizer will become even more widespread as more and more agenda is introduced by subject experts especially on the subject of nourishment in healthy nutrition. Pumpkin seeds consuming appetizer in Turkey are in the 6th place after almonds in the order of the most consumed appetizer.

The confectionary pumpkin has been produced in Turkey for many years and has a production value of 41.612 tons (TÜİK, 2015) in 61.500 hectares, and its production is on an increasing trend. Furthermore, this increases both the appeal of producers to look for alternative products and the widespread recognition of products from the food industry (chocolate, confectionery, bread and pastry industry and edible oil), medicine (prevention of prostate growth, alleviation of menopausal symptoms), cosmetics and animal feed industry. It is anticipated that this product will have a tendency to increase due to its unique advantages in production in the coming period. In this study, it has been tried to reveal the general situation of confectionary pumpkin farming in Turkey, which has been spreading for a long time as a traditional product for many years.

***Keywords:*** confectionary pumpkin, mineral mater, oil content, appetizer

## INTRODUCTION

The origin of the squash and pumpkin is America. Before the discovery of America continent, there are archaeological finds that *Cucurbita pepo, Cucurbita moschata, Cucurbita mixta* and *Cucurbita maxima* are grown in the southwestern part of this continent, north of Mexico and South America (Bassett, 1986). In general, when squash fruits are consumed as vegetables, seeds are consumed both in the production of edible oil and as appetizer. It is foreseen that the consumption of as appetizer will become even more widespread as more and more agenda is introduced by subject experts especially on the subject of nourishment in healthy nutrition. In Turkey, consumption as appetizer, pumpkin seeds are in the 6th place after almonds in the order of the most consumed nuts. On the other hand, both because producers are looking for alternative products and because they are used in a wide range of fields from food industry (chocolate, confectionery, bread and pastry industry and edible oil), medicine (prevention of prostate growth, lightening of menopausal symptoms), cosmetics and animal feed industry so the attractiveness of product increases. Because of these reasons, the pumpkin farming in Turkey has become a production value which is increasing day by day. In 2007, a total of 31,262 tons of seed pumpkins were produced in 269,158 decares of area, while in 2016, 428.11 tons of seed pumpkins were produced in 628.441 decares inland.

Pumpkin cultivation has some advantages over some other vegetable types. These can be a suitable species for sowing seasons, the ease of harvesting, the possibility of cultivating large amounts of cultivated crops, the difficulty in terms of diseases and pests (Seymen et al., 2013), the lack of a need for frequent irrigation or the ability to cultivate in completely barren conditions (Seymen et al., 2016).

The pumpkin seed contains approximately 30-50% fat and is rich in antioxidants and phenols (Türkmen et al., 2015; Seymen et al. 2016). It is rich in omega-3 (w-3) and omega-6 (w-6) fatty acids, which are fatty acids that can't be synthesized by the human body (Aydın, 2004). Pumpkin seeds are rich in Ca, K, P, Mg, Mn, Fe and Zn minerals, and are a source of vitamin B group. Because the biological value of seeds protein is high, it is evaluated as an additive to many food products, especially bread, salami and sausage (Kreft et al., 2002).

In this study, it has been tried to reveal the general situation of seed pumpkin farming in Turkey, which has been spreading for a long time as a traditional product for many years. It is also aimed to make a comparative economic analysis of the appetizer and oil production compared to the determined alternative products.

## CONFECTIONARY PUMPKIN FARMING IN TURKEY

Confectionary pumpkin is one of the most important vegetable species grown in Turkey (Yavuz et al., 2005a; b). In addition to being consumed as a appetizer, it is a type of vegetable that grows increasingly day by day due to its quality and

high fat and fatty acids.

In 2007, a total of 31.262 tons of confectionary pumpkin were produced in a total area of 269,158 decares. In 2016, 42,181 tons of crops were produced in 628,441 decares inland. In the decade, production increased by about 133%, while production increased by 35%. It has been observed that there is a significant increase in the number of years, and it is seen that the breeding becomes increasingly important day by day. When the average decare yield in 2010 was examined, it was 71 kg / decare while the average yield was 67 kg / decare according to the values in 2016. When the average of long years is examined, it has about the same production values (Table 1). Pumpkins are grown in our country without irrigation on barren land. Therefore, while yields of this type can be below the average of the country, yields are higher than the average of the country in the irrigated land. One of the biggest problems in our country is made growing with local populations. It is thought that due to the studies done, different kinds of varieties will be developed for arable and irrigated land and the yield to be obtained from unit area will be high.

When the regions are examined on the basis, we cultivate pumpkin in 9 regions in our country. Although North Eastern Anatolia, Middle Eastern Anatolia, Mediterranean and Western Black Sea regions have been made of pumpkin cultivation, the region is only made in certain provinces and there hasn't been increase in growing over the years (Table 1).

In the West Marmara region, 1,613 tons of products were obtained from 19,874 decares area in 2007, while production area and production value decreased in years. In 2016, 7.888 decares of land were reduced to 735 tons of pumpkin production, with a reduction of about 119% in production (Table 1).

When the Aegean Region is examined, 238 tons of production is obtained from 1,646 decares in 2007, while 370 tons of products were obtained from 3,089 decares in 2016. Pumpkin production increased by 55% in the Aegean region (Table 1).

Production and growing areas in the Eastern Marmara region have generally not changed. The production area, which was 24.213 decares in 2007, was 20.606 decares in 2016. Production values decreased from 3,346 tons to 2,066 tons (Table 1).

The western Anatolia region is also an important confection as an area of confectionary pumpkin and increases in daytime production are observed. While 2,325 tons of production was done in 24,935 decares in 2007, production of 5,031 tons in 45.645 decares was realized in 2016. During this 10-year period, there was an increase of about 116% in production (Table 1).

The most important region in Turkey for confectionery pumpkin growing is the Central Anatolian region. This region constitutes approximately 87% of the cultivated areas in the country and 80% of the total production. In this region, 23,483 tons of production was made in the area of 198,010 decares compared to 2007 data. When examined over the years, there have been significant increases in production area and production value. In the transition from 2010 to 2011, a significant increase in production values was observed. It can be said that this increase was due to the increase in demand for the product in the previous year and the increase in value of product prices. After this year, there was a significant increase in the production pumpkins in the region and a total of 33,782 tons of production was obtained from 548,419 decares in 2016. In this region, an increase of about 44% was observed in the production of pumpkins in decades (Table 1).

Kayseri, Nevşehir, Aksaray, Konya and Eskişehir were the main productions area of pumpkin production in Turkey. When the data of 2008, 2012 and 2016 were examined, significant increases were observed in the growing area and production value in Kayseri and Nevşehir provinces. In 2008, pumpkin farming was carried out in 28 provinces. In 2008, Kayseri (4,028 tons), Aksaray (3,655 tons), Nevsehir (2,662 tons), Konya (2,094 tons), Sakarya (1,393 tons) and Karaman (1,053 tons) were the most important pumpkin farming provinces. In 2012, the pumpkin farming was in 29 provinces. This year, Kayseri (12,356 tons), Nevşehir (10,423 tons), Aksaray (2,977 tons), Konya (1,149 tons) and Eskisehir (1,068 tons) were the most pumpkin produced. In 2016, Kayseri (15,053 tons), Nevşehir (13,513 tons), Aksaray (4,028 tons), Konya (3,928 tons) and Eskisehir (1,842 tons) were the most important producers. As a result of the decade production values, an increase of approximately 273% was observed in the province of Kayseri. In addition to this, an increase of 408% in Nevşehir, 10% in Aksaray, 88% in Konya and 202% in Eskişehir were observed (Table 2).

Table 1. The production values of pumpkin farming, according to the regions in years of 2007-2016 in Turkey (TÜİK, 2016).

| Year | TURKEY | | North Eastern Anatolia | | Middle East Anatolia | | West Marmara | | Aegean | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Area (da) | Production (ton) | Area (da) | Pro. (ton) | Area (da) | Pro. (ton) | Area (da) | Pro. (ton) | Area (da) | Pro. (ton) |
| **2007** | 269.158 | 31.262 | - | - | 5 | 10 | 19.874 | 1.613 | 1.646 | 238 |
| **2008** | 249.516 | 18.340 | - | - | 105 | 17 | 17.644 | 1.635 | 1.611 | 237 |
| **2009** | 281.352 | 21.971 | - | - | 382 | 17 | 16.389 | 1.511 | 1.786 | 281 |
| **2010** | 372.572 | 26.694 | 335 | 42 | 325 | 16 | 16.337 | 1.431 | 3.857 | 464 |
| **2011** | 488.003 | 32.396 | 370 | 47 | 56 | 4 | 12.703 | 1.093 | 2.837 | 347 |
| **2012** | 500.807 | 32.144 | 280 | 30 | 41 | 3 | 11.986 | 1.039 | 2.858 | 350 |
| **2013** | 515.808 | 35.586 | 280 | 30 | 36 | 3 | 11.034 | 955 | 2.646 | 323 |
| **2014** | 552.648 | 36.331 | 260 | 29 | 17 | 2 | 10.917 | 952 | 2.457 | 295 |
| **2015** | 615.119 | 41.612 | 240 | 27 | 17 | 2 | 11.185 | 1.004 | 2.707 | 333 |
| **2016** | 628.441 | 42.181 | 160 | 19 | 10 | 1 | 7.888 | 735 | 3.089 | 370 |
| **Years** | **East Marmara** | | **Western Anatolia** | | **Mediterranean** | | **Middle Anatolia** | | **West Blacksea** | |
| | Area (da) | Production (ton) | Area (da) | Production (ton) | Area (da) | Production (ton) | Area (da) | Production (ton) | Area (da) | Production (ton) |
| **2007** | 24.213 | 3.346 | 24.935 | 2.325 | 290 | 149 | 198.010 | 23.438 | 50 | 43 |
| **2008** | 14.390 | 2.020 | 31.510 | 3.274 | 290 | 149 | 183.766 | 10.852 | 50 | 43 |
| **2009** | 14.148 | 2.010 | 39.640 | 3.386 | 320 | 162 | 208.657 | 14.577 | 200 | 24 |
| **2010** | 22.006 | 2.448 | 39.490 | 2.974 | 300 | 36 | 289.109 | 19.203 | 800 | 79 |
| **2011** | 18.339 | 2.099 | 36.868 | 2.990 | 250 | 50 | 416.000 | 25.707 | 570 | 57 |
| **2012** | 15.532 | 1.751 | 24.991 | 2.408 | 220 | 44 | 444.328 | 26.469 | 520 | 47 |
| **2013** | 16.526 | 1.892 | 27.790 | 2.886 | 220 | 44 | 456.756 | 29.408 | 510 | 45 |
| **2014** | 23.653 | 2.504 | 28.682 | 3.192 | 220 | 40 | 485.932 | 29.269 | 500 | 48 |
| **2015** | 22.936 | 2.420 | 42.808 | 4.738 | 220 | 44 | 533.916 | 32.956 | 1.080 | 88 |
| **2016** | 20.606 | 2.066 | 45.645 | 5.031 | 220 | 22 | 548.419 | 33.782 | 2.394 | 155 |

Table 2. The production values of pumpkin cultivation in Turkey in 2008, 2012 and 2016 (TÜİK, 2016).

| Provinces | 2008 | | 2012 | | 2016 | |
|---|---|---|---|---|---|---|
| | Area (da) | Production (ton) | Area (da) | Production (ton) | Area (da) | Production (ton) |
| Bitlis | 5 | 10 | - | - | - | - |
| Batman | 150 | 113 | - | - | - | - |
| Tekirdağ | 2.590 | 284 | 1.045 | 116 | 1.125 | 137 |
| Malatya | 100 | 7 | 21 | 1 | - | - |
| Edirne | 13.664 | **1.221** | 9.640 | 783 | 6.220 | 534 |
| Kırklareli | 940 | 78 | 866 | 85 | 248 | 25 |
| Balıkesir | 300 | 40 | 300 | 41 | 195 | 29 |
| Çanakkale | 150 | 12 | 135 | 14 | 100 | 10 |
| Afyon | 1.588 | 229 | 2.646 | 324 | 2.610 | 320 |
| Kütahya | 3 | 1 | 12 | 2 | 459 | 48 |
| Uşak | 20 | 7 | - | - | 20 | 2 |
| Bursa | 10 | 2 | - | - | - | - |
| **Eskişehir** | **6.024** | **609** | **10.556** | **1.068** | **18.926** | **1.842** |
| Kocaeli | 31 | 16 | 31 | 5 | 30 | 5 |
| Sakarya | 8.325 | **1.393** | 4.945 | 678 | 1.650 | 219 |
| Ankara | 4.170 | 127 | 10.075 | 576 | 9.575 | 434 |
| **Konya** | **18.390** | **2.094** | **9.166** | **1.149** | **30.620** | **3.928** |
| Karaman | 8.950 | **1.053** | 5.750 | 683 | 5.450 | 669 |
| Burdur | 40 | 24 | - | - | - | - |
| Kahramanmaraş | 250 | 125 | 220 | 44 | 220 | 22 |
| **Aksaray** | **32.054** | **3.655** | **38.135** | **2.977** | **45.960** | **4.028** |
| Niğde | 5.380 | 270 | 7.330 | 386 | 8.540 | 499 |
| **Nevşehir** | **58.327** | **2.662** | **145.129** | **10.423** | **172.969** | **13.513** |
| Kırşehir | 120 | 12 | 1.408 | 101 | 2.610 | 206 |
| **Kayseri** | **87.345** | **4.028** | **249.517** | **12.356** | **313.101** | **15.053** |
| Sivas | 540 | 225 | 2.289 | 181 | 4.060 | 385 |
| Trabzon | 10 | 3 | - | - | - | - |
| Ordu | 40 | 40 | - | - | - | - |
| Erzincan | - | - | 280 | 30 | 160 | 19 |
| Elazığ | - | - | 20 | 2 | 10 | 1 |
| Gaziantep | - | - | 42 | 1 | 10 | - |
| Kilis | - | - | 9 | 2 | - | - |
| Manisa | - | - | 200 | 24 | - | - |
| Kırıkkale | - | - | 320 | 32 | 280 | 22 |
| Yozgat | - | - | 200 | 13 | 899 | 76 |
| Çankırı | - | - | 520 | 47 | 394 | 35 |
| Çorum | - | - | - | - | 2.000 | 120 |

## THE ECONOMIC IMPORTANCE OF THE PUMPKIN FARMING IN TURKEY

The main material of this study is the data of Konya Directorate of Provincial Food Agriculture and Livestock. Survey data from producers obtained by the Konya Directorate of Provincial Food Agriculture and Livestock has been used. The data belongs to the year 2016.

The production data of Konya province were used in the cost of pumpkin and compared products. Konya is one of the most important agricultural centers of Turkey and Central Anatolia. 8,25% of the total agricultural area of Turkey is in Konya. In addition, the share of Konya in total crop production value in Turkey is 5,49% and the share in animal production value is 2,34%. (TURKSTAT, 2016). Therefore, research findings of Konya province are determinant for Central Anatolia Region and Turkey.

The economic situation for the production of pumpkin, as appetizer and edible oil within the scope of the research has been assessed separately. The profitability comparison of sunflower, barley, wheat, sugar beet and maize, which may be pumpkin as appetizer and alternatives, has been made considering the criteria such as soil structure, climatic conditions, cultivation possibilities and product requirements. Likewise, profitability comparison was made for oil obtained from sunflower, canola, safflower and maize, which may be alternative to oilseed pumpkin.

The production costs of the products covered by the research are the sum of the variable costs and the fixed costs. Seed, fertilizer, pesticide, water fee, fuel, oil and repair and maintenance costs of tools and machinery, temporary worker wages, product insurance premiums, marketing expenses and revolving fund interest, which are used in vegetable production and increased or decreased depending on the width of production activity, are variable character. For fixed costs, the interest and depreciation costs calculated for the fixed capital elements used in plant production are taken into consideration. Taxes, insurance and rent expenses paid to fixed capital elements can also be added to these (Kıral et al., 1999). Within this study, the conversion costs for oil extraction from the products and the byproduct income that can be obtained from the product pulps have been neglected. The aim is to compare the profitability of these products. Therefore, in all of these products, production costs up to the acquisition of raw material are taken into account. Oil costs and product profitability were also compared by taking oil conversion ratios into consideration.

Gross production value is the value obtained by multiplying the quantities of products obtained at the end of an agricultural activity in a production location by unit prices with a market value, by the addition of annual productive increases in the plant or animal's capital in the production activity in question. The gross production value of the enterprise is the sum of the gross production values of the existing production branches in enterprise. In addition to the main products in the production branches of the enterprise, non-market by-products are also obtained. If there is a possible sale of by-products from the side products, this value is included in the gross production value of the enterprises branch (Erkuş et al., 1995).

Gross profit is calculated by subtracting costs that vary from gross production value. Net profit is calculated by subtracting production costs from gross production value. Comparative profit shows the ratio of gross production value to production costs (Erkuş et al., 1995).

Unit product costs are calculated by subtracting the by-product revenue from the total production costs for the relevant activity line and dividing the remaining value by the amount of the main product produced (Kıral ve ark., 1999).

Land is one of the limited production factors. For this reason, producers are aiming to reach a product component that will maximize profits from limited arable. The unit product costs and profitability of sunflower, barley, wheat, sugar beet and maize, which have the similar cultivation conditions to the pumpkin evaluated in the region, were compared. The gross profit of pumpkin in the research area was 435.90 TL / da. The highest gross profit after sugar beet and maize is the product of pumpkin (Table 3). The gross profit obtained from the unit is an important criterion indicating the success of the enterprise (Oğuz ve Bayramoğlu, 2015).

The net profit calculated by taking into account the fixed costs incurred regardless of agricultural production is also an important success criterion. The net profit of pumpkin is 322,00 TL / da. On the net profit calculation, the highest profit after the sugar beet and maize is the pumpkin (Table 3). Net profit is the profit of the entrepreneur who is responsible for the organization of production in an enterprise and the risk of production. The net profit from the unit is one of the clearest success criteria in enterprises analyzes and comparisons (Oğuz ve Bayramoğlu, 2015).

It is not enough for a producer in agricultural production to think only of absolute profit. You have to take into account your comparative profit. In the study area, the comparative profit of pumpkin is 1.56, and growing in the region is more advantageous than barley, wheat and sugar beet which are the most common products. Comparative profit, for the production of pumpkin in the region of 1 TL cost, the profit of 1.56 TL, indicating that the profit. The main purpose of economic activities is to provide the highest profit in return for a certain expenditure. For this reason, comparative profit is an important criterion for comparing profitability of products. Although the gross profit of pumpkin is lower than that of sugar beet, it is more advantageous in terms of comparative profit (Table 3). This shows us that there are differences in comparative profit in various regions or within the same region in various agricultural enterprises. In the emergence of this difference, climate, soil, the quality and quantities of agricultural products obtained, quantity and prices of the resources involved in production, and agricultural technology also play a role (Erkuş et al., 1995). In Konya province, which is a research region, it is understood that pumpkin cultivation are economically feasible.

Table 3. Comparison of profitability of pumpkin to some agricultural products

| | **Pumpkin** | Sunflower | Barley (dry) | Barley (watery) | Wheat (bread dry) | Wheat (watery bread) | Sugar beet | Maize |
|---|---|---|---|---|---|---|---|---|
| Variable costs (TL/da) | 464,10 | 306,60 | 130,87 | 230,94 | 144,69 | 262,72 | 729,80 | 432,60 |
| Fixed costs (TL/da) | 113,90 | 94,20 | 41,94 | 81,49 | 44,16 | 85,31 | 143,90 | 113,00 |
| Total production costs (TL/da) | 578,00 | 400,80 | 172,81 | 312,43 | 188,85 | 348,03 | 873,70 | 545,60 |
| Yield (kg/da) | 120,00 | 390,00 | 222,30 | 422,04 | 237,97 | 462,07 | 6.500,0 | 1.325,0 |
| Price (TL/kg) | 7,50 | 1,80 | 0,74 | 0,74 | 0,88 | 0,88 | 0,19 | 0,72 |
| Byproduct income(TL/da) | - | - | 37,51 | 78,25 | 42,92 | 83,11 | 14,00 | 0,00 |
| Gross production value (TL/da) | 900,00 | 702,00 | 202,01 | 390,56 | 252,33 | 489,73 | 1.249,0 | 954,00 |
| Product cost (TL/kg) | 4,82 | 1,03 | 0,61 | 0,55 | 0,61 | 0,57 | 0,13 | 0,41 |
| Gross profit (TL/da) | 435,90 | 395,40 | 71,14 | 159,62 | 107,64 | 227,01 | 519,20 | 521,40 |
| Net profit (TL/da) | 322,00 | 301,20 | 29,20 | 78,13 | 63,48 | 141,70 | 375,30 | 408,40 |
| Comparative profit | 1,56 | 1,75 | 1,17 | 1,25 | 1,34 | 1,41 | 1,43 | 1,75 |

Note: The average parity for 2016 is $ 1 = 3 TL

Pumpkins are an important source of nutrients in terms of human health with fatty acids and components it contains, as well as being an important oil source. Pumpkins are not consumed very much in Turkey because the price is high. However, in Europe, frying oil and salads are consumed abundantly. It is estimated that the consumption of pumpkin oil will increase and the oil industry will develop in Turkey due to economic development. For this reason, unit product cost and profitability were compared for the oiled pumpkin, which has the same growing conditions as the region, and oil obtained from sunflower, canola, aspir and maize. The gross profit from the pumpkin oil in the study area was found to be 6.255,90 TL / ha. Compared with other vegetable oils, the gross profit from the pumpkin oil appears to be quite high (Table 4).

The comparative profit of pumpkin oil in the study area is 11.63. The product with the highest comparative profitability after the safflower in the region is pumpkin. Compared to sunflower, maize and canola, there is a very high profitability. For this reason, pumpkin will make a significant contribution to the regional economy due to the increase in consumption.

Table 4. Comparison of profitability of pumpkin for some oilseed crops

| | **Pumpkin** | Sunflower | Canola | Safflower (watery) | Safflower (dry) | Maize |
|---|---|---|---|---|---|---|
| Variable costs (TL/da) | 464,10 | 306,60 | 267,80 | 92,49 | 80,20 | 432,60 |
| Fixed costs (TL/da) | 113,90 | 94,20 | 114,50 | 51,80 | 44,57 | 113,00 |
| Total production costs (TL/da) | 578,00 | 400,80 | 382,30 | 144,29 | 124,77 | 545,60 |
| Yield (kg/da) | 120,00 | 390,00 | 330,00 | 193,75 | 125,33 | 1.325,00 |
| Oil conversion rate (%) | 35[1] | 45[2] | 46[3] | 23[4] | 27[4] | 17[5] |
| Oil yield (lt/da) | 42,00 | 175,50 | 151,80 | 44,56 | 33,84 | 225,25 |
| Oil price (TL/lt)* | 160 | 9 | 5 | 80 | 80 | 7 |
| Gross production value (TL/da) | 6.720,00 | 1.579,50 | 759,00 | 3.565,00 | 2.707,13 | 1.576,75 |
| Oil cost (TL/lt) | 13,76 | 2,28 | 2,52 | 3,24 | 3,69 | 2,42 |
| Gross profit (TL/da) | 6.255,90 | 1.272,90 | 491,20 | 3.472,51 | 2.626,93 | 1.144,15 |
| Net profit (TL/da) | 6.142,00 | 1.178,70 | 376,70 | 3.420,71 | 2.582,36 | 1.031,15 |
| Comparative profit | 11,63 | 3,94 | 1,99 | 24,71 | 21,70 | 2,89 |

[1]Seymen vd., 2016. [2]Baydar and Erbaş, 2005. [3]Taylor vd., 1999. [4]Coşge vd., 2007, [5]Yazıcıoğlu and Karaali, 1983.

* Approximate retail prices

## CONCLUSIONS

In recent years in Turkey, there has been an increase in interest in pumpkin farming. When the last decade period was examined, there was a 133% increase in pumpkin fields and a 35% increase in the production amount. The average pumpkin yield of Konya in the scope of the survey is about 120 kg / da, but the average yield in Turkey is 67 kg / da. The main reasons for low yield in the country are; because of the wrong selection of the varieties belonging to the region and the difficulty in obtaining varieties. It is especially important to develop new varieties, because of pumpkin growing regions.

Pumpkin seeds as edible oil and appetizer can bring a high profit margin to the producers. For this reason, the dissemination of pumpkin growing in the research area will contribute significantly to the regional economy and producers. However, this contribution may be possible with the increase of pumpkin industry and pumpkin demand.

## REFERANCES


Aydın, A. 2004, Sağlığımız ve omega-3 yağ asitler, *Sağlıkta ve Hastalıkta Beslenme Simpozyumu Dizisi*, No:41, s.181-189.

Bassett. M.J. 1986, Breeding vegetable Crops, *The Avı Puplishing Company Inc*, Vegatable Cropc Department University of Florida Gainesville, Florida.

Baydar, H. ve Erbaş, S. 2005. Influence of Seed Development and Seed Position on Oil, Fatty Acids and Total Tocopherol Contents in Sunflower (Helianthus annuus L.). Turk J Agric For, 29 (2005) 179-186 © TÜBİTAK.

Coşge, B. Gürbüz, B. Kıralan, M. 2007. Oil Content and Fatty Acid Composition of Some Sanflower (Carthamus tinctorius L.) Varieties Sown in Spring and Winter. International Journal of Natural and Engineering Sciences, 1 (3): 11-15, 2007.

Erkuş, A. Bülbül, M. Kıral, T. Açıl, A.F. Demirci, R. 1995. Tarım Ekonomisi. Ankara Üniversitesi Ziraat Fakültesi, Eğitim, Araştırma ve Geliştirme Vakfı Yayınları No: 5, Ankara.

Kıral, T. Kasnakoglu, H. Tatlıdil, F.F. Fidan, H. ve Gündogmus, E. 1999. Tarımsal Ürünler İçin Maliyet Hesaplama Metodolojisi ve Veri Tabanı Rehberi. TEAE Yayınları, Yayın No:37, ISBN: 975-407-051-2, Aralık 1999, Ankara.

Kreft, S. Strukelj, B,. Gaberscik, A. Kreft, I. 2002, Rutin in buckwheat herbs grown at different UV-B radiation levels: comparison of two UV spectrophotometric and an HPLC method, *Journal of Experimental Botany*, Vol. 53, No. 375, pp. 1801-1804.

Oğuz, C., Bayramoğlu, Z. 2015. Tarım Ekonomisi Kitabı. Atlas Akademi, 2.baskı, ISBN: 978-605-63373-3-8, Nisan 2015.

Seymen M, Uslu N, Türkmen Ö, Juhaimi F.A, Özcan M.M, 2016. Chemical Compositions and Mineral Contents of Some Hull-Less Pumpkin Seed and Oils. Journal of the American Oil Chemists. 93:1095-1099.

Seymen, M. Ö. Türkmen M. Paksoy, 2013. Selection of edible pumpkin seeds (Cucurbita pepo L.) genotypes. Jurnal of Selçuk University Natural and Applied Science. 2(4): pp-29-39.

Seymen, M. Yavuz, D. Yavuz, N. Türkmen, Ö. 2016. Effect on Yield and Yield Components of Different Irrigation Levels in Edible Seed Pumpkin Growing. International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering Vol:10, No:5, 214-219.

Taylor, A.J. Smith, C.J. Wilson, I.B. 1991. Effect of Irrigation and Nitrogen Fertilizer on Yield, Oil Content, Nitrogen Accumulation and Water Use of Canola (Brassica napus L.). Fertilizer Research, 29: 249-260, 1991. © 1991 Kluwer Academic Publishers, Printed in the Netherlands.

TÜİK, 2017. https://biruni.tuik.gov.tr/bitkiselapp/bitkisel.zul. Available date: 20 March 2017.

TÜİK, 2016. Turkish Statistical Institute. Regional Statistics, Access: https://biruni.tuik.gov.tr/bolgeselistatistik/tabloOlustur.do#, Access date: 05.05.2017

Türkmen, Ö. Uslu, N. Paksoy, M. Seymen, M. Fidan, S. Özcan, M.M. 2015. Evaluation of fatty acid composition, oil yield and total phenol content of various pumpkin seed genotypes. La Rivista Italiana Delle Sostanze Grasse- Vol-92- Pp-93-97.

Yavuz, D. Seymen, M. Yavuz, N. Türkmen, Ö. 2015. Effects of irrigation interval and quantity on the yield and quality of confectionary pumpkin grown under field conditions. Agricultural Water Management 159 (2015) 290–298.

Yavuz, D. Yavuz, N. Seymen, M. Türkmen, Ö. 2015. Evapotranspiration, crop coefficient and seed yield of drip irrigated pumpkin under semi-arid conditions. Scientia Horticulturae 197 (2015) 33–40.

Yazicioğlu, T., and A. Karaali. 1983. “On the fatty acid composition of Turkish vegetable oils.” European journal of lipid science and technology 85.1 (1983): 23-29.

# O-77 Determination of the effect of humic acid on growth and development parameters of parsley (*Petroselinum sativum* Hoffm.) grown in boron soil

[a]Tuncay TURSUN, [b]Şener AKINCI

[a]*Institute of Pure and Applied Sciences, Marmara University, TR- 34722 Istanbul, Turkey.*

[b]*Department of Biology, Faculty of Arts and Sciences, Marmara University, TR-34722 Istanbul, Turkey*

Key words: Boron, *Petroselinum sativum*, Parsley, Humic acid.

**Abstract:**

The effects of two different boron (B) concentrations on parsley (*Petroselinum sativum* Hoffm.) growth parameters and its nutrient composition were determined, together with potential interactive role of humic acid. The experimental design consisted of 5 sets with four replicate samples as control group (C), which contained Hoagland solution only, and four experimental treatments, two of which, B1 and B2, had boron + Hoagland solutions with 15 and 150 ppm B respectively, and the other two, HB1 and HB2, had the same boron concentrations and additionally 10 ml humic acid for each. Examination of growth parameters showed that parsley is resistant to 15 ppm boron concentration, which cause a significant increase in plant height. However, applying humic acid caused plant heights of the HB2 group to decrease significantly. Nutrient analysis results proved that humic acid increased Fe and Zn content in parsley, with significantly increased Fe and Zn content in HB2 compared to C, B1 and B2. The result showed that parsley may grow in, and tolerate, boron containing soil, and that humic acid has no significant effect on the uptake of B from soil within parsley leaves

## Introduction:

Boron is an non metal element widely found in both lithosphere and hydrosphere ranging from 5-10 mg $kg^{-1}$ in rocks (Shorrocks 1997), 3-30 µg $kg^{-1}$ in rivers (Power and Woods, 1997). It contained magmatic rock and B is associated with organic matter in the formation of coal (Kabata-pendias and Pendias, 1999). Boron is an essential element for plants required as micro level since its mobility limited in *phloem* in some species. If increases in the soil becomes toxic to the plant since than needed for normal growth (Marschner, 1995; Reid, 2010). Boron may uptake by plants as boric acid ($H_3BO_3$) or borate anion ($B(OH)_4^-$) forms. When B accumulated in plants, the symptoms of chlorotic and or necrotic spots on the tip or edges of older plants leaves appeared (Wilcox, 1960; Nable et al. 1997)

Humic substances are sediments in lignite beds that formed by decay of organisms such as plants, animals and microorganisms after millions of years.

Humic acids increase cation exchange capacity (CEC) in the soil (Petit, 2004, Stevenson, 1994) and promote both plant growth and root development. For instance in root stimulation; the length and dry weight of root increae in maize (Eyheraguibel et al., 2008) in *Helianthus annuus* L. (Kolsarıcı et al., 2005) in maize root, (Sharif et al., 2002), root dry weight increase in tomato and cucumber (Atiyeh et al., 2002); root development in ryegrass (Bidegain et al., 2000).

Parsley (*Petroselinum sativum* Hoffm.) is biennial plant blonging Apiaceae family and very common and popular aromatic culinary herb cultivated in many parts of the world. In this research, the effects of two different of two boron (B) concentrations on parsley (*Petroselinum sativum* Hoffm.) growth paramaters and its nutrient composition were determined, together with potential interactive role of humic acid.

## Materials and Methods

The seeds of parsley called as "Giant of Italy" cultivar were obtained from Vilmorin trade mark by Anadolu seed

production and marketing company. The liquid Humic (BİOTOTAL is a trade products of Genta LTD, Turkey) was used in the present study. The seeds were planted in plastic pots contained the mixture of torf (GARDOL) and perlite (Taşper Perlit San.Tic. Ltd. Şti. -www.tasper.com.tr -) 1:3 respectively. After a month, the germinated plantlets were tansferred into plastic pots (10 cm in diam. and 8 cm in height) and each contained same mixture of growing media as 130 g in total. The experimental sets were prepared as 5 blocks each of 7 replicates with four individual plants.

The total five treatments were arranged in a completely randomized block design with seven replicates as follows: The control (C) contained only Hoagland-Arnon (1950); two boron concentrations (15 and 150 ppm B1 and B2 respectively) and 10 mL Humic acid additon into those of boron (B1HA and B2HA) determined as humic treatments.

The pots were set up as blocks using completely randomised method (Mead and Curnow, 1983) at 23±2 ºC the moisture level of the mixture was maintained at 55% ± 5 and sets were exposed to 4000-4200 lux plant floresans intensity for 14/10 day and night periods respectively (Akinci et al., 2009).

**Statistical:**

Data from growth parameters and nutrient analyses were subjected to NCSS (V9 for Windows) for paired-sample T test and evaluated to be significant at the level of $P < 0.05$.

**Results and Discussion**

Growth parameters at the harvesting process after 55 days of transplanting, determined by measuring of seedlings in the pots as plant heights (PH), No of leaves (NL), leaf area (LA), average leaf area (ALA), fresh weight of leaves (FLW), stems (FSW) and roots (FRW). After kept them 24 hr in etuve for fully removal of tissue water (DLW, DSW, DRW) were determined (Table 1). The leaves of parsley dried completely in etuve at 80 C for 24 hrs then weigh and were crushed using mortar and pestle making them a powder according to weta ash method after Kacar (1972). Na and K by flame photometer; Fe, Zn, Ca, Mn, Mg, and B were determined by Inductively Coupled Plasma Mass Spectrometer (ICP-MS).

B application on parsley caused gradual reduction in plant heights by increasing concentrations (e.g 15 and 150 ppm B) as 2.66% and 15.34% in B1 and B2 respectively. The decrease in both HB1 and HB2 were significantly appeared as 17.73% and 4.15% compared to B1 and B2 respectively ($\alpha$=0.05). The mean of root length (RL) increased (12.94%) significantly in the treatment of B1 compared to controls at the level of 95% confidence level (Table 1) Contrary this, in B2 and two humic acid treated samples, RL significantly decreased.

In the present investigation, B concentration decreased in B1 and B2 application respectively as 50.59% and 67.56% compared to controls (Figure 1.). This results were not agree with the studies stated that B content increasing in plants mostly correlated with increased B concentration in soil (Eaton, 1944, Jame et al., 1982). Iron accumulated in parsley leaves in B2 and both humic treatments (e.g HB1 and HB2) rather than controls (Figure 2.). HA increased Fe concentration in both HB1 and HB2 tratments. Zn changes in parsley leaves were similar to B, Fe and Mn content accumulation which had a slight decrease in B1, and gradually increase, in B2; HB1 and HB2 treatments. Application of HA, in HB1 differed significantly from B1 at the level of 95% confidence level. At the same significant level, the K content decreased by 4.62% in HB2 compared to B1.

**Conclusions**

Boron is a crucial micronutrient and plays an important role in plant growth and development mainly involved in carbohydrate metabolism and cell division.

1. B caused increase in leaves fresh and dry weights and leaf area in B1 treatments.
2. The present study revealed that 15 ppm B (B1) application to parsley plants was adequate amount that promoted plant growth.
3. 150 ppm B (B2) seemed to excessive amount that decreased (badly effected) in all growth parameters.
4. HA effected absorption of elements in Fe and Zn.
5. Boron content increased after HA application.
6. K concentration were decreased in both HA treatments.

HA can contribute uptake of certain nutrient from soil although the ratios absorbed did not seem to adequate to full requirements of parsley plants to ideal growth and development in pot experiment.

**Table 1** Growth parameters

| | K | B1 | B2 | HB1 | HB2 |
|---|---|---|---|---|---|
| Plant height PH (cm) | 15.025 ± 0.467 | 14.625 ± 0.446 | 12.719 ± 0.428*/** | 12.031 ± 0.355*/** | 12.194 ± 0.548*/** |
| Root length RL (cm) | 13.294 ± 0.616 | 15.013 ± 0.404* | 12.713 ± 0.598** | 12.244 ± 0.499** | 10.906 ± 0.703*/** |
| Leaves fresh weight LFW(g) | 1.293 ± 0.068 | 1.508 ± 0.067* | 1.003 ± 0.048*/** | 0.880 ± 0.032*/** | 0.705 ± 0.089*/**/*** |
| Leaves dry weight LDW (g) | 0.184 ± 0.008 | 0.218 ± 0.014* | 0.156 ± 0.00** | 0.126 ± 0.010*/** | 0.104 ± 0.012*/**/*** |
| Stalk fresh weight (SFW) (g) | 1.687 ± 0.185 | 1.590 ± 0.124 | 1.233 ± 0.075*/** | 1.000 ± 0.058*/** | 0.883 ± 0.099*/** |
| Stalk dry weight (SDW) (g) | 0.180 ± 0.019 | 0.180 ± 0.013 | 0.138 ± 0.005** | 0.101 ± 0.005*/**/*** | 0.098 ± 0.014 |
| Root fresh weight (RFW) (g) | 0.753 ± 0.139 | 0.893 ± 0.150 | 0.725 ± 0.047 | 0.505 ± 0.040** | 0.325 ± 0.063*/**/*** |
| Root dry weight(RDW) (g) | 0.212 ± 0.036 | 0.234 ± 0.049 | 0.146 ± 0.007** | 0.102 ± 0.013** | 0.057 ± 0.013*/** |
| Leaf area (LA) ($mm^2$) | 24611 ± 1715 | 28770 ± 1230 | 18348 ± 1666*/** | 17632 ± 793*/** | 14875 ± 1913*/** |
| Average leaf area (ALA) ($mm^2$) | 1253.5 ± 6.330 | 1285.0 ± 76.314 | 1001.0 ± 41.795** | 912.0 ± 35.649*/** | 801.5 ± 28.324*/** |

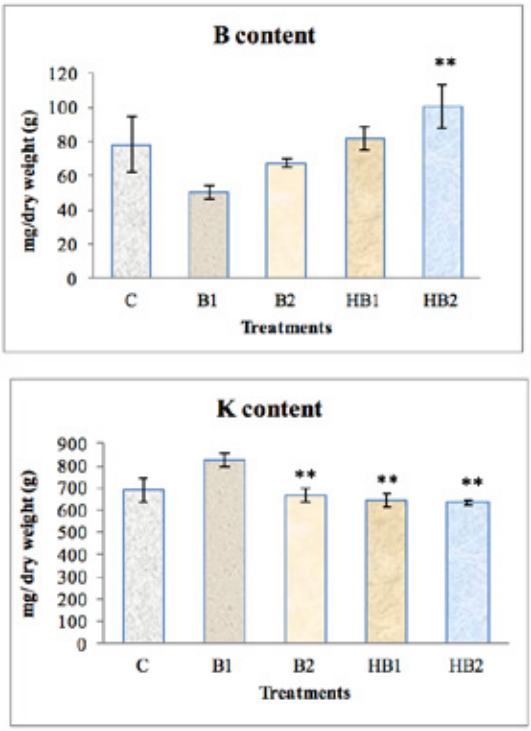



Figure 1.

*: Significantly different from C; **: Significantly different from B1;

***: Significantly different from B2

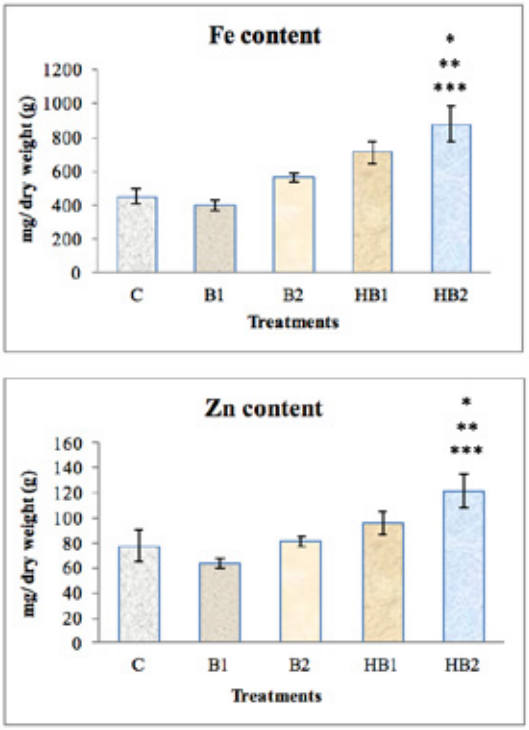



Figure 2.

*: Significantly different from C; **: Significantly different from B1;

***: Significantly different from B2

References

Akinci S, Buyukkeskin T, Eroglu A, Erdogan BF (2009). The effect of humic acid on nutrient composition in broad bean (*Vicia faba* L.) roots. Notulae Sci. Biol. 1(1):1-8.

Atiyeh, R.M.; Lee, S.; Edwards, C.A.;Arancon, N.Q. and Metzger, J.D. 2002.: "The Influence of Humic Acids Derived from Earthworm-processed Organic Wastes on Plant Growth", BioresourceTechnology,84.

Bidegain, R.A.; Kaemmerer, M.; Guiresse, M.; Hafidi, M.; Rey, F.; Morard, P. And Revel, J.C 2000. "Effects of Humic Substances from Composted or Chemically Decomposed Poplar Sawdust on Mineral Nutrition of Ryegrass", Journal of Agricultural Science, 134 (2000) 259.

Eyheraguibel B, Silvestre J, Morard P (2008) Effects of humic substances derived from organic waste enhancement on the growth and mineral nutrition of maize. Bioresour. Technol. 99: 4206-4212.

Hoagland DR, Arnon DI (1950). The water-culture method for growing plants without soil. California Agric. Exp. Stn. Circ. 347, 32.

Kabata-Pendias A, Pendias H (1999). Biogeochemistry of Trace Elements, 2nd ed., Wyd. Nauk PWN, Warsaw. 400 (Po).

Kacar B (1972). Chemical Analyses of Soil and Plant. Press of Ankara Univ. Ag. Fac. 53 (In Turkish)

Kolsarıcı, O, Kaya MD, Day S, Ipek A, Uranbey S (2005). Effects of humic acid rate on emergence and seedling growth of sunflower (*Helianthus annuus* L.). Ziraat Fakultesi Dergisi, Akdeniz Universitesi. (2): 151-155. (In Turkish).

Marschner H (1995). Mineral Nutrition of Higher Plants. 2nd. Ed. Academic Press, London. 889 p.

Mead R, Curnow RN (1983). Statistical methods in agricultural and experimental biology. Chapman and Hall, London.

Nable RO, Cartwright B, Lance RC (1990). Genotypic differences in boron accumulation in barley: Relative susceptibilities to boron deficiency and toxicity. In: El Bassam N, Dambroth M, Loughman B, eds. Genetic Aspects of Plant Mineral Nutrition. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 243-251.

Pettit RE (2004). Organic matter, humus, humate, humic acid, fulvic acid and humin: their importance in soil fertility and plant health [Online].

Power PP, Woods WG (1997). The chemistry of boron and its speciation in plants. *Plant Soil* 193, 1-13.

Reid R (2010). Can we really increase yields by making crop plants tolerant to boron toxicity? Plant Science 178: 9-11.

Sharif M, Khattak RA, Sarir MS (2002). Effect of different levels of lignitic coal derived humic acid on growth of maize plants. Commun. Soil Sci. Plant Anal. 33(19-20): 3567-3580.

Shorrocks V (1997). The occurrence and correction of boron deficiency. *Plant Soil* 193, 121-148.

Stevenson FJ (1994). Humus Chemistry: Genesis, Composition, Reactions. 2nd. Edition, John Wiley and Sons, Inc, New York. 285.

Wilcox LV (1960). Boron injury to plants, Agriculture information bulletin no. 211 Agricultural Research Servıce. United States Department of Agriculture. Washington, D.C.

# O-81 Organic Livestock in Turkey

İbrahim Ak[1]

## Abstract

*Organic agriculture begins with the request of the EU countries for organic products in 1984. The production area of organic products, the number of producers and the amount of production have increased considerably day by day. Since consumer awareness and purchasing power are low in Turkey, a significant part of the organic herbal products are exported to mainly abroad countries. Organic agriculture has developed based on crop production and exports. However, due to problems with export of animal products and inadequate demand in the domestic market, organic livestock production has developed hardly. The number of organic livestock farms is only 188. Despite of the high potential of organic livestock in the country, and organic livestock has not developed in the outer market due to export problems and the inland demand is inadequate. For this reason, significant support is needed to increase the production and consumption of organic animal products. In this article provides general information about animal husbandry in Turkey, the current situation of organic animal husbandry, problems and solution will be discussed.*

**Key words**: Organic farming, organic livestock, organic milk, organic meat, organic eggs

## Introduction

Problems that intensive farming caused brought up the organic farming method to the agenda in agriculture. In organic livestock, which is one of the main components of organic agriculture, animals in the farm are allowed to show all their natural behaviors, animal feeds are generally produced in enterprise and they are organic, harmful feed additives are not

[1] Uludag University, Faculty of Agriculture, Animal Science Department, Bursa-Turkey, e-mail: selena@uludag.edu.tr

used in order to increase the efficiency. Production works are supervised by control and certification organizations and healthier products are offered to consumers without causing environmental pollution. For this reason, important developments have been carried out in production and consumption of organic agricultural products in countries where consumer awareness and income levels are high.

## Organic Livestock in Turkey

Organic agriculture in Turkey began in 1984 with the request of European countries about organic products. Most of the products produced consist of plant products and they are exported to other countries. Except honey, all of the exported products consist of plant products.

Turkey has a great potential in terms of the number of animals. Intensive livestock is practiced in almost all of the poultry farming and in a part of the dairy cattle farming. The farming of animal species such as sheep and goats is mostly carried out based on pasture and intensively. Sheep and goat farming is often carried out with low-yielding domestic breeds, which are usually resistant to disease. The use of inputs in sheep and goat farming is very low, yield per unit animal and income levels of breeders are low. Although the potential for organic livestock production in the country is very high, this potential is not sufficiently used.

The regions which have large grass and pasture areas and which are not polluted due to intensive agriculture and industry, mainly Eastern Anatolia Region, possess greater potential for organic livestock and beekeeping. However, there are problems in the export of animal products due to some animal diseases seen in the country. In domestic market, inadequate demand due to low consumer consciousness and purchasing power negatively affect the development of organic animal farming. Thus, the number of enterprises engaged in organic livestock production is very low. Data on organic animal production in Turkey in recent years is given in Table 1.

**Table 1: Information about organic animal production in Turkey distributed by years (2006-2016)**

| Years | Number of producers | Number of animals | Milk production (ton) | Meat production (ton) | Egg production (x1000 pcs) |
|---|---|---|---|---|---|
| 2006 | 6 | 14.407 | 2.875 | 12 | 241.940 |
| 2007 | 16 | 42.192 | - | - | - |
| 2008 | 31 | 38.942 | 8.711 | 554 | 4.424 |
| 2009 | 38 | 129.737 | 12.994 | 377 | 11.767 |
| 2010 | 105 | 387.984 | 11.604 | 6.803 | 17.890 |
| 2011 | 137 | 453.513 | 14.794 | 1.359 | 26.237 |
| 2012 | 151 | 253.783 | 17.627 | 481 | 36.106 |
| 2013 | 163 | 1.021.382 | 54.781 | 4.970 | 48.041 |
| 2014 | 216 | 1.121.159 | 15.510 | 2.107 | 64.899 |
| 2015 | 179 | 997.707 | 19.739 | 2.606 | 58.939 |
| 2016 | 188 | 1.215.632 | 21.431 | 1.609 | 147.600 |

Source: TUIK 2017

As seen in Table 1, the number of animal breeders and animals, the amount of milk, meat and egg production have increased in the last 10 years. The increase in the production of organic eggs, which are among the organic animal products, is higher.

Organic farming is done in 188 farms in Turkey. Approximately half of these farms consist of ruminants and the other half consist of poultry farms. While 95% of organic milk production is obtained from cattle, 92% of organic meat production is obtained from chickens. Moreover, the rate of organic animal products in total production is below 0.1%. It is observed that consumer interest and demand for organic eggs and chicken meat is higher than other organic animal products since poultry farming in Turkey is mostly carried out with conventional methods. Although beekeeping in the country is highly developed and there is a chance of exporting, the rate of organic honey in total honey production is only 0.33%. Although the increase in organic livestock is observed every year in our country, the rate of organic animal products in total animal production is low and inadequate. As shown in Table 3, 65 animal breeders are engaged with organic animal farming with 7.234 cattle, produce 20.298 tons of organic milk and 74 tons of organic beef per year. Although organic milk production accounts for only 0.12% of total milk production, demand insufficiency and marketing problems are encountered.

Due to the fact that sheep and goats consist of disease-resistant domestic breeds and that a significant part of their feed needs can be met from natural grazing areas, it is an important livestock sector in terms of organic meat and milk production. At present, 16 sheep and 15 goat breeders are engaged in organic production in 31 farms with 17.334 sheep and 7.022 goats in Turkey. 277 tons of organic milk and 903 tons of organic meat, which consist of 232 tons of sheep milk, 901 tons of lamb meat, 45 tons of goat milk and 2 tons of goat meat are produced.

Since conventional poultry farming is common throughout the country, it is observed that there is an increase in the interest and demand of consumers in cage-free chicken or organic chicken meat and eggs. Hence, the production of organic eggs and poultry meat which is among organic livestock has made more progress in recent years. In our country, 276 beekeepers are engaged with organic beekeeping with 40,371 hives and produce 349 tons of organic honey per year. Organic honey production accounts for 0.33% of total honey production.

**Problems of Organic Animal Production**

In Turkey, demand in organic animal products are low according to reasons such as problems in exportation of organic animal products, low purchase power and consumer awareness within domestic market and distrust of organic products. Production rate of organic animal products are low and their prices are high. Low production rate causes certification services, product processing and marketing cost to increase. Because the mediator quantity is high, it causes the breeder to undersell the products, but the consumers to buy products with high price. Also producer organization and control services are inadequate. There are major problems in organic husbandry in terms of input supply, foremost in feed. Lack of informed and experienced technical staff is present in many husbandry enterprises. Transition to organic husbandry makes some sectors to have negative opinions for organic husbandry. In Turkey, supports for organic agriculture and husbandry are inadequate.

### Solution Proposals for Organic Husbandry

Due to handicaps in exportation of animal products, aim of organic husbandry should be domestic markets in short term. Consumption adjuvant adjustments and supports are needed to increase organic animal products. To avoid marketing problems, production should be increased correspondingly with consumption. Important pasture land should be protected and improved and formation of new pasture lands should be encouraged. Production and consumption of animal products such as organic milk and egg which are vital for infant and child nutrition should be increased with priority. Sheep and goat breeding should be encouraged in suitable regions, foremost Eastern Anatolia region of Turkey which has higher potential for organic husbandry. Consumers should be informed about the benefits of organic animal products and feeling of trust issue should be built in consumers.

### Conclusions

Turkey has a significant potential for plant and animal production in organic agriculture. However, production and consumption of organic animal products are very low in regard to problems emerged in exportation of animal products, lack of consumer awareness and low purchase power. Nutrition with organic products should be important for healthier generations especially infants and children. In the comparison of conventional and organic product costs, issues that organic products provide such as health, clean environment, contributions to environment and preservation of gene pool should not be ignored. Besides, it should not be forgotten that organic husbandry is an important and inseparable part of plant production in organic agriculture.

Dissemination of organic agriculture allows protection of nature and ecosystem, increasing income level of small farmers, agro-tourism and rural development, to prevent rural-urban migration and feeding with healthier nutrition for people, especially infants and children.

## References


Ak, İ. 2013. Türkiye'de Organik Hayvancılık. Türkiye II. Organik Hayvancılık Kongresi 24-26 Ekim 2013, Bursa, 27-39 s.

Ak, İ., M. Koyuncu. 2001. Organic Meat and Milk Production Potential From Small Ruminants in Turkey. Internation Conference on Organic Meat and Milk from Ruminants. Athens, Greece, 4-6.October 2001. p: 42.

Aksoy, U. 1999. Dünya'da ve Türkiye'de Organik Tarım. Türkiye I. Organik Tarım Sempozyumu. 21-23 Haziran 1999, İzmir, Sayfa:3-10.

GTHB, (2017). Gıda Tarım ve Hayvancılık Bakanlığı, BUGEM Organik Tarım İstatistikleri. www.tarim.gov.tr

Evrensel, T. 2001. Çevresel Kirlenme ve Kanser İlişkileri. ÇESAV "Organik Tarım ve İnsan Sağlığı" Paneli, 25 Mayıs 2001, Ankara.

Gökkuş, A. 2013. Organik Hayvancılıkta Çayır Meraların Önemi, Türkiye II.Organik Hayvancılık Kongresi 24-26 Ekim 2013, Bursa, 87-93 s.

Soysal, D. ve İ. Ak. 2007. Güney Marmara Bölgesi Koşullarında Organik/Organik Kuzu Eti Üretim Olanakları. Hasad Hayvancılık, Yıl:22, 261:38-44.

Pekel, E., A. Ünalan. 1999. Hayvansal Üretimde Organik Tarımın Yeri ve Türkiye İçin Önemi. Türkiye I. Organik Tarım Sempozyumu. 21-23 Haziran 1999, İzmir, Sayfa:17-24.

TUİK, (2017). Türkiye İstatistik Kurumu Tarım İstatistikleri, www.tuik.gov.tr

Vural, H., Turhan, Ş., Ak, İ., Erdal, B. 2013. Tüketicilerin Organik Ürün Tüketim Eğilimlerinin Belirlenmesi. Türkiye II. Organik Hayvancılık Kongresi 24-26 Ekim 2013, Bursa, 267-274 s.

Yurttagül, M. 2001. Besinlerdeki Tarım İlacı Kalıntıları. ÇESAV "Organik Tarım ve İnsan Sağlığı Paneli" 25 Mayıs 2001, Ankara.

# O-82 Effects of Hen Age on Egg Shell Color in Laying hens

Vahdettin Sarıyel, Ali Aygün, İskenderYıldırım and Doğan Narinç

## INTRODUCTION

The eggs are important sources of quality protein, vitamins, minerals, and essential unsaturated fatty acids.

Consumer preferences for egg shell color vary worldwide. Consumers in Italy, the UK, Portugal and Ireland prefer only brown shell eggs.

However, it is almost equally preferred white and brown shell eggs in Germany, Holland, Spain (Arthur & O'sullivan, 2005).

The majority of color pigments in egg shells of brown laying hens is protoporphyrin-IX, but biliverdin-IX is also present (Kennedy & Vevers, 1976).

Egg shell color is affected by factors such as hen age, genotype, nutrition, stress and diseases. In this study, the effect of hen age on egg shell color was investigated.

## MATERIALS AND METHODS

A total of 30 Brown laying hens, 30 week old, were obtained from The Research and Application Farm at the Faculty of Agriculture at Selcuk University (Konya, Turkey).

The hens were housed in individually cages and fed a layer ration.

Feed and water were provided ad libitum.

All eggs were collected over a 24-h period. The photoperiod was 16 hours light / 8 hours dark.

At 30, 38, 45, 54 and 59 week of age, eggs were collected on 3 consecutive days to measure the eggshell color parameters (L*, a* and b*).

Color measurement was performed using a Minolta Chroma Meter CR-400 (Minolta, Osaka, Japan).

The L* , a* and b* color measurements were determined according to the CIELab color space system, where L* corresponds to dark/light chromaticity (measured on a scale of 0 %, dark, to 100%, light), a* to green/red chromaticity (on a scale of -60 %, green, to 60 %, red) and b* to blue/yellow chromaticity (on a scale of -60 %, blue, to 60 %, yellow).

The eggshell color was measured at the large pole of the egg.

Data were analyzed using the One way analysis of variance (ANOVA). The significant differences between means were obtained by Duncan's Multiple Range Test. All analyses were carried out using Minitab Version 14 (Minitab, Ins., State College, PA, USA).

## RESULTS

Table 1. Effects of hen age on eggshell color parameters (mean± SE)

| Weeks | L | a | b | Hue | Chroma |
|---|---|---|---|---|---|
| 30 | 61.94±0.90 | 16.37±0.54 | 30.53$^{a}$±0.32 | 28.09±0.65 | 34.71±0.45 |
| 38 | 63.62±0.88 | 15.78±0.54 | 30.66$^{a}$±0.31 | 27.00±0.65 | 34.57±0.45 |
| 45 | 62.64±0.88 | 15.36±0.54 | 29.54$^{b}$±0.31 | 27.41±0.66 | 33.64±0.46 |
| 54 | 61.03±0.90 | 16.51±0.54 | 30.74$^{a}$±0.32 | 28.08±0.66 | 34.95±0.46 |
| 59 | 61.41±0.97 | 16.40±0.59 | 31.46$^{a}$±0.34 | 27.68±0.71 | 35.59±0.50 |
| *P value* | 0.267 | 0.511 | 0.002 | 0.730 | 0.073 |

SE: Standard Error

There were no significant differences among treatments group for shell L*, shell a*, shell Hue and shell Chrome values (Table 1).

The lowest b* value was in eggs produced at 45 wk of age.

However, there was no significant difference between the other groups in terms of b*value.

## DISCUSSION

In many countries, the lighter or darker of shell color is considered an important egg quality characteristic for consumers.

Shell L* value might be used to express whether the color of the eggshell was dark or light and could be considered as a discriminative color criterion: more the shell L* value decreases, more the egg shell color is darker (Aygun, 2013).

In our study, shell L$^{*}$ value does not seem to have an age effect. Similarly, there was no significant difference between the eggshell color at 35 to 75 wk, but the 25 wk eggshell color was significantly darker than all other age groups (Samiullah et al., 2014).

However, Odabaşı et al., (2007) stated that Lightness of the shell color increased as the flock aged, whereas a* decreased. Changes in the b* component of shell color were not substantial.

The inconsistency between our results and their results may be due to differences in the hen age, genotype and method of measurement of the shell color.

The extent of pigment deposition is influenced by the housing system, hen age, hen strain, diet, stressors, and certain diseases such as infectious bronchitis (Samiullah et al., 2015).

As a result, the hen age only affected the shell b* value.

**References**

Arthur, J.A. and O'sullivan N. (2005). Breeding chickens to meet egg quality needs. Int. Hatch. Practice: 19, 7-9.

Aygun, A. 2013. Effects of force molting on eggshell colour, egg production and quality traits in laying hens. Rev Med Vet-Toulouse 164:46-51.

Kennedy, G.Y. and Vevers H.G. (1976). A survey of avian eggshell pigments. Comp. Biochem. Phys., 55: 117-123.

Odabasi, A.Z., Miles R.D., Balaban M.O. and Portier K.M. (2007). Changes in brown eggshell color as the hen ages. Poult. Sci., 86: 356-363.

Samiullah, S., J. Roberts, and K. Chousalkar. 2014. Effect of production system and flock age on egg quality and total bacterial load in commercial laying hens. J. Appl. Poultry Res. 23:59–70

Samiullah, S., J. Roberts, and K. Chousalkar. 2015. Eggshell color in brown-egg laying hens—a review. Poultry science 94:2566-2575.

# O-84 EKOLOJİK AÇIDAN HZ. PEYGAMBER'İN SÜNNETİNE BAKIŞ

Prof. Dr. Fikret KARAPINAR

Necmettin Erbakan Üniversitesi

Ahmet Keleşoğlu İlahiyat Fakültesi

Hadis Anabilim Dalı Öğretim Üyesi

fikretkarapinar@gmail.com

Son ilahi din olarak gönderilen ve cihanşümul bir nitelik arz eden İslam dininin bu doğrultuda varlığın her alanını bir şekilde biçimlendirdiği, yorumladığı veyahut da kuşattığını söylemek mümkündür. Kur'ân ve sünnet, İslam'ın bu misyonunun gerçekleşmesi noktasında önemli birer kaynak mesabesindedir. Bu minvalde olmak üzere ekolojik dengenin korunması, çevre bilincinin oluşturulması, doğal kaynakların ölçülü kullanılması gibi küresel ölçekte ancak modern çağda gündeme gelebilen meselelere dair ilgili ayet ve hadislerde "insan/evren-çevre ilişkisi" çerçevesinde bir takım tespitler yapıldığı, ilkeler belirlendiği ve tavsiyelerde bulunulduğu görülmektedir.

Hz. Peygamber'in sünneti özelinde belirtilecek olursa; hadisler, "insan, içerisinde bulunduğu çevre ile nasıl bir ilişki tarzı geliştirme(me)li?" gibi bir soru karşısında önemli veriler sunmaktadır. Evleri ve ibadet yerlerini temiz tutma; çevreyi koruma; kıyamet kopuncaya dek ağaç dikmeye özendirme; çevre-şehir ilişkisini sağlıklı bir zemine oturtma; ortak kullanım alanlarını ve su kaynaklarını kirletmeme; başkalarına rahatsızlık veren şeyleri ortalıktan kaldırma; israf ve aşırı tüketim alışkanlıklarından kaçınma; hayvanlar dâhil bütün canlıları sevme ve onlara merhamet gözüyle bakma gibi hususlar akla ilk gelen örnekler arasındadır. Aslına bakılırsa bu tebliğin sunulması, biraz da insan-çevre ilişkisi kapsamında değerlendirilebilecek benzer rivayetler üzerinden nebevî sünnetin pek fazla gündeme getirilmeyen bir veçhesine ışık tutma maksadı taşımaktadır. Böylelikle çevre bilincinin oluşturulması ve çevre ahlakının geliştirilmesi gibi konulara sünnet temeli üzerinden de bir nebze katkı sağlanacağı öngörülmektedir.

## 1. Kavramsal Çerçeve

Hava, su, toprak, bitki, hayvan ve madenler çevreyi oluşturan şartlardan olup insanların ortak varlıklarıdırlar. Ekolojik denge de bunların adil ve dikkatli kullanımına bağlıdır. "Çevre" kavramı, farklı bakış açılarına ve anlayışlara göre çok sayıda tanımı yapılabilen bir nitelik taşımaktadır. Örneğin bu tariflerden birine göre çevre, insanla birlikte kainattaki tüm canlı ve cansız varlıkları, dahası canlı varlıkların eylemlerini dolaylı ya da dolaysız etkileyen ya da etkileyebilecek türdeki fiziksel, kimyasal, biyolojik ve toplumsal nitelikteki bütün etkenleri kapsamaktadır.[1] Söz konusu kavramın içeriği sadece doğal çevre ile sınırlandırılmamış; bilakis birbirini kuşatan daireler biçiminde yüzlerce çevrenin iç içe olduğu ifade edilmiştir. Yine çevre kavramının kapsamının olabildiğince iyi belirlenmesinin, insan-toplum ve insan-doğa ilişkilerinin daha bütüncül şekilde kavranabilmesine imkân tanıyacağı; ayrıca insanlığın karşı karşıya bulunduğu bozulma ve bunalımın sadece doğal çevreyle sınırlandırılmaması gerektiği gibi noktaların altı çizilmiştir.[2] Yine daha öz bir anlatımla çevre, "kişiyi etkileyen

1 Keleş, Ruşen-Hamamcı, Can, *Çevrebilim*, İmge Kitabevi Yayınları, Ankara 2002, s. 28; Çepel, Necmettin, *Doğa Çevre Ekoloji ve İnsanlığın Ekoloji Sorunları*, Altın Kitaplar Yayınevi, İstanbul 1992, s. 38.

2 İnam, Ahmet, "Çevrelenmiş Bir Çevrede İnsan Olma Savaşı", *Teori*, Mart 1993, s. 45'den naklen; Özdemir, İbrahim, "Çevre Bilincinin Gelişmesinde Çevre Ahlakı'nın Önemi", *Ankara Üniversitesi İlahiyat Fakültesi Dergisi,* (Özel Sayı, Cumhuriyetin 75. Yıldönümüne Armağan), s. 297.

dış koşul ve durumların toplamı" olarak tanımlanmıştır.[3] Bu çalışmada çevre kavramı ile insanın içinde yaşadığı sosyal, fiziki ve dünya kastedilmektedir.

Çevreyle ilişkili bir terim olan "ekoloji", canlıların hem kendi aralarında hem de çevreleriyle olan ilişkilerini tek tek veya bir arada inceleyen bilim dalının adı olup Türkçede "çevre bilim" şeklinde ifade edilebilir.[4]

Birbiriyle ilişkili iki kavram olan "hadis" ve "sünnet" kavramlarından ilki, Hz. Peygamber'in söz, fiil ve takrir/onaylarının yanı sıra yaratılışı ve ahlakıyla ilgili nakledilen her türlü bilgi anlamına gelmektedir. Ayrıca bu kavramın Hz. Peygamber'in sadece sözlerini karşılamak için kullanılması da yaygındır.

Hadisle eş anlamlı olarak kullanılabilen sünnet ise, yukarıdaki tarifte sayılan maddelere ilaveten Hz. Peygamber'in sîret, meğazî, şemâil ve hatta peygamberlikten önceki güzel davranışlarının tamamını kapsayan bir mahiyete sahiptir.[5] Yine modern dönemde yapılan bir tanıma göre sünnet; dinde, şerîat haline getirilip takip edilen yol ve ortaya konulan doğru peygamberî metottur.[6] Muhammedî yol, Hz. Peygamber (s.a) tarafından izlenen yol haritası, tatbikat haline getirilen hayat tarzı, dinde izlenen yol, yöntem ve çizgi olarak da görülen sünnet; inanç, ibadet, muâmelat, ahlâk ve âdâb gibi esasları yani yaşamla ilgili tüm konuları kapsamaktadır. Sünnetin bu kapsayıcı özelliği temel hadis kaynaklarından birine göz atıldığında rahatlıkla fark edilebilecektir. Muhaddislerin, sünnet kavramını tanımlamaları esnasında Hz. Peygamber'in "en güzel örnekliği" prensibini göz önünde bulundurdukları anlaşılmaktadır. Bununla birlikte daha dar bir çerçevede sünnet, sadece Hz. Peygamber'in fiillerini karşılamak için de kullanılabilmiştir.

Pek çok Kur'an ayetinde de geçtiği üzere, Allah Teâlâ kâinatı eşsiz bir denge ve ölçü ile yarattığını ve görünen bu düzeni devam ettirenin bizzat kendisi olduğunu bildirmiş[7], var ettiği bütün nimetleri üstün vasıflarla donattığı insanın emrine vermiş[8] ve onu evrendeki bu düzeni bozmaktan sakındırmıştır.[9] Her ne kadar doğal çevrenin yaratılışı bizatihi insan unsurunun varlığı ile kaim değilse de "*İnsanların kendi işledikleri kötülükler sebebiyle karada ve denizde bozulma ortaya çıkmıştır.*"[10] ayetinden de anlaşılabileceği üzere, insanlık âlemi doğal çevrenin düzeninde meydana gelen aksaklıklarda büyük bir pay sahibidir. Yukarıda yapılan çevre tanımlarından hareketle konunun "sosyal çevre" ve "doğal çevre" biçiminde iki ana başlıkta ele alınması mümkündür. Ancak burada ele alınan bazı hususların her iki başlıkla da irtibatının kurulabileceği öncelikle belirtilmelidir.

**2. Sosyal Çevre**

Çeşitli faktörlerin devreye girmesiyle tahrip edilmemesi kaydıyla evrende kusursuz bir güzelliğin ve eşsiz bir safiyetin var olduğu açıkça görülebilmektedir. Dış dünya için müşahede edilen bu vakıanın bir başka yüzü olarak; Hz. Peygamber'in "*Her (yeni) doğan, fıtrat üzere doğar.*"[11] hadisi, insanın doğal gerçekliğinde var olan temizlik ve duruluğu ifade ve tespit adına önemli bir delildir. Bu noktadan hareketle bir insanın ruh ve beden bütünlüğünden başlayıp diğer insanlarla oluşturduğu sosyal çevre(ler)e kadar uzanan bir düzlemde teşekkül eden beşerî yapıların korunması ve hayatiyetini sağlıklı bir şekilde devam ettirebilmesi büyük bir önem taşımaktadır.

3 Keleş, Ruşen, *İnsan, Çevre ve Toplum*, (Yayına hazırlayan), İmge Yayınları, Ankara 1992, s. 17.

4 *TDK Büyük Türkçe Sözlük*, "ekoloji". (Erişim tarihi: 06.08.2017)

5 Bk. Heytemî, Ahmed b. Hacer, *Fethu'l-Mubîn li Şerhi'l-Erbaîn,* Kahire ts., s. 24; Acâc, Muhammed el-Hatîb, *Usûlu'l-Hadîs Ulûmuhu ve Mustalahuhu*, Beyrut 1981, s. 19; Ebû Zehv, Muhammed Muhammed, *el-Hadîs ve'l-Muhaddisûn*, Beyrut 1984, s. 10; Ebû Gudde, Abdülfettah, *es-Sünnetü'n-Nebeviyyetü ve Beyânü Medlûliha'ş-Şer'î ve't-Ta'rif bi hâli Süneni'd-Dârekutnî,* Beyrut 1992, s. 7-8. Sünnet tanımları ve değerlendirmeleri için bk. Keleş, Ahmet, *Sünnet Yaşayan Hz. Muhammed*, İnsan Yay., İstanbul, 2003.

6 Ebû Gudde, *a.g.e.,* s. 9, 19.

7 Örneğin bk. Hicr, 15/19-21; Furkan, 25/2; Kamer, 54/49; Talak, 65/3; Abese, 80/19; A'lâ, 87/3.

8 Örneğin bk. Bakara, 2/29; En'âm, 6/97; A'râf, 7/10; İbrahim, 14/32-33; Hicr, 15/16, 19, 20, 22; Nahl, 16/10-11; Kehf, 18/7; Lokman, 31/20; Câsiye, 45/12-13; Zâriyât, 51/48; Mülk, 67/15; Nuh, 71/19-20.

9 Örneğin bk. Rahman, 55/7-8.

10 Rum, 30/41.

11 Buhari, Cenâiz, 91; Müslim, Kader, 22, 23; Ebu Davud, Sünne, 18; Tirmizi, Kader, 5.

İşte bu gibi maksatların hayata geçirilebilmesi bağlamında sünnet verilerinin bizlere kayda değer veriler sunduğu görülmektedir.

İslam dininin, çeşitli biçimleriyle bir kısım ibadetlerin ön şartı olarak da belirlediği temizlik ilkesi, aynı zamanda beşerî çevre şeklinde de ifade edebileceğimiz sosyal çevrenin yapı taşı olan "insan" öğesinin ruhî ve bedenî hayatının devamlılığı açısından adeta bir zorunluluktur. Bu bağlamda "*Temizlik imanın yarısıdır...*"[12] ve "*Allah güzeldir, güzel olan şeyleri sever; temizdir, temiz olan şeyleri sever...*"[13] *gibi hadisler, ilkesel açıdan zikre değerdir. Benzer şekilde, "...Haberiniz olsun ki bedende öyle bir et parçası vardır ki o iyi olursa bütün beden iyi olur; bozuk olursa bütün beden bozulur. İşte o (et parçası) kalbdir.*"[14] hadisinde insanî gerçekliğe dair yapılan tespit, fert özelinde "ruh, beden ve kılık-kıyafet temizliği" şeklinde sınıflandırılabilen olası bütün türlerin hem başlangıç noktasını belirlemesi hem de üzerine oturacağı temeli ortaya koyması bakımından oldukça dikkat çekicidir. Diğer taraftan aşağıdaki rivayet, Allah Rasûlü (s.a)'in muasırı olduğu toplumun temizlik alışkanlıkları kazanması için de büyük bir çaba sarf ettiğini ortaya koyması bakımından zikre değerdir: Müşrikler Selman-ı Farisi'nin yanına gelerek alaylı bir üslupla,"*Görüyorum ki dostunuz (Muhammed), size her şeyi hatta tuvalete nasıl oturacağınızı dahi öğretiyor!*" dediler. Bunun üzerine Selman, *"Evet"* diye karşılık vererek Hz. Peygamber'in tuvalet adabıyla ilgili tavsiyelerini art arda sıraladı.[15]

Hz. Peygamber'in şahsiyetinde örnekliğini bulan sünnet kimliği, her iki çevre türü açısından da kritik önemine temas edilen "birey"i daima fıtrî olana yönlendirmekte ve onu doğal olmayandan sakındırmaktadır. Bu bağlamda, günümüzde ürkütücü boyutlara ulaşan bir sağlık sorunu haline gelmesi dolayısıyla obeziteye değinilebilir. Hz. Peygamber tarafından farklı ifade biçimleriyle olumsuzlanan şişmanlık durumunu örneklendirmesi bakımından şu rivayete yer verilmesi uygun olacaktır: *"Ademoğlu midesinden daha kötü bir kap doldurmamıştır. (Hâlbuki) Âdemoğluna kendini ayakta tutacak kadar yiyip içmesi yeterlidir. Şayet bu miktardan fazla yiyecek ise üçte biri yemek, üçte biri içecek, üçte biri de nefes için içindir."*[16] *Diğer taraftan, sünnetin -bir takım bedensel ve zihinsel engellerle doğan kimseler bir tarafa- herkesin yaratılıştan sahip olduğu tabii donanımların değerini bilmeye dikkat çektiği görülür. Örneğin bireylerin hasta olmadan sağlıklarının kıymetini bilmeleri gerektiği*[17] *çağlar öncesinde öğretilerek her ferde bir anlamda kendisinin koruyucu hekimi olması tavsiyesinde bulunulur. Benzer şekilde, "Kuvvetli mü'min, zayıf mü'minden daha hayırlı ve sevimlidir..."*[18] hadisinin hem ruhî hem de bedenî zindeliği salık veren bir muhtevada anlaşılması mümkündür.

Sünnetin, insanların etkileşim halinde oldukları sosyal çevreleri hakkında vurgulu bir tonla tesis ettiği ilkelerin başında insanların yanı sıra diğer canlılara da zarar verebilen her türlü şeyin ortalıktan kaldırılması hususu gelmektedir. Öyle ki; bir rivayette, *"Canlı varlıklara eziyet veren şeyleri yollardan kaldırmanın (imâtatü'l-ezâ) imanın şubelerinden biri olduğu"* bildirilmiştir.[19] Keza ortak kullanım alanlarına tükürülmesi ve balgam çıkarılması hoş karşılanmamıştır.[20] Günümüzde bu rivayetlerin ilkesel kapsamına -bilhassa şehir yaşamı özelinde- gereksiz yere korna kullanma, yüksek sesle müzik dinleme, yaya yollarına araç park etme, cadde ve sokaklara tezgâh açma ve çok gürültü yaparak apartmandaki komşuları rahatsız etme gibi olumsuz davranışlar eklenebilir. Hz. Peygamber'in namazı cemaatle kılma ve güzel koku kullanma noktasındaki teşviklerine[21] karşılık; *"Sarımsak*

12 Müslim, Tahâret, 1.
13 Tirmizi, Edeb, 41.
14 Buhari, İman, 39; Müslim, Müsakat, 107; İbn Mace, Fiten, 14.
15 Müslim, Tahâret, 57; İbn Mace, Tahâret, 16; Ahmed b. Hanbel, *Müsned*, V, 437.
16 Tirmizi, Zühd, 47. Benzer rivayetler için bk. İbn Mace, Et'ime, 50; Ahmed b. Hanbel, *Müsned*, IV, 132.
17 Örneğin bk. Buhari, Rikâk, 1; Tirmizi, Zühd, 1; İbn Mace, Zühd, 15.
18 Müslim, Kader, 34; İbn Mace, Sünnet, 10; Zühd, 14.
19 Müslim, İman, 58. Ayrıca bk. Buhari, Cihat 72; Müslim, Mesacid, 57; Zekât, 56; el-Birr ve's-Sıla, 129, 130; Tirmizi, Fezâilü'l-Kur'ân, 19; Ahmed b. Hanbel, *Müsned*, I, 179.
20 Buhari, Salat, 37; Müslim, Mesacid, 57.

*yiyen kimse mescitlerimizde bize eziyet vermesin, mescitlerimize yaklaşmasın!"*[22] *tarzındaki rivayetler daha anlamlı hale gelmektedir. Üzerinde hassasiyetle durulan başlıklardan birini de, mescitlerin avlularıyla birlikte temiz tutulması ve güzel kokularla tütsülenmesi oluşturmaktadır.*[23]

**3. Doğal Çevre**

Buraya kadar aktarılan rivayet örnekleriyle sosyal çevreye karşı duyarlı biri olduğu görülen Hz. Peygamber'in bu özelliğinin doğal çevre öğelerini de kuşattığı anlaşılmaktadır. Bir adım daha ötesinde, nebevî terbiye modelinin sahabe kuşağındaki tezahürleri arasında olmak üzere; Hz. Ebu Bekir'in (r.a) Üsame (r.a) ordusuna hitap ederken söylediği "*Hurma ağaçlarını sökmeyiniz ve onları yakmayınız; hiç bir meyve ağacını kesmeyiniz, ihtiyaç durumu hariç, hiçbir koyun, hiç bir inek ve hiç bir deve öldürmeyiniz…*"[24] sözleri ile Hz. Ömer'in (r.a) Ebu Musa el-Eş'arî'yi (r.a) Basra'ya vali olarak gönderirken görevleri arasında sokakların temizliğini de sayması[25] gibi örneklere yer verilebilir.

Üzerinde durulması gerektiği düşünülen deliller arasındaki, *"...Yer (yüzü) bana mescid ve temizlik sebebi kılındı. Onun için ümmetimden kendisine namaz vakti erişen herkes namazını orada kılıversin…*"[26] rivayeti, dinî hüküm içerikli bir yapıda olup namaz gibi temel bir ibadetin edasının mekânsal genişlik imkânını dile getirmektedir. Ancak bunun da ötesinde söz konusu rivayetin, tıpkı insanın fıtrat üzere yaratıldığını bildiren rivayet gibi, ilkesel açıdan doğal çevrenin de aslen temiz ve güzel olduğunu ortaya koyması bakımından burada altı çizilmelidir.

Görülebildiği kadarıyla nebevî öğretinin insan unsurundan başlayan çevresel duyarlılık alanı, diğer bütün canlı ve cansız varlıkları kapsamaktadır. Birkaç örnek vermek gerekirse; can taşıyan bütün varlıklara merhamet gözüyle bakılması emredilmiş, hayvanlara dağlama gibi yollarla işkence yapılması, lanet edilmesi ve aşırı yükleme yapılması gibi fiiller yasaklanmış, kuş yuvalarının bozulması ve yavrularının alınması men edilmiş, evcil hayvanların beden ve ağıllarının temizliğine ve yavrularının bakımına hassasiyet gösterilmesini istenmiştir.[27] Aslına bakılırsa; medeniyetimizin bir "su" medeniyeti olmasında, can taşıyan her varlığa iyiliğin çok sevaplı bir iş olduğunu bildiren rivayetlerin katkısı yadsınamaz. Keza Hz. Peygamber'in Uhud dağını kastederek söylediği, *"Bu bizi seven bir dağdır, biz de onu severiz."*[28] *rivayeti, cansız varlıklara karşı gösterilen ve günümüz dünyasında üzerinde biraz daha fazla durulması gerektiğini düşündüğümüz, yüksek bir bilişsel ve duyuşsal düzeye işaret etmektedir.*

*Sünnet tecrübesi, doğal çevrenin korunması ve güzelleştirilmesi noktasında önemli veriler sunmaktadır. Hz. Peygamber'in bu bağlamdaki önerilerinin başında, gölgelenilmesi ya da meyvelerinden yenilmesi gibi maksatlarla ağaç dikilmesi gelmektedir. Doğrusu şu ki kıyamet koparken bile kişinin elinde bulunan bir fidanı toprakla kavuşturması yönündeki nebevî tavsiyenin,*[29] *günümüzde önemi çok daha iyi anlaşılan bu konuyu özendirmek için kullanılabilecek en beliğ ve veciz bir anlatım biçimi olarak kabul edilmesi mümkündür. Ayrıca söz konusu rivayetlerde, ağaçlardan ya da diğer zirai ürünlerden istifade edenin insan veya hayvan oluşuna bakılmaksızın ekim dikim yapan kimsenin her halükarda sevap kazanacağı bildirilmiş ve yine ağaçların gereksiz yere kesilmesinden sakındırılmıştır.*[30] *Diğer taraftan, Hz. Peygamber'in Mekke, Medine ve Taif'te bazı yerleri "haram*

21 Ebu Davud, Teraccül, 6.
22 Örneğin bk. Ahmed b. Hanbel, *Müsned*, II, 266.
23 Buhari, Salat, 74; Ebu Davud, Salat, 13; Tirmizi, Cum'a, 64; Edeb, 41.
24 İbnü'l-Esir, *el-Kâmil fi't-Târih,* Beyrut 1987, II, 200.
25 Darimî, Mukaddime, 46.
26 Buhari, Salat, 56.
27 Örneğin bk. Buhari, Ezan, 90;Bed'ü'l-Halk, 17; Edeb, 27; Müslim, Sayd, 57; Ebu Davud, Edeb, 58; Tirmizi, el-Birr ve's-Sıla, 16.
28 Buhari, Meğazi, 27.
29 Buhari, *el-Edebü'l-Müfred*, s. 168 (479); Ahmed b. Hanbel, *Müsned*, III, 184, 191; Beyhaki, *Sünen*, II, 184.
30 Buhari, el-Hars ve'l-Müzâraa 1; Edeb, 27; Müslim, Müsakat, 7-13; Ebu Davud, Edeb, 158, 159; Ahmed b. Hanbel, *Müsned*, V, 374, 416. Ayrıca bk. Yıldırım, Duran Ali, *Kur'an'da Fesat,* Çimke Basımevi, Konya 2016, s. 275-276.

*bölge" olarak ilan ederek buralarda ağaçları kesmeyi, otları koparmayı ve avlanmayı yasakladığı bilinmektedir.*[31] *Yine onun yönlendirmesiyle Medine'de Züreybü't-Tavîl olarak bilinen mevki zamanla orman haline gelmiştir.*[32] *Aslında zikredilen bu uygulamalar, günümüzdeki sit alanlarını ve milli parkları akla getirmektedir.*

*Sosyal çevre konusu ele alınırken değinilen "imâtatü'l-ezâ" ifadesi kapsamındaki rivayetlerin doğal çevre öğeleriyle de ilişkilendirilmesi mümkündür. Ayrıca sözü edilen rivayetlere, işlek yollar üzerinde konaklama yapmama; insanların gelip geçtikleri yollarda, gölgelendikleri ağaç altlarında ve hayvanların yuvalarının olduğu yerlerde tuvalet ihtiyacını gidermeme yönündeki ikazlar eklenebilir.*[33] *Kaydedilen son tedbirin kapsamına, sosyal ve doğal çevrenin hayat unsuru olan su kaynaklarının da girdiği görülür.*[34] Temas edilen rivayetler bir bütün haliyle doğal hayatın ve sosyal yaşantının sürdüğü alanların kirletilmeyip temiz tutulması gerektiği mesajı taşımaktadır denilebilir.

Doğal çevrenin korunması açısından atılabilecek en önemli adımlardan biri de mevcut kaynakların dengeli kullanılıp israftan kaçınılmasıdır. İnsan ihtiyaçlarının "sınırsız" olarak tanımlandığı ve ülkeler arası gelişmişlik düzeyinin kişi başına tüketilen kâğıt ya da üretilen atık miktarı gibi değerlerle ölçüldüğü günümüz dünyasında israf oldukça yaygın ve çok çeşitli bir hale gelmiştir. Diğer canlılarla birlikte çevreyi de ciddi biçimde tehdit eden bu duruma karşılık aşağıdaki rivayet, velev ki ibadet amacıyla olsa bile, hiçbir doğal kaynağın gereğinden fazla kullanılmaması gerektiğini öğütlemektedir: Hz. Peygamber, abdest sırasında suyu gereğinden fazla kullanan bir sahabiyi, "*Bu israf ne?*" diye uyarmıştır. O sahabînin, "*Abdestte israf olur mu?*"sorusuna; *"Evet, hatta akan bir nehir kenarında olsan bile!"* diyerek karşılık vermiştir.[35] Hz. Peygamber'in bu cevabının bütün hayatı kuşatıcı bir mahiyette anlaşılması mümkündür.

**4. Sonuç**

Bu çalışma, sünnetin sosyal ve doğal çevre öğelerine nasıl baktığı sorusuna odaklanarak sünnet-çevre ilişkisi zemininde genel bir perspektif sunma amacıyla yapılmıştır. Nebevî sünnetin, buraya kadar ele alınan rivayetlerde geçen öneriler ve uyarılar aracılığıyla nihai olarak insanın ve tabiatın aslındaki güzelliğin ve doğallığın korunarak daha da geliştirilmesini hedeflediği söylenebilir. Sünnetin bu bağlamda ortaya koyduğu ilkelerin başında, daima fıtri olana yönelme, beşeri ve doğal kaynakların kullanımında orta yolu tutup israftan kaçınma gibi hususlar gelmektedir. Bir başka açıdan bakılacak olursa; sözü edilen tavsiye ve ikazların çoğunun, olası sağlık ya da çevre sorunlarına karşı birer ön tedbir işlevi gördüklerini söylemek imkân dâhilindedir. Şu halde, ilkesel çapta ortaya konulan bu gibi prensiplerin günümüzde güncelliğinden hiçbir şey kaybetmediği söylenebilir.

Çalışmada özet haliyle sunulmaya gayret edilen rivayetler bile günümüze her iki çevre türüne ait öğeleri de kuşatan bir "ekolojik sünnet" mirasının bırakıldığını söylemeye yetecek düzeydedir. Diğer bir ifadeyle, Hz. Peygamber hayatı boyunca çevrenin korunmasıyla fiilen ilgilenmiş; dahası bu doğrultuda bizlere kendisinden çok sayıda sözlü rivayet aktarılmıştır.

İncelenmesi durumunda; bu tebliğe malzeme oluşturan rivayetlerin, hadis literatürünün birçok temel kaynağında tahriç edilip muhtelif kitap ve bâb adlarına yayıldığı görülmektedir. Geçmişte daha çok ibadat ve ahlak alanlarıyla ilişkilendirilen bu tür rivayetlerin günümüzde ekolojik hassasiyetlerle bir arada -ancak anakronizme düşülmeden- daha geniş çalışmalara konu edilmesi imkân dâhilindedir. Son olarak şu noktanın da altı çizilmelidir ki sünnet kaynaklarından yararlanma düzeyimizi belirleyecek ön şartlardan birini de yapılacak çevre tanımları

31 Buhari, *es-Sahîh,* Cihad bölümü. Buhari, Fezâilü'l-Medine, 1; Müslim, *es-Sahîh,* Hacc bölümü. Ayrıca bk. Müslim, Hacc, 88; Buhari, Lukata, 7.
32 Belâzurî, *Fütûhu'l-Büldân*, çev. Zakir Kadiri Ugan, Maarif Basımevi, İstanbul 1955, I, 15.
33 Müslim, Tahâret, 68; Ebu Davud, Tahâret, 14; Nesai, Tahâret, 30; İbn Mâce, Edeb, 47.
34 Buhari, Vudû, 68; Müslim, Tahâret, 94, 95,96. Ebu Davud, Tahâret, 36.
35 İbn Mace, Tahâret, 48; Ahmed b. Hanbel, *Müsned*, II, 221.

oluşturacaktır. Şu halde sünnetin ekolojik bir gözle ele alınması noktasında, araştırmacı(lar) tarafından kabul edilecek çevre tanım(lar)ı belirgin bir rol oynayacaktır.

## O-88 DOĞACI KELAMCILARA GÖRE DOĞA, BİLGİ VE AKIL İLİŞKİSİ

**Prof. Dr. Ramazan ALTINTAŞ**

**NEÜ, İlahiyat Fakültesi.**

**e-mail: ramazanaltintas59@hotmail.com**

### ÖZET

Bilgi ve akıl ilişkisini temellendirmede insanın eylemleri bağlamında yapılan tartışmaların birbiriyle ilişkisi vardır. Kelam felsefesinde *doğa* düşüncesi de bu bağlantının ayrılmaz parçasını oluşturur. *Doğa,* insanda, iradesiz meydana gelen psikolojik güdülerdir. Huy, mizaç ve yaratılış gibi özellikler bunun içerisine girer. Kelam tarihinde doğa, bilgi ve akıl arasında güçlü bir bağın olduğu fikrini ilk defa Mu'tezile kelam âlimlerinden Nazzam, Muammer b. Abbad ve Cahız dile getirmişlerdir. Doğa felsefesinin temelinde insanın özgürlüğü meselesi büyük rol oynar. Doğacılık fikrini savunan Mu'tezile kelamcılarını, herşeyin kaynağı ve tek yaratıcısı olarak gören *natüralistler*den ayırmak gerekir. Doğacı Mu'tezile kelamcıları kendi dönemlerinde natüralistlerle de Allah inancı konusunda ciddi tartışmalar yapmışlardır. Natüralistlerle doğacı kelamcılar arasında ayrım noktalarından birisi bilgi konusuyla ilişkilidir. Doğacı kelamcılara göre, *bütün bilgilerimiz doğuştandır. İnsan bu bilgileri daha önce İlahi kudret insan doğasına yüklediği için bilir.* Çünkü *insanın zorunlu ihtiyaçları* ile insan doğası, bilgisi ve aklı arasında yine doğal bir işbirliği vardır. Netice olarak Allah, insanın tabiatına içgüdüsel olarak yararları arzu etme ve zararlardan kaçınma gibi bir doğal duyguyu yerleştirmiştir. İşte bu noktada insanda bulunan iç ve dış faktörler harekete geçer. Böylece insan, özgür irade ve bilgisi ile yaptığı eylemlerden sorumlu hale gelir.

**Anahtar Kavramlar**: Doğa, akıl, bilgi, kudret, Mu'tezile, irade özgürlüğü.

### ABSTRACT

## RELATIONSHIP BETWEEN NATURE, KNOWLEDGE AND LOGIC ACCORDING TO NATURALIST KALAM SCHOLARS

**Prof. Dr. Ramazan ALTINTAŞ**

**NEU, Faculty of Theology.**

**E-mail: ramazanaltintas59@hotmail.com**

Debates made in the context of human actions have connection to each other in an attempt to reconcile the relationship between knowledge and reason. In the philosophy of Ilm al-Kalām, philosophy of nature also forms an integral part of this connection. Nature in human beings includes psychological instincts that take place without mankind's willpower. Features such as temperament, humor and creation can be included as well. In the history of Kalām, the idea that there exists a strong connection between nature, knowledge and reason was firstly expressed by Mu'tazila scholars including Nazzam, Muammer b. Abbad and Cahız. The issue of human freedom plays a major role on the basis of philosophy of nature. It is necessary to distinguish between Mu'tazila scholars who defend the idea of naturalism and the naturalists who regard the nature as the sole source and creator. Naturalist Mu'tazila scholars had serious debates with naturalists about the faith in Allah during their time period. One of the distinction points between naturalists and naturalists Kalam scholars is related to the topic of knowledge. According to naturalist Kalam scholars, human beings are born with innate knowledge of our world. Human beings are born with this knowledge since the divine power has pre-loaded them into the human nature. Because there is

a natural cooperation between human compulsive needs and human nature, knowledge and intelligence. As a result, Allah has instinctively instilled a natural feeling of desire toward benefits and of avoidance from harms. At this point, internal and external factors in human beings go into action. Thus, the person becomes responsible for the actions which s/he has committed with free will and knowledge.

**Key Concepts:** Nature, reason, knowledge, power, Mu'tazila, freedom of will.

# DOĞACI KELAMCILARA GÖRE KUDRET, BİLGİ VE AKIL İLİŞKİSİ

**Prof. Dr. Ramazan ALTINTAŞ**[1*]

## GİRİŞ

Akıl, bilgi ve kudret ilişkisini temellendirmede insanın eylemleri çevresinde yapılan tartışmaların birbiriyle çok yakın bağlantıları vardır. Kelam felsefesinde *tab'* düşüncesi de bu bağlantının ayrılmaz bir parçasını oluşturur. İlâhi kudret ve insan kapasitesinin zıtlaşması meselesindeki zorlukların üstesinden gelmek için Nazzâm (ö. 221/835) gibi kimi seçkin Mutezili düşünürler, bazı felsefî yollara başvurdular. Bunların başında *"tab'/doğa"* düşüncesi gelir. "*Doğa ehli"* denilen Mu'tezile âlimlerini, doğayı tek belirleyici kaynak ve meydana gelen olayların yaratıcısı olarak gören *natüralistler*den ayırmak gerekir. Çünkü onlar, kendi zamanlarında natüralistler denilen tabiatçılarla çeşitli tartışmalara girmişlerdir. Kaldı ki onların kastettiği doğa, insan tabiatıdır.[2]

### 1. Tab'ın *Sözlük ve Terim Anlamı*

*Tab'* insanda, iradesiz meydana olan şeydir. Huy, mizaç, seciye ve yaratılış gibi özellikler bunun içerisine girer. *Tabîat* ise, *cisimlerin yapısında bulunan; sıcaklık, soğukluk, kuruluk, yaşlık gibi kuvvetlerdir.* Cisim onunla doğal olgunluğa erişir.[3] Mu'tezile kelamcısı *Nazzâm,* cisimlere ait olan tabiat konusunda *Muammer b. Abbâd es-Sülemî*'nin (ö. 280/835) düşüncesini benimser. *Tab'* telakkisini mantıkî sınırına kadar götüren Muammer, cisimlerin varlığını Allah'a nispet ederken, arazların varlığının bizzat cisimlerin fiillerine nispet edilmesi gerektiğini ileri sürmekteydi. Bu fiil, ya ateş gibi cansız nesnelerde tabiî zorunlulukla (tab'an) veya insan gibi canlı varlıklarda irâdî bir şekilde (ihtiyâren) ortaya çıkar.[4] *Muammer,* kendi döneminde, "renklendirme, diriltme ve öldürme fiillerinin fâili Allah'tır, bu fiiller araz kategorisine girmez" diyen muârızlarına karşı, *'tab'/doğa'* fikriyle cevap verme yoluna gider. Her ne kadar Allah, cisimlere renk verirse de, cisimler bu rengi kabul eder veya etmez. Eğer cisimler bu rengi kabul etmişlerse, renk cismin d*oğası* sebebiyle meydana gelmektedir. Yani cisim, bu doğaya sahip kılınmıştır. Eğer renk, cismin tabiatından kaynaklanıyorsa, onun fiilidir. Tab'an bir şeye ait olan şeyin başka bir fâilin fiili olduğu söylenemez. Allah cismi renklendirmeyi kararlaştırabilir, ama cisim, tabiatından olmayan rengi almayabilir.[5]

### 2. İnsanın Özgürlüğü ve Tab' Düşüncesi

Mu'tezile'ye göre adalet, Allah'ın bütün fiillerinin güzel olduğunu kabul edip kötü şeylerden O'nu soyutlamak ilkesine dayanır. Allah iyinin yaratıcısıdır, zulüm ve diğer her türlü kötünün yaratıcısı ise in-

1*NEÜ Ahmet Keleşoğlu İlahiyat Fakültesi Öğretim Üyesi, Türkiye/Konya.

2 Bkz. Kâdî Abdülcebbâr, *el-Muğnî* fî *Ebvâbi't-Tevhîd ve'l-Adl,* (thk. M. Ali en-Neccâr-Abdülhalîm en-Neccâr), Kahire, 1965, XII, 235.

3 Cürcânî, S. Şerif, *et-Ta'rîfât*, Beyrut, 1987, s. 182.

4 Krş. Eş'arî, Ebu'l-Hasen, *Makâlâtü'l-İslâmiyyîn*, (thk. Hellmut Ritter), Wıesbaden, 1980, s. 548.

5 Eş'arî, *Makâlât*, s. 405-406.

sandır. Allah ise kötülük fiilinden beridir.[6] İşte başta Nazzam ve Kâdî Abdülcebbâr gibi kelamcılar, adalet anlayışlarını kötülüğün sorumluluğundan Allah'ı soyutlamak temeli üzerine inşa etmişlerdir. Bu sebeple onlar, *"ilâhi kudret, ahlâk kanunlarına boyun eğer",* iddiasında bulunmuşlardır. Bu bağlamda tab' yasaları da ilahi kudretten bağımsız değildir. Onun için, ilâhi adâletin bir gereği olarak insanın yapıp-ettiklerinden sorumlu tutulması gerekir. Bu da insanın özgürlüğünü koruma çabasıdır.

Gerek Mu'tezile, gerek Eş'arî ve gerekse Mâtürîdî Kelam ekollerine göre bilgi zorunlu ve müktesep olmak üzere iki kısma ayrılır.[7] Mu'tezile'ye göre, zorunlu bilgi iki şekilde elde edilir: Bunlardan ilki, algı (idrak)dır ki, bilgiye ulaşmada en açık yöntemdir. Algı ile elde ettiğimiz bilgi türünde bir şeyi ispat etmek için delile gerek yoktur. Sonuçta bir bilgiye delil getirilmeden ulaşılmışsa, tekrar delil getirmek gerekmez. İdrak (algı) ya dış dünyanın nesnelerine ya da iç dünyanın rûhî gerçeklerine yönelir. Acı, sıcaklık ve soğukluğu hissetmemiz gibi. Bu algılamanın derecesine göre insan ya bir davranışta bulunmaya ya da bir davranışta bulunmamaya yönelir.[8] Bizi eylemde bulunmaya tab'ımızda baskın olan özellik teşvik eder. Bu bağlamda zorunlu bilginin elde edilişi, genel hakikatler bağlamında akıl aracılığı ile herkes tarafından algılanır. Zulüm ve yalan konuşmanın herkes tarafından kabih (kötü) olduğunun bilinmesi gibi. Zorunlu bilgi vahye dayanmaz. İster inansın, isterse inanmasın herkes tarafından kabul edilir.[9] Çünkü metafiziki ve ahlakî değerleri bilmede kıstas vahiy değil, akıldır. Ahlakî değerler objektif olup evrensellik arzeder.

Kelam ilminde bilgi kaynaklarının ilkini, beş duyu organından doğan idrak oluşturmaktadır. Görülenin idraki, gözün, görülen nesneye yönelmesiyle gerçekleşir. Böyle bir sonuç ise, doğacı Mu'tezile kelamcılarına göre Allah'ın yarattığı insan *'tab'*ından meydana gelen mütevellid fiillerden doğan bir parça sayılır. Mu'tezili düşüncede insanın ihtiyarî fiillerini -Allah'ın müdahalesi olmaksızın- meydana getirmesine *mütevellidât* denilir. Bu fiilin doğuşuna insanda bulunan tab' kudreti sebep olmaktadır. İnsanın tab' gücü, bu fiillerin kaynağıdır.[10] Mu'tezile'ye göre insanın fiilleri ya doğrudan (el-mübâşır) ya da dolaylı (el-mütevellid) olarak meydana gelir. İnsanın bir aracı kullanmadan özgür iradesiyle yaptıklarına doğrudan; fiil ile fâil arasında bir aracı kullanarak yaptığı fiillere dolaylı fiiller denir.[11] Bu konuda Nazzâm'ın görüşünü, *Ebu'l-Hasan el-Eş'arî* (ö. 324/936) şöyle nakleder:

"İnsanın dışında başkasında meydana gelen şey, meydana geldiği şeyin sahip olduğu yaratılış/tab' gereği, Allah'ın fiilidir. Sözgelimi, biri onu ileriye doğru attığında taşın ileriye doğru gitmesi, biri onu aşağıya doğru attığında onun aşağıya doğru gitmesi, biri onu yukarıya doğru attığında onun yukarı doğru gitmesi gibi; aynı şekilde *idrâk* de yaratılış gereği Allah'ın fiilidir. Bunun anlamı, Allah, taşa bir kimse tarafından atıldığında ileriye doğru gidecek bir *tabiat* vermiştir, bundan dolayı taş ileriye doğru gider. Aynı şekilde, diğer varlık alanındaki mütevellit fiillerin durumu da böyledir."[12]

Açıkçası Nazzâm, cisimdeki tabiatı Allah'tan bağımsız görmemektedir. Onun felsefesine göre, insanın tabiatının dışındaki güç yetiremediği her şey, Allah'ın fiilidir. Yine Nazzâm, kendisine, *"sen beni, ben sana yöneldiğim için görüyorsun"* diyen bir kimseye engel olarak şöyle demiştir: "Görme olayı, gözün kendisinden değil, *tabiat*ında bulunan görme idrakinden dolayıdır."[13] Yani, rüyet ve idrak tabiattan doğuyor. Bu

6 Kâdî Abdülcebbâr, *el-Usûlü'l-Hamse*, tahk., Faysal Bedir Avn, Kuveyt, 1998, s. 69.
7 Bkz.. Bâkıllânî, Ebu Bekr Muhammed, *et-Temhîd*, Beyrut, 1987, s. 26-27; Kâdî Abdülcebbâr, *el-Muğnî*, XII, 59.
8 Bkz. Kâdî Abdülcebbâr, a.g.e., XIII, 66.
9 Kâdî Abdülcebbâr, a.g.e., VI, 18, 63, 21.
10 Bkz. Kâdî Abdülcebbâr, *Şerhu'l-Usûli'l-Hamse*, s. 388.
11 Kâdî Abdülcabbâr, *el-Muğnî, (Tevlîd),* Kahire, ts., IX, s. 37, 124, 137.
12 Eş'arî, a.g.e., s. 404.
13 Eş'arî, *Makâlât,* s. 382.

sebeple *idrak, Allah'ın eylemidir*. Çünkü idrâk, mütevellid fiillerdendir. Dolayısıyla *bilgi* de tamamıyla insanın özel gayretine dayalı akıl yürütme biçimi olan *"nazar*"dan mütevellittir. Bir akıl yürütme şekli olan *nazar* ise, kalbin hareketinin gereği olan Allah'ın bir fiilidir. Buradan çıkan sonuca göre, *bilgi, kalbin hareketinden bir harekettir.*[14]

Mu'tezile kelamcısı Ebu'l-Huzeyl el-Allaf da idrâk konusunda Nazzâm'dan farklı düşünmez. Ona göre *idrâk, akibet bilgisidir.* İdrâk*, gözde değil, kalpte yerleşir*.[15] Netice itibariyle her iki düşünür de kalbin ve diğer organların eylemlerini birbirinden ayırmaktadırlar. Mu'tezile içerisinde Muammer gibi "cisimlerdeki *tabiatın* her ne kadar Allah tarafından yaratılmışsa da Allah'tan bağımsız ve O'nun gözetimi olmaksızın fiili yapmasıdır"[16] şeklinde görüş beyan edenlerin varlığı da bilinmektedir. Bu görüşler özellikle Eş'arîlerin insanda hâdis kudret çözümlemesi ile uyuşur.

### 3. **Tab' Düşüncesinin Metafizikî ve Ahlakî Konulara Uygulanması**

Mu'tezile kelam bilginleri "tab" düşüncesini bazı inanç ve ahlak konularına uygulamışlardır. Örneğin, Mu'tezili düşünür Nazzam, 'tab'/doğa' düşüncesini Allah'ın varlığını ve ahlâkî değerleri bilmede aklın kıstas olduğu görüşe dayandırmıştır. Buradan o, zıtların birleşemeyeceği sonucuna ulaşır. Bu tamamıyla, Mu'tezile kelamının temelini oluşturan adâlet ve tevhid sorununu araştırmakla, bilgi sorunu ilişkisini te'yit etmektir.[17] Özellikle Mu'tezile kelamında adalet, özgürlüğü içeren bir kavramdır. Zira kişinin aklının ve özgürlüğünün olmadığı yerde adaletten söz edilemeyeceği gibi nazari bilgiden de söz edilemez. Özgürlük, bireyi başkalarından bağımsız ve ayrıcalıklı kılan bir şey olup, akıldan önce gelir. Akıl ise, sözü edilen özgürlük kavramına bir dayanak olarak daha sonra gelir. Akıl, anlama ve yorumlama gücüne sahip bir yeti olup, naklin de temelini oluşturur. Bu görüş, *Ebû Hanîfe* (ö. 150/767) ve izleyicileri olan Mâtürîdîlerin *"tümel bilgi sahibi akıl"* teorileriyle uyuşmaktadır. Metafiziki ve ahlakî ilkeleri bilmede akıl, ilâhi yasadan önce gelir. Allah'ı bilme, insana, akıl yüzünden farzdır.[18]

Bir başka Mu'tezile düşünürü olan Câhız, "*bütün bilgilerimiz doğuştan ('tıbâ')dır. Kim bir şey bilirse, öğretim ve Allah'ın yaratması ile değil, ancak tabiatı gereği bilir"*[19] diyerek, Nazzam gibi; bilgi, kudret ve tab' arasında zorunlu bir ilişki kurar. İnsan, diğer canlılardan kudreti, iş yapma ve seçme eylemini gerçekleştirme yeteneği ile ayrılır. İnsana özgü bu eylemler, kudret, istidâat ve aklın varlığı şeklinde bir sıra düzeni oluşturur. İnsan ile hayvanlar arasındaki farkı en güzel bir şekilde Kur'an'da geçen '*teshîr*' âyetleri açıklar. *Teshîr*, zorla özel bir maksada doğru sevk edilmektir. Bu hususla ilgili birçok âyet vardır. Bunlardan birisi şöyledir: "*Göklerde olanları, yerde olanları, hepsini sizin buyruğunuz altına vermiştir. Doğrusu bunlarda düşünen kimseler için dersler vardır."*[20]

İnsanla hayvan arasındaki farklılık sadece *'suret'lerdeki* farklılık değildir. İlk örnek olmak yönüyle insan, nutfeden/spermden, insanlığın babası Âdem ise, topraktan yaratılmıştır. İnsan iki ayakları üzerinde yürür ve elleriyle ihtiyaçlarını giderir. Bütün bu özellikler, ahmak, deli ve çocuklarda da vardır. Fark ise, güç yetirmededir. Güç yetirmenin varlığı, aklın varlığını, aklın varlığı ise, bilginin varlığını gerektirir. Akıl ve bilg-

14 Eş'arî, *Makâlât,* s. 386.
15 Eş'arî, a.g.e., s. 312.
16 Bkz.. Eş'arî, a.g.e., s. 569, 572.
17 Ebû Zeyd, Nasr Hâmid*, el-İtticâhu'l-Aklî fi't-Tefsîr*, Beyrut, 1982, a.g.e., s. 50;
18 Ebû Hanîfe ve tereftarlarının görüşleri için bkz. Eş'arî, *Makâlât,* s. 138-139; Beyâzîzâde, Kemaleddin, İşârâtü'l-Merâm *min İbârâti'l-İmâm*, İstanbul, 1949, s. 76.
19 İsferâyinî, Ebu'l-Muzaffer, *et-Tebsîr fi'd-Dîn*, Beyrut, 1983, s. 81.
20 el-Câsiye 45/13. Diğer âyetler için bakınız. er-Ra'd 13/2; İbrahim 14/32-33; en-Nahl 16/12, 14; el-Hacc 22/65; el-Ankebût 29/61; Lokmân 31/20, 29; Fâtır 35/13; ez-Zümer 39/5; ez-Zuhruf 43/13.

inin varlığı, gücün varlığını gerektirmez. Akıl izleyen olarak, istidâatın bir neticesidir. Bilgi de aklın neticesidir. Güç yetirebilmenin yokluğu, aklın etkinliğini ortadan kaldırır ve bilginin temelini yıkar. O halde istidâat, aklın varlığı için bir temeldir. Bilginin varlığı da aklın varlığı üzerine atfedilir.[21] Çünkü bilgiyi oluşturan güç, işlevsel akıldır.

Câhız, *insanın zorunlu ihtiyaçları* ile tabiat, bilgi ve akıl arasında bir ilişkinin varlığını kabul eder. O, bu ilişki ağını anlatmak için filozoflardan birisinin diliyle şunları anlatır: Hakîmlerden birisine şöyle denilir: "Ne zaman aklını kullandın?" O da, "doğduğum saatte" der. Bu sözünü onların inkâr ettiğini görünce hakîm kişi sözlerine şöyle devam eder: "Ben, korktuğum zaman ağladım, acıktığım zaman yiyecek istedim, ihtiyaç duyduğum zaman (annemin) göğsünü istedim, verildiği zaman da sustum" der ve "bütün bunların ihtiyacı ölçüsünde olduğunu, aynı zamanda da bu ihtiyaçları gidermede daha fazla akla ihtiyaç olmadığını" ekler.[22] Bunun manası, çocuğun *tabiatının* hayatî önem taşıyan ihtiyaçları, bilgisi ile sınırlandırılmıştır. İşte Câhız, çocuğun istediği ve ihtiyaç duyduğu şeyleri hissetmesine, *akıl* ismini veriyor**.**[23] Bilgiyi, akıl olarak tanımlamanın temeli de buna dayanmaktadır. Bu örneklerden sonra Câhız, çocuk ya da bireyin halinden topluma/cemiyete geçiyor. Şöyle ki, "insanların birbirine muhtaç olmaları, en alt tabakadan en üst tabakaya varıncaya kadar, onların tabiatlarında ayrılmaz bir niteliktir"[24] diyen Câhız, görüşlerini fiillerle bağlantılı olan *"doğacılık*" düşüncesi üzerine temellendirmektedir. Câhız'ın akıl anlayışına göre çocuk, akıl ya da bilgiye, hayatî ihtiyaçları ölçüsünde ihtiyaç duyar. İnsan topluluklarının tabiatı, yeni zorunlu ihtiyaçları gerekli kılar. İhtiyaçlar, yeni araçlar vasıtasıyla, insanın kendi dünyasını ve diğer insanlarla olan ilişkilerini bilmeye ve kavramaya yardımcı olur. İnsan toplulukları için genel manada bilginin olması zorunludur. Bilgi düzeyi arttıkça zararlı ve faydalı olan şeylerin arası ayırt edilir. Böylece insan kendisini saadete götüren bilgiyi elde eder. İnsan duyuların bilgisinden akıl ile kavranılan şeylerin bilgisine terakki eder.[25] Kesbe dayalı bilgi arttıkça, eş-zamanlı olarak müktesep akıl da artış gösterir. Allah, insanın tabiatına içgüdüsel olarak yararları celp etme ve zararlardan kaçınma gibi bir duygu yerleştirmiştir. İşte bu noktada iç ve dış sâikler insanı harekete geçirir. İnsan özgür iradesi ve bilgisi ile yaptığı eylemlerin sonuçlarından sorumludur.

Bilgi ile insanî ihtiyaçlar arasındaki bağlantı doğaldır. Bu sebeple Câhız, bilgiyi, insanî varlığın zaruretlerinden bir zorunluluk saymıştır. O'na göre, kudret, akıl ve bilginin varlığının esasıdır. Bu sebeple Câhız, bu çelişkiyi çözümlemek için *tabiatlar* düşüncesine sığınmıştır. Bundan dolayı, *"bilgiler tabiatı gereği zorunludur, hiçbir bilgi insanın eylemlerinden değildir. İradenin dışında insanın hiçbir kesbi yoktur. Diğer fiiller insandan tabiatlar yoluyla meydana gelir"*[26] şeklinde bir gerekçe üretir.[27]

Mu'tezilenin müteahhirînden olan kelamcısı Kâdî *Abdülcebbâr* ise, Câhız'ın bu görüşünü desteklemekle birlikte kudretin akıl, tab' ve bilginin esası oluşu konusunda daha mufassal görüşlere yer verir. Örneğin, Kâdî'ya göre; "kanıtlara yönelik gözlem sonucu zorunlu olarak insanın iç doğasında (tab') bilgi şekillenir." *Kâdî,* nazar hakkında da, "gözlem, doğa ve içsel zorunluluk sonucu belirginleşebilir. Bazen insanın isteğine (ihtiyâr) bağlı olarak da gündeme gelebilir. Ne zaman ki, gözlemle ilgili etkenler ve dürtüler güçlenirse, o takdirde insanın iç doğasında böyle bir istek zorunlu olarak uyanır. Dış etkenlerle iç dürtüler eşit düzeyde olduklarında, insanın özgür iradesi devreye girer. Ancak gözlem iradesi, kesinlikle serbest iradeye bağlıdır. Diğer

21 Ebû Zeyd, Nasr Hamid, *el*-İtticâhu'l-*Aklî fi't-Tefsîr*, Beyrut, 1982, s. 50.
22 Eş'arî, *Makâlât*, s. 225.
23 Ebû Zeyd, a.g.e., s. 51.
24 Eş'arî, a.g.e., s. 225-234.
25 Ebû Zeyd, a.g.e., s. 51.
26 Bkz. Bağdâdî, Abdülkâhir*, el-Fark Beyne'l-Frak,* Beyrut, 1990, 175-76.
27 Krş. Altıntaş, Ramazan, *İslam Düşüncesinde İşlevsel Akıl*, İstanbul: Pınar Yayınları, 2003, 203-204.

fiilleri irade etmek gibi" şeklinde yorum yapar.[28]

Kâdî Abdülcebbâr'ın görüşlerinin satır aralarından anladığımız kadarı ile, bilgi; tab' ile insanın özgür iradesi sonucu meydana gelmektedir. İnsanın tabiatının harekete geçmesi, dış etkenlerden bağımsız değildir. Bu itimat hareketinden sonraki hareket gibidir. Bu bir nevi *tevlid* düşüncesidir. Dış etkenlerin hareketiyle iç etkenlerin hareketi ortak bir bilgi üretimini gerçekleştirmektedir. Nitekim İbn *Rüşd,* hidâyet olayını tahlil ederken, Câhız ve Kâdî Abdülcebbâr gibi düşünür. O, *"dış dünyadan iştahımızı çeken ve arzu ettiğimiz bir şeyi, özgür irademiz ve isteğimiz olmaksızın zorunlu olarak arzu ederiz. İçimizde uyanan bir meyil/tabiat sebebiyle ona doğru hareket ederiz"* demektedir."[29] O halde, iman olayında, bir dış âmil olan gözlem sonucu iç dünyamızdaki meyil veya '*doğa'* içgüdüsü, birbirini etkileyerek insanı harekete sevk ediyor. Ama bu hareket kendiliğinden bir sonuca ulaşmıyor. Son merhalede insanın özgür iradesi yönlendirici ve tayin edici bir fonksiyon icra etmektedir. Bu yönüyle Câhız'ın *"tabiat*"cılığı bir nevi determinizm olarak değerlendirilebilir. Kâdî Abdülcebbâr'ın dediği gibi, Câhız, *"güç yetiren insanın fiilleri"*[30] noktasında Cebriye determinizminden ayrılmaktadır.

Ayrıca Mu'tezile'den *Sümâme* ve *Câhız* gibi bazı düşünürlerden, *"kulun iradeden başka fiillerinin bulunmadığını"*[31] söyleyenler olmasına rağmen*, "iradenin dışındaki şeyler"* konusunda ihtilaf edilmiştir. Câhız'ın, *"iradeden sonra olan şey, tabiatı gereği insanın fiilidir, onun ona ihtiyarı yoktur"* görüşü, bilginin zorunluluğu görüşünü gerektirir. Bu görüşe göre fiil, tabiatlar yasasıyla irtibatlandırılmıştır. Böyle bir görüş, Câhız ve diğer Mu'tezile bilginlerine göre, imanda cebrîliktir. Bu durum, "*kâfir, tabiatına yüklenmediğinden dolayı imana güç yetiremez*" sözüne götürür. Fakat Câhız, böyle bir sonucu, "*kâfirde, Allah ve O'nun sıfatları hakkındaki bilgi zorunlu olarak meydana gelmiştir, kâfir inadı ve inadı üzerinde ısrar ederek kâfir olmuştur. Kâfirler, mezhebinin sevgisine boğulmuş âriflik ve inatçı arasındadırlar"*[32] görüşü ile inkâr olayını izah eder. Her ne kadar Câhız inkâr veya iman olayını *"tab'"* fikrinden bağımsız yorumlamış gibi görülse de, aslında o, nihaî durumda serbest iradeyi devreye sokmakta, *"araçla, aracı eylem"* arasındaki farklılığı gözardı etmemektedir. Örneğin, el organının yaptığı iş, el doğasının fiilidir, dil organının işlediği şey, dil doğasının filidir, bir başka ifade ile Allah, erkeğe kadınlara ilgi duyma doğasını vermiştir, ama zina eylemini yasaklamıştır. İnsan, sahip olduğu araçların doğası gereği özgür bir şekilde eylemlerini meydana getirir. Bütün bu örneklerde görüldüğü gibi, tabiat ve eylemin fâili birbirinden kesin olarak ayrı ayrı şeylerdir. Öyle ki, içgüdü ve doğanın belirleyici olduğu unsurlarda bile, insan, kendi hür iradesinden kaynaklanan eylemlerde sorumluluk taşımaktan kurtulamaz. *Câhız*, tabiatçı (natüralist) filozoflar gibi, tabiatın kendisine takılıp kalmamış, tabiat düşüncesinden yola çıkarak, duyu-ötesi alanın bilgisiyle irtibat kurmuştur.

### 4. **Tab' Düşüncesinin Âhiretle İlgili Konulara Uygulanması**

Diğer taraftan, cisimlere *tabiat* isnat eden Câhız, bu görüşünü kanıtlamak için "*Allah hiç kimseyi cehenneme sokmaz, ancak, ateş tabiatı gereği cehennemlikleri kendisine çeker, kendisinde ebedî olarak onları tutar. Sonra onları kendi tabiatına dönüştürerek, kendisinden bir parça haline getirir. Ebedî olarak cehennemde hiçbir kimse kalmaz. Cennet de bunun gibidir. Kendi halkını, tabiatı gereği kendine çeker. Yoksa Allah hiç kimseyi cennete sokmaz."*[33] görüşlerini ileri sürer. O, cehennemin ebedi olmadığına inanır.

---

28 Kâdî Abdülcebbâr, *el-Muğnî*, XII, 316.
29 Krş. İbn Rüşd, Ebu'l-Velîd Muhammed, *el-Keşf an Menâhici'l-Edille (Felsefe-Din İlişkileri içinde), Çev. S. Uludağ*), İstanbul, 1985, s. 328-329.
30 Bkz. Kâdî Abdülcebbâr, a.g.e., XII, 316.
31 Eş'arî, *Makâlât*, s. 407.
32 Cârullâh, Zühdi Hasan, *el-Mu'tezile,* Beyrut, 1990, s. 154
33 Bkz. Bağdâdî, *el-Fark,* s. 176; Cârullah, *el-Mu'tezile,* s. 154.

Eş'arî Kelam Okuluna bağlı olan *Abdülkâhir el-Bağdâdî*, Câhız'ın tabiat felsefesini haklı olarak şöyle eleştirir. "Eğer insanın iradeden başka özgür eylemleri yoksa namaz, oruç, hac, zina, hırsızlık, iftira, adam öldürmek gibi fiillerin de insanın eylemlerinden olmaması gerekir. Bu görüşe göre insan sadece irade fiilinden sorumludur. Bütün fiiller, kendisinden *tabiatı* gereği meydana gelmiştir. Eğer bütün bu fiiller, kesbe dayalı değil de tabiî olarak meydana gelmişse, insan, rengi ve bedeninin şeklinden dolayı, kendi kesbinden meydana gelmediği için nasıl sevap ve ceza görmüyorsa, işte aynen bunun gibi, kesbi ile ilgili olmayan işlerden dolayı sevap ve ceza görmemesi gerekir."[34]

## SONUÇ

*Sonuç* itibariyle söylemek gerekirse, İslam düşünce tarihinde Bağdat Mu'tezilesi, 'tabiat'çılığı bir başka ifade ile doğacılığı benimsemiştir. Doğacılık düşüncenin temelinde, insanın eylemlerinde özgür olduğu iddiasını kanıtlama vardır. Tabiatçı/doğacı kelamcılardan olan Nazzam ve Câhız'ın aksine Kâdı Abdülcebbâr, nedensellik anlayışında illet, malulünü zorunlu olarak gerektireceği için malul yerine 'sebep' kavramını kullanmıştır. Sebep, sonucunu zorunlu gerektirmeyen kadirle makdûr arasında bir vasıtadır. Doğacı/tabiatçı Mu'tezile kelamcıları Gazalî'nin aksine; ateşin yakmasında, suyun kandırmasında, ekmeğin doyurmasında etken olan nesnelerdeki 'tab'dır düşüncesinden hareket etmişlerdir. Basra Mu'tezilesi ve Abdülcebbar ise, '*tab'* yerine *'itimad'* ve "âdet" sözcüğünü kullanmayı tercih etmiştir. Çünkü âdet, Allah'ın yarattığı bir şeydir. Dolayısıyla, Allah, peygamberine verdiği mucize ile tabiat kurallarını ihlal edebilir.

## KAYNAKÇA


Altıntaş, Ramazan, *İslam Düşüncesinde İşlevsel Akıl*, İstanbul: Pınar Yayınları, 2003.

Bağdâdî, Abdülkâhir, *Usûlü'd-Dîn,* İstanbul, 1928.

Bağdâdî, Abdülkâhir*, el-Fark Beyne'l-Frak,* Beyrut, 1990,

Bâkıllânî, Ebu Bekr Muhammed, *et-Temhîd*, Beyrut, 1987.

Beyâzîzâde, Kemaleddin, İşârâtü'l-Merâm *min İbârâti'l-İmâm*, tahk. M. Zâhid el-Kevserî, İstanbul, 1949,

Cârullâh, Zühdi Hasan, *el-Mu'tezile,* Beyrut, 1990.

Cürcânî, S. Şerif, *et-Ta'rîfât*, Beyrut, 1987.

Ebû Zeyd, Nasr Hâmid*, el-İtticâhu'l-Aklî fi't-Tefsîr*, Beyrut, 1982.

Eş'arî, Ebu'l-Hasen, *Makâlâtü'l-İslâmiyyîn*, (thk. Hellmut Ritter), Wıesbaden, 1980.

İbn Rüşd, Ebu'l-Velîd Muhammed, *el-Keşf an Menâhici'l-Edille (Felsefe-Din İlişkileri içinde), Çev. S. Uludağ*), İstanbul, 1985.

İsferâyinî, Ebu'l-Muzaffer, *et-Tebsîr fi'd-Dîn*, Beyrut, 1983.

Kâdî Abdülcebbâr, *el-Usûlü'l-Hamse*, tahk., Faysal Bedir Avn, Kuveyt, 1998,

Kâdî Abdülcebbâr, *el-Muğnî* fî *Ebvâbi't-Tevhîd ve'l-Adl,* (thk. M. Ali en-Neccâr-Abdülhalîm en-Neccâr), Kahire, 1965,


34 Bkz. Bağdâdî, a.g.e., s. 176.

**O-89 Kırgızistan'ın Tarımsal Mekanizasyon Düzeyinin Coğrafik Bölgeler Açısından Değerlendirilmesi**

**Tair ESENALİ UULU**[1] **Hüseyin ÖĞÜT**[2,3] **Tamer MARAKOĞLU**[3]

[1]Kırgızistan – Türkiye Manas Ü*niversitesi, Ziraat Fakültesi, Bitki Koruma Bölümü, 720044, Bişkek, Kırgızistan*

[2] Kırgızistan – Türkiye Manas Ü*niversitesi, Meslek Yüksek Okulu, Otomotiv Programı, 720044, Bişkek, Kırgızistan*

[3]*Selçuk Üniversitesi, Ziraat Fakültesi, Tarım Makinaları ve Teknolojileri Mühendisliği Bölümü, 42000, Konya, Türkiye*

Özet

Bu çalışmada, Kırgızistan'ın tarımsal mekanizasyon düzeyinin, coğrafik bölgeler açısından belirlenmesi amaçlanmıştır. Bu amaçla, Kırgızistan'ın coğrafik bölgelerinin tarımsal mekanizasyon düzeyi verileri için 2016 yılına ait Kırgızistan İstatistik Kurumu ve Tarım Bakanlığı İstatistik verileri kullanılmıştır. Çalışma sonucunda, Kırgızistan'da 1000 ha işlenen alana düşen traktör sayısı, birim işlenen alana düşen traktör gücü, bir traktöre düşen işlenen alan sayısı ile traktör başına düşen tarım alet ve makinaları ortalama sayıları 2016.yılı için sırasıyla 55,4 traktör/1000ha, 0.93 kW/ha, 18,1 ha/traktör ve 2,08 ekipman/traktör olarak bulunmuştur. Ayrıca bu çalışmada, Kırgızistan'ın genel olarak tarımsal yapısı değerlendirilerek, Avrupa ve Türkiye ile karşılaştırılmaları yapılmıştır.

**Anahtar kelimeler:** *tarımsal mekanizasyon, traktör, coğrafik bölgeler, Kırgızistan*

**Evaluation of Kyrgyzstan's Agricultural Mechanization Level in Terms of Geographic Regions**

**Abstract**

This study has been conducted to evaluate the level of Kyrgyzstan`s agricultural mechanization in terms of geographic regions. Data used in this study were obtained from National Statistical Committee and Ministry of Agriulture of Kyrgyz Republic databases from 2016 year. The criteria of Kyrgyzstan`s agricultural mechanization level such as cultivated area per tractor, tractor power per unit of cultivated area, the number of tractors per cultivated area and the number of equipment per tractor were found 18.1 ha/tractor, 0,93 kW/ha, 55.4 tractor/1000 ha, 2.08 equipment/tractor, respectively. In addition to this study, Kyrgyzstan`s agricultural structure evaluated and compared with EU and Turkey.

**Keywords:** *agricultural mechanization, tractor, geographic regions, Kyrgyzstan*

## GİRİŞ

Tarımsal mekanizasyon, tarımsal üretimde yapılan işlerin kolaylaşmasını ve üretim alanından daha yüksek verim alınmasını sağlayan, tarımsal üretim teknolojisidir. Tarım sektöründe çağdaş üretim tekniklerinin uygulanabildiği gelişmiş makine ve araçların kullanılması tarım işletmelerinin ekonomik ve teknik düzeylerini belirlemektedir. Tarımsal mekanizasyon, tarım alanlarını geliştirmek, her türlü tarımsal üretimi yapmak ve ürünlerin işlemlerini gerçekleştirmek amacıyla kullanılan tüm enerji kaynağı, mekanik araç ve gerecin tasarımı, yapımı, geliştirilmesi, pazarlanması, yayım ve eğitimi, işletilmesi ve kullanılması konularını içermektedir. (Zeren ve ark., 1995; Koçtürk ve Avcıoğlu, 2007; Özgüven ve ark., 2010; Altuntaş, 2016).

Dünya'da tüm ülkelerin tarımsal mekanizasyon düzeyleri farklı gelişme ve uygulama gösterdiği bilinmektedir. Bu farklılık bir ülkenin bölgelerinde olduğu gibi, bir bölgede yer alan tarımsal işletmelerde de farklı olabilmektedir (Koçtürk ve Avcıoğlu, 2007). Ülkelerin tarımsal mekanizasyon düzeyinin belirlenmesinde traktör ve traktörle kullanılan alet ve makinalarının sayısal yoğunluğu ile işletme alan büyüklükleri temel olmaktadır (Altuntaş, 2016).

Kırgızistan'ın coğrafik bölgelerine göre tarımsal üretim verimliliğine bölgenin iklim özellikleri, arazi varlığı ve büyüklüğü, arazi şekli, bitkisel üretim sistemi, toprak yapısı, yeterli iş gücü faaliyetleri ve tarımsal alet ve makine kullanım durumu etkili olmaktadır. Modern tarım tekniğinin vazgeçilmez girdisi olan tarımsal mekanizasyon, pahalı ve uzun vadeli yatırımlar olması nedeniyle iyi bir planlamayı gerektirmektedir. Bunun için ülkesel ve bölgesel bazda tarımsal mekanizasyon durumu ve sorunları yeterince ortaya konulmalıdır (Baydar ve Yumak, 2000). Kırgızistan'ın tarımsal mekanizasyon düzeyine yönelik günümüze kadar herhangi bir çalışma yapılmamıştır. Bu çalışma Kırgızistan'ın tarımsal mekanizasyon durumunu ortaya koymak amacıyla gerçekleştirilmiştir.

### Kırgızistan'ın Tarımsal Yapısı

Orta Asya'nın en verimli ve sulu topraklarında yerleşmiş olan Kırgızistan'da tarım önemli sektörlerden birisi olmaktadır. Sovyet Birliği yıkılmasından sonra bağımsızlık kazanan Kırgızistan 1991-1995 yılları arasında tüm sektörl-

erde olduğu gibi tarım sektöründe de büyük bir kriz dönemi geçirmiştir. 1995 yılında tarım sektörünün GSMH'nin içindeki payı %43,9 iken, 2005 yılında %33,3 ve 2015 yılında ise %15,9'unu oluşturmuştur. (Mogilevskii ve ark.). Kırgızistan'da özel mülkiyete dayalı küçük aile işletmelerinin hakim olduğu bir tarımsal yapı mevcuttur. Tarım sektöründe 1990.yılında başlatılan reformlar sonucunda 1991 yılında 2000 kollektif-işletme yerine 1994 yılında 20000 kooperatif oluşturulmuş ve 2001 yılında bu sayı 250000 den fazla küçük aile işletmeleri haline dönüşmüştür. Buna bağlı olarak, 1994 yılında işletme başına 15 ha iken, 2002 yılında 3 ha olmuştur. Kırgızistan İstatistik Kurumu 2015 yılı verilerine göre toplam 401419 küçük yapılı tarımsal işletme bulunmaktadır. Kırgızistan'da halkın %65'i kırsal kesimde yaşamakta ve toplam nüfusun yaklaşık %30 u tarım sektöründe çalışmaktadır. Tarım sektörünün GSMH'deki payının azalması, Kırgızistan'da hizmet ve sanayi sektörünün gelişmekte olduğunu göstermektedir.

Kırgızistan'ın 10.9 milyon hektar olan toprak varlığının 1.3 milyon hektarını tarım arazileri oluşturmaktadır. Toplam ekili ve dikili alanların %64,3' ünde sulu tarım, %35,7' sinde ise kuru tarım yapılmaktadır. Bitkisel ürünler olarak buğday, arpa, mısır, patates, kavun, yağ bitkileri, sebze ve meyve bitkileri yetiştirilmektedir. Kuzeyde Çüy bölgesinde şeker pancarı ve Güney bölgelerde pamuk en önemli yetiştirilen bitkiler olmaktadır.

Kırgızistan'ın %65' ini dağlar kaplamakta ve tarımsal araziler coğrafi açıdan dağlık bir yapıya sahiptir. Tanrı Dağlarının oluşturduğu farklı ekosistem, çok sayıda mikroklimaya sahip alanlar bulunmaktadır. Rakım 400 ile 7439 metre arasında değişmekte olup, tarım ürünleri genellikle 700 ile 1200 metre yükseklikte yetiştirilmektedir. İklim olarak karasal iklim mevcut olup, kış mevsimleri çok soğuk ve yazın sıcak geçer.

## MATERYAL VE YÖNTEM

### Materyal

Çalışmada materyal olarak kullanılan veriler Çizelge 1'de verilmiştir. Bu veriler Kırgızistan'a ve coğrafik bölgelere ilişkin 2015-2016 yılına ait tarım makinaları ve aletleri sayılarını göstermektedir. (Anonim, 2015 Anonim, 2016). Veriler içerisinde tüm bölgelere ait işlenen alan değerleri, traktör ve biçerdöver sayısı, traktörle çekilen tarım alet-makine sayıları yer almaktadır.

**Çizelge 1. Kırgızistan ve coğrafik bölgelere göre traktör ve tarım alet-***ekipmanlarının dağılımı (adet)*

| Coğrafik Bölgeler | Traktör | Biçerdöver | Pulluk | Gübre dağıtım makinesi | Kültivatör | Ekim makinesi | Tarım arabası | Çayır biçme makinesi | Balya makinesi | Tırmık | Pülverizatör | Harman makinesi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Celal-Abad | 2584 | 175 | 972 | 44 | 3139 | 307 | 1133 | 248 | 117 | 53 | 20 | 22 |
| Isık-Göl | 3449 | 540 | 1222 | 8 | 1675 | 440 | 1376 | 481 | 224 | 108 | 84 | 140 |
| Narın | 1908 | 245 | 613 | 0 | 1591 | 231 | 831 | 404 | 195 | 130 | 5 | 40 |
| Talas | 1882 | 95 | 1110 | 25 | 391 | 281 | 1029 | 228 | 65 | 53 | 78 | 22 |
| Oş | 3604 | 214 | 616 | 16 | 3868 | 369 | 1043 | 257 | 132 | 53 | 17 | 34 |
| Batken | 1315 | 82 | 511 | 9 | 369 | 51 | 515 | 108 | 83 | 29 | 9 | 10 |
| Çüy | 6682 | 904 | 1849 | 182 | 6535 | 1059 | 3733 | 962 | 632 | 258 | 299 | 227 |
| **Kırgızistan** | **21424** | **2253** | **8266** | **284** | **17700** | **2738** | **9660** | **2688** | **1448** | **684** | **512** | **495** |

### Yöntem

Bir bölgenin tarımsal mekanizasyon düzeyinin belirlenmesinde dikkate alınan en önemli ölçü birim traktör gücü (kW/ha) olmaktadır. Bunun yanında; traktör/1000 ha, ekipman/traktör ve ton-ekipman/traktör değerleri de mekanizasyon düzeyinin belirlenmesinde kullanılan diğer kriteriler olmaktadır.

Bu çalışmada, 2016 yılına ait istatistik veriler kullanılarak, Kırgızistan geneli ve bölgeler için aşağıda veriler kriteriler hesaplanmıştır (Anonim, 2016). Bu kriteriler;

1. İşlenen alana düşen traktör gücü (kW/traktör): Mevcut mekanik gücün toplam işlenen alana bölünmesiyle hesaplanmaktadır
2. Traktör başına düşen tarım alanı (ha/traktör): Toplam tarım alanının güç değerlerine bakılmaksızın traktör sayısına bölünmesiyle belirlenmektedir

3. Birim tarım alanına düşen traktör sayısı (traktör/1000 ha): Toplam traktör sayısının işlenen tarım alanına bölünmesiyle elde edilmektedir

4. Traktör başına düşen alet- ekipman sayısı (ekipman/traktör): Toplam alet-ekipman sayısının toplam traktör sayısına bölünmesiyle hesaplanmaktadır

Çalışmanın sonunda yer alan, Kırgızistan, Avrupa Birliği ve Türkiye tarımsal mekanizasyon düzeylerinin karşılaştırılmasında ise tarım sektörüne ait nüfus, tarımsal nüfus, toplam tarım alanı, traktör sayısı, traktör başına düşen ekipman sayısı, 1000 ha alana düşen traktör sayısı, traktör başına düşen tarım arazisi, ortalama traktör gücü, 1 ha alana düşen traktör gücü gibi genel kriteriler esas alınmıştır.

## BULGULAR VE TARTIŞMALAR

### Kırgızistan'ın Coğrafik Bölgelerine Göre Tarımsal Mekanizasyon Düzeyi

2016 yılı Kırgızistan Tarım Bakanlığı İstatistik verilerine göre, Kırgızistan'ın coğrafik bölgelerine göre tarımsal amaçlı işlenen alanlar ve traktörlerin sayısındaki değişim, Çizelge 2'de verilmiştir. Kırgızistan'da tarımsal amaçlı işlenen arazi miktarının 2016 yılı itibariyle yaklaşık 1185900 hektar olduğu ve traktör sayısının ise 21424 adet olduğu görülmektedir (Çizelge 2). Coğrafik bölgeler açısından tarımsal üretimde traktör kullanımının oranı büyükten küçüğe doğru, sırasıyla, Çüy (%31,20); Oş (%16,82); Isık-Göl (%16,10); Celal-Abad (%12,06); Narın (%8,91); Talas (%8,78) ve Batken (%6,13) olarak bulunmuştur. Tarımsal işlenen alan yönünden ilk sırayı Çüy bölgesi %34,59 oranıyla alırken, bunu Isık-Göl %15,15; Oş %14,83; Celal-Abad %12,57; Talas %8,79; Narın %8,77 ve Batken %5,21 oranıyla diğer bölgeler takip etmektedir.

**Çizelge 2. Kırgızistan'ın coğrafik bölgelerine göre işlenen alanlar ve traktör sayıları**

| Coğrafik Bölgeler | İşlenen alan (ha) | Kırgızistan oranı (%) | Traktör sayısı (adet) | Kırgızistan oranı (%) |
|---|---|---|---|---|
| Celal-Abad | 149000 | 12,57 | 2584 | 12,06 |
| Isık-Göl | 179700 | 15,15 | 3449 | 16,10 |
| Narın | 104100 | 8,77 | 1908 | 8,91 |
| Talas | 104300 | 8,79 | 1882 | 8,78 |
| Oş | 175900 | 14,83 | 3604 | 16,82 |
| Batken | 61700 | 5,21 | 1315 | 6,13 |
| Çüy | 410300 | 34,59 | 6682 | 31,20 |
| **Kırgızistan** | **1185900** | **100,00** | **21424** | **100,00** |

*(Tarım Bakanlığı Istatistik Verileri, 2016)

Kırgızistan'ın coğrafik bölgelerine göre 2016 yılı verilerine göre, tarımsal mekanizasyon düzeyleri Çizelge 3'de verilmiştir. Kırgızistan'ın tarımsal mekanizasyon düzeyinin belirlenmesinde işlenen birim alana düşen traktör gücü (kW/ha); traktör başına düşen işlenen alan (ha/traktör); 1000 ha işlenen tarım alanına düşen traktör sayısı (traktör/1000 ha); ve birim traktör başına düşen ekipman sayısı (ekipman/traktör) kriterleri ele alınmıştır. Çizelge 3 incelendiğinde Kırgızistan'ın coğrafik bölgelerine göre, işlenen birim tarım alanına düşen traktör gücü (kW/ha) açısından (2003 yılı verilerine göre), 1.23 kW/ha değeri ile en yüksek değer Batken Bölgesi'nde gözlenirken, 0.78 kW/ha değeriyle Çüy Bölgesi'nde en düşük seviyede bulunmuştur. Celal-Abad, Narın Bölgeleri için 0,93 kW/ha olan Kırgızistan ortalaması değerinin üstünde bulunurken, diğer bölgelerde ise Kırgızistan ortalaması altında bir değere sahiptir. Kırgızistan'ın birim tarım alana düşen traktör sayısı (traktör/1000 ha) değeri 2016 yılı verilerine göre 55,4 traktör/ 1000 ha ile traktör başına düşen alan ve ekipman sayısı, sırasıyla, 18,1 ha/traktör ve 2,08 ekipman/traktör değerinde olduğu belirlenmiştir. Birim alana düşen traktör sayıları coğrafik bölgeler açısından incelendiğinde en yüksek 61,4 traktör /1000ha değeriyle Çüy Bölgesi'nde, en düşük ise Batken Bölgesi için 46,9 traktör/1000ha değerinde bulunmuştur. Coğrafik bölgeler açısından birim traktör başına düşen tarım alanı, Çüy bölgesinde en düşük 16,3 ha/traktör değeriyle bulunurken, 21,3 ha/traktör değeriyle de en yüksek Batken bölgesinde görülmüştür. Traktör başına düşen ekipman sayısı 2,34 ekipman/traktör değeriyle en yüksek değer Celal-Abad Bölgesi'nde görülürken, bu değer en düşük 1,29 ekipman/traktör değeri ile Batken Bölgesi'nde bulunmuştur. Bugüne kadar yapılan çalışmalarda Kırgızistan'da ortalama traktör gücü belirlenmemiştir. Bu çalışma kapsamında, 2003 yılında yapılan kayıtlardan elde edilen tüm verilerin değerlendirilmesi sonucunda Kırgızistan için ortalama traktör gücü 51 kW olduğu ilk defa bu çalışmada belirlenmiştir.

**Çizelge 3. Kırgızistan ve bölgelere ait mekanizasyon verileri**

| Coğrafi Bölgeler | kW/ha** | ha/traktör | traktör/1000ha | ekipman/traktör |
|---|---|---|---|---|
| Celal-Abad | 1,21 | 17,4 | 57,6 | 2,34 |
| Isık-Göl | 0,72 | 19,2 | 52,1 | 1,67 |
| Narın | 1,05 | 18,3 | 54,6 | 2,12 |
| Talas | 0,81 | 18,1 | 55,4 | 1,74 |
| Oş | 0,94 | 20,5 | 48,8 | 1,78 |
| Batken | 1,23 | 21,3 | 46,9 | 1,29 |
| Çüy | 0,78 | 16,3 | 61,4 | 2,36 |
| Kırgızistan | 0,93 | 18,1 | 55,4 | 2,08 |

*Kırgızistan için ortalama traktör gücü 51 kW olarak bulunmuştur.

**Kırgızistan için KW/ha değeri Çizelge 4' te yer alan veriler kullanılarak elde edilmiştir.

Kırgızistan'da ülke genelinde Tarım ve Hayvancılık alanlarını kapsayan detaylı bilgileri içeren İstatistik kayıtlar ilk defa 2003 yılında Kırgızistan İstatistik Kurumu tarafından yapılmış, ve 2004 yılında yayınlanmıştır. Bu yapılan kayıtlar esas alınarak, 2003 yılında toplam 21216 adet traktörün yürüme organları (2 tekerlekli ve 4 tekerlekli) ile güç gruplarına göre dağılımı, Kırgızistan'ın coğrafik bölgeleri için Çizelge 4' te verilmiştir. Kırgızistan İstatistik Kurumunun yaptığı kayıtlarda traktör güç gruplaması 2 tekerlekli traktörlerde – 50-90 BG, 100-120 BG, 130-150 BG, >170 BG 4 tekerlekli traktörler ise – 1-45 BG, 50-100 BG, 100-120 BG, 150-155 BG, 165 BG, 200 BG, 250-300 BG olarak ayırt edilmiştir.

**Çizelge 4. Kırgızistan'ın 2003 yılında yapılan kayıtlara göre iki tekerlekli (2T) ve dört tekerlekli (4T) traktörlerin güç gruplarına göre coğrafik bölgeler bazında değişimi**

| Traktör Tipi Gücü (BG) | | Coğrafi Bölgeler | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Batken | Celal-Abad | Narın | Oş | Talas | Çüy | Isık-Göl | Kırgızistan |
| 2T | 50-90 | 127 | 420 | 441 | 400 | 219 | 775 | 496 | 2878 |
| | %oranı | 4,41 | 14,59 | 15,32 | 13,89 | 7,60 | 26,9 | 17,23 | 100 |
| | 100-120 | 51 | 71 | 6 | 52 | 11 | 78 | 13 | 282 |
| | %oranı | 18,08 | 25,17 | 2,12 | 18,43 | 3,90 | 27,65 | 4,60 | 100 |
| | 130-150 | 9 | 25 | 11 | 24 | 3 | 56 | 17 | 145 |
| | %oranı | 6,20 | 17,24 | 7,58 | 16,55 | 2,06 | 38,62 | 11,72 | 100 |
| | >170 | - | 11 | - | 5 | 2 | 12 | 4 | 34 |
| | %oranı | 0 | 32,35 | 0 | 14,70 | 5,88 | 35,29 | 11,76 | 100 |
| 4T | 1-45 | 717 | 1683 | 409 | 1420 | 429 | 1204 | 618 | 6480 |
| | %oranı | 11,06 | 25,97 | 6,31 | 21,91 | 6,62 | 18,58 | 9,53 | 100 |
| | 50-100 | 658 | 1372 | 1083 | 1341 | 925 | 3139 | 1428 | 9946 |
| | %oranı | 6,61 | 13,79 | 10,88 | 13,48 | 9,30 | 31,56 | 14,35 | 100 |
| | 100-120 | 3 | 19 | 10 | 19 | 8 | 134 | 32 | 225 |
| | %oranı | 1,33 | 8,44 | 4,44 | 8,44 | 3,55 | 59,55 | 14,22 | 100 |
| | 150-155 | 1 | 10 | 11 | 16 | 6 | 15 | 13 | 72 |
| | %oranı | 1,38 | 13,88 | 15,27 | 22,22 | 8,33 | 20,83 | 18,05 | 100 |
| | 165 | 23 | 89 | 62 | 65 | 35 | 205 | 104 | 583 |
| | %oranı | 3,94 | 15,26 | 10,63 | 11,14 | 6,00 | 35,16 | 17,83 | 100 |
| | 200 | - | 6 | 3 | 13 | 5 | 57 | 16 | 100 |
| | %oranı | 0 | 6 | 3 | 13 | 5 | 57 | 16 | 100 |
| | 250-300 | 3 | 9 | 3 | 3 | 2 | 54 | 5 | 79 |
| | %oranı | 3,79 | 11,39 | 3,79 | 3,79 | 2,53 | 68,35 | 6,32 | 100 |
| ***Toplam (2003)** | | **1592** | **3715** | **2039** | **3360** | **1645** | **6017** | **2848** | **21216** |
| ****Toplam traktör sayıları (2016)** | | **1315** | **2584** | **1908** | **3604** | **1882** | **6682** | **3449** | **21424** |

*(Kırgızistan istatistik Kurumu yayınları, 2004), 2T: 2 Tekerlekli, 4T: 4 Tekerlekli

**(Tarım Bakanlığı İstatistik Verileri, 2016)

**Kırgızistan'ın Coğrafik Bölgelerine Göre Tarım Alet ve Makineleri Varlığı**

Bir ülkenin tarımsal mekanizasyon seviyesini tarım alet ve makine varlığı göstermekte olup, bu seviyenin belirlenmesinde traktör başına düşen tarım alet ve makinaları oranı önemli kriter olmaktadır. Kırgızistan'ın coğrafik bölgelerine göre birim traktör başına düşen tarım makinaları oranları Çizelge 5' te verilmiştir. Çizelge 5'te görülen tarım makinaları temel tarımsal üretim işlemlerini esas alarak pulluk, tırmıklar, kültivatör, ekim makinesi, gübre dağıtım makinesi, pülverizatör, harman makinesi, balya makinesi ve tarım arabası olarak sıralanmıştır. Çizelge 5 incelendiğinde Kırgızistan'da tarım alet ve makinaları varlığı çok düşük düzeyde olduğu ortaya konulmuştur. Kırgızistan'ın geneli için traktör başına düşen pulluk oranının 0,39 düzeyinde olduğu görülmektedir. Bu rakama göre yaklaşık 3 traktör 1 adet pulluk kullanmakta olduğu söylenebilir. Traktör başına düşen tırmık ve kültivatör oranlarının Kırgızistan ortalaması sırasıyla 0,03 ve 0,83 olarak belirlenmiştir. Kırgızistan için traktör başına düşen ekim makinesi oranı 0,13 düzeyinde oldukça düşük olmaktadır. Kırgızistan geneli için traktör başına düşen gübre dağıtım makinesi, pülverizatör ve harman makinesi oranları sırasıyla 0,01 0,02 ve 0,02 olduğu gösterilmektedir. Buna göre, Kırgızistan'da neredeyse gübre dağıtımı, ilaçlama işlemleri ve toplama-hasat işlemleri traktör ile yapılmamakta olduğu söylenebilir. Traktör başına balya makinesi ve çayır biçme makinaları oranları Kırgızistan ortalaması sırasıyla 0,07 ve 0,13 olup, traktör başına tarım arabası oranı ise diğer tarım alet ve makinalarından en yüksek düzeyde 0,45 değerinde bulunmuştur. Genel olarak Kırgızistan'ın bölgeleri arasında tüm tarım alet ve makinaları dağılımında büyük değişkenler söz konusu değildir. Tarımsal mekanizasyon düzey belirlenmesinde traktör dışında biçerdöverlerin kullanımı önemli olmaktadır. Biçerdöver kullanımı açısından bakıldığında, Kırgızistan'daki toplam biçerdöver sayısı 2253 adet olup, coğrafik bölgeler arasında Çüy Bölgesi %40,1 oranı ile Kırgızistan ortalamasının ilk sırasını almaktadır.

**Çizelge 5. Traktör başına düşen bazı tarım alet-makine dağılımının Kırgızistan'ın coğrafik bölgelerine göre dağılımı**

| Tarım alet ve makine tipi | Coğrafik bölgeler | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Batken | Oş | Celal-Abad | Talas | Çüy | Isık-Göl | Narın | Kırgızistan |
| Pulluk | 0,38 | 0,17 | 0,37 | 0,58 | 0,27 | 0,35 | 0,32 | 0,39 |
| Tırmıklar | 0,02 | 0,01 | 0,02 | 0,03 | 0,04 | 0,03 | 0,07 | 0,03 |
| Kültivatör | 0,28 | 1,07 | 1,21 | 0,21 | 0,98 | 0,49 | 0,83 | 0,83 |
| Ekim makinesi | 0,03 | 0,10 | 0,12 | 0,15 | 0,16 | 0,13 | 0,12 | 0,13 |
| Gübre dağıtım makinesi | 0,01 | 0,01 | 0,02 | 0,01 | 0,03 | 0,01 | 0 | 0,01 |
| Pülverizatör | 0,01 | 0,01 | 0,01 | 0,04 | 0,05 | 0,03 | 0,01 | 0,02 |
| Harman makinesi | 0,01 | 0,01 | 0,01 | 0,01 | 0,03 | 0,04 | 0,02 | 0,02 |
| Balya makinesi | 0,06 | 0,04 | 0,05 | 0,04 | 0,10 | 0,06 | 0,10 | 0,07 |
| Çayır biçme makinesi | 0,08 | 0,07 | 0,09 | 0,12 | 0,14 | 0,14 | 0,21 | 0,13 |
| Tarım arabası | 0,39 | 0,29 | 0,43 | 0,55 | 0,56 | 0,40 | 0,44 | 0,45 |

*(Tarım Bakanlığı İstatistik Verileri, 2016), Pulluk: tüm kulaklı ve diskli pulluklar, Tırmıklar: diskli ve dişli tırmıklar, Ekim makinesi: tahıl ekim makinesi, Gübre dağıtım makinesi: kimyasal gübre dağıtım makinesi, Çayır biçme makinesi: traktörle çekilen çayır biçme makinesi

**Tarımsal Mekanizasyon Düzeyine İlişkin "Türkiye – Avrupa Birliği – Kırgızistan" Verilerinin Değerlendirilmesi**

Tarım sektörü, hem Kırgızistan'da hem Türkiye'de ulusal ekonominin önemli kısmını oluşturmaktadır. Kırgızistan ve Türkiyede Çizelge 6' da görüldüğü gibi, toplam nüfusun yaklaşık %30'u tarım sektöründe çalışmaktadır. Avrupa Ülkelerinde ise bu değer %10'un altındadır.

Kırgızistan'da ortalama işletme arazi büyüklüğü değeri 2.7 ha olup, Türkiye'de bu değer 2.5 kat, Avrupa ülkelerinde ise 6 katı fazla olmaktadır. Tarım arazilerinin parçalı ve ortalama işletme arazisi değerinin düşük olması tarım alet ve makinaları kullanımındaki verimliliği de azalmaktadır. Küçük alana sahip işletmelerde modern tarımsal makine satın alma talebi çok düşük olup, ülkemizde tarımsal mekanizasyon durumunun gelişmesini olumsuz yönde etkilemektedir.

Birim işlenen tarımsal alana düşen traktör gücü (kW/ha) açısından, Avrupa Birliği ülkelerinde bu değer 6 kW/ha ve Türkiye'de ise 3.34 kW/ha düzeyinde olup, Kırgızistan'da bu değerin çok düşük olduğu görülmektedir. Türkiye'de Kırgızistan'ın 3 katı, Avrupa Birliği ülkelerinde ise 5 katı fazla değere sahiptir.

Kırgızistan'ın tarımsal mekanizasyon düzeyini gösteren kriterilerden traktör başına düşen tarım makinesi sayısı 2.08 adet olup, bu değer Türkiye'de 5.2 ve Avrupa Birliğinde 10 olduğu belirlenmiştir. Traktör başına düşen tarım makinesi sayısı çok düşük olması ve traktör başına düşen tarım makine ağırlığının bilinmemesi bu yönde çalışmaların yapılmasını ve tarım makinaları sayılarının arttırılması gerektiğini göstermektedir.

Çizelge 6'ya göre Kırgızistan'da traktör güç ortalamasının 68 BG olup, Türkiye ile yakın değerde olduğu, Avrupa Birliği traktör güç ortalamasının 100 BG'nin üzerinde olduğu görülmektedir. Bu durum Kırgızistan'da yüksek üretim teknolojilerinin kullanılmasını sağlayacak makinelerin yetersiz olduğunu göstermektedir.

**Çizelge 6. Türkiye - AB - Kırgızistan Örneklerinde Son Yıllara Ait Tarımsal Mekanizasyon Durumunun Karşılaştırılması**

| | Türkiye | Avrupa Birliği | Kırgızistan |
|---|---|---|---|
| Nüfus (2011, Milyon) | 74.1 | 501 | 5.4 |
| Tarımsal Nüfus (2014, Milyon, %) | 21 (%28) | 28 (%6) | 1,58 (%29.3) |
| Toplam Tarım Alanı (2012, ha) | 23.795.000 | 163.500.000 | 1.185.900 |
| İşletme sayısı (2012, milyon) | 2.2 | 13.7 | 0.4 |
| Ortalama İşletme Büyüklüğü (ha) | 6.8 | 17.5 | 2.7 |
| Tarımsal GSYH (2012, %) | 7.60 | 1.90 | 15.9 |
| Toplam tarımsal üretim (2015, milyar euro) | 57.50 | 347.70 | 3.2 |
| Traktör Sayısı (adet) | 1.000.000 | 15.000.000 | 21424 |
| 1 ha Alana Düşen Traktör Gücü (kW) | 3.34 | 6 | 0.93 |
| Traktör Başına Düşen Ekipman Ağırlığı (ton) | 4.2 | 12 | - |
| Traktör başına Düşen Ekipman Sayısı (adet) | 5.2 | 10 | 2.08 |
| 1000 ha Alana Düşen Traktör Sayısı (adet) | 45 | 57 | 55 |
| Traktör Başına Düşen Tarım Arazisi (Ha) | 26 | 11.3 | 18.1 |
| Ortalama Traktör Gücü (BG) | 60 | >100 | 68 |

## SONUÇ

Bu çalışmada, Kırgızsitan'ın tarımsal mekanizasyon durumunun belirlenmesine çalışılmıştır. Tarımsal işlenen alan ve traktör sayıları incelendiğinde, Çüy bölgesi ilk sırayı alırken Batken bölgesi en düşük olarak belirlenmiştir. Kırgızistan'ın coğrafik bölgeler açısından tarımsal mekanizasyon düzeylerine ait kriterilerinden birim traktör başına işlenen alan (ha/traktör) ve birim işlenen tarım alanına düşen traktör gücü (kw/ha) değerleri en yüksek Batken Bölgesi'nde, en düşük Çüy Bölgesi'nde bulunmuştur. Bölgeler bazında tüm kriterilerde aşırı düzeydeki farklılıklar söz konusu değildir.

Kırgızistan'ın tarımsal mekanizasyon düzeyi genel anlamda dünya ortalamasının çok altında bir değerlere sahip olduğu gözlemlenmiştir. Özellikle kullanılan traktör ve tarım aletlerinin eski olması nedeniyle verimliliğin düşük olduğunu söyleyebiliriz.

Kırgızistan'da tarımsal mekanizasyon düzeyinin belirlenmesine yönelik çalışmalar yapılmaması, mevcut sorunların belirlenmemesi, modern tarım makine ve aletlerin geliştirilmesi ve sayılarının arttırılması konusunda ilgili alanların yeterince çalışmaması halkın tarımsal üretimde teknolojiden çok uzakta kalmalarına neden olmaktadır.

## KAYNAKLAR


Anonim, 2015. Kırgızistan İstatistik Kurumu, Tarımsal Alanlar Verileri

Anonim, 2016. Kırgız Cumhuriyeti Tarım Bakanlığı, Traktör ve tarımsal Alet-Makine İstatistik Verileri

Kırgızistan İstatistik Kurumu Yayınları, 2004. The First National Agricultural Census of Kyrgyz Republic. 464 s. Bişkek.

Altuntaş E. 2016. Türkiye'nin Tarımsal Mekanizasyon Düzeyinin Coğrafik Bölgeler Açısından Değerlendirilmesi. Türk Tarım-Gıda Bilim ve Teknoloji dergisi, 4(12): 1157-1164.

Baydar S, Yumak H. 2000. Van ve Bitlis İllerinin Tarımsal Mekanizasyon Durumu ve sorunları üzerine bir araştırma, Tarımsal Mekanizasyon 19.Ulusal Kongresi, 62-68 Konya

Özgüven MM, Türker U, Beyaz A. 2010. Türkiye'nin tarımsal yapısı ve mekanizasyon durumu. GO Ziraat Fakültesi dergisi, 28(2): 89-100.

Koçtürk B, Avcıoğlu A. 2007. Türkiye'de bölgeler ve illere göre tarımsal mekanizasyon düzeyinin belirlenmesi. Tarım Makinaları Bilimi dergisi., 3(1): 17-24

Zeren Y, Tezer E, Tuncer İK, Evcim Ü, Güzel E, Sındır KO. 1995. Tarım-Alet-Makine ve Ekipman Kullanım ve Üretim Sorunları, Ziraat Mühendisliği Teknik Kongresi Tarım Haftası 1995 Kongresi, 9-13 Ocak, Ankara

Mogilevskii, Roman et al. 2017. The outcomes of 25 years of agricultural reforms in Kyrgyzstan, Discussion Paper, Leibniz Institute of Agricultural development on Transition Economies, 40.162

# O-97 Investigation of Rheological Behavior of Kyrgyz Traditional Beverages Bozo and Maksym during Storage Period

J. Iskakova[1], A. Deidiev[1], J. Smanalieva[1]

[1] Kyrgyz-Turkish Manas University, Engineering Faculty, Food Engineering Department, Bishkek, Kyrgyzstan

E-mail: janil-298@rambler.ru

## ABSTRACT

Bozo and Maksym are Kyrgyz traditional beverages made from cereals using both lactic acid bacteria and yeast fermentation. In this study, the technological production method of Bozo and Maksym were compared and rheological properties of these beverages were investigated. Flow behaviors of the beverages were investigated during storage (6, 14 and 21 days) at fridge temperature of 5°C. The rotational measurement condition was used to obtain flow behaviors of the samples by measuring steady shear viscosity (η) and shear stress (τ) at shear rate from 0.1 to 100 $s^{-1}$. It was found that both beverages reacted as a non-Newtonian pseudo-plastic fluids with yield stress value. Three models such as Herschel-Bulkley, Casson, and Ostwald-De-Waele were used to describe the flow behavior of the samples. The Casson model was found as the most appropriate to fit the flow curves of both investigated beverages with correlation coefficient $R^2$=0.9995–0.9999 for both Bozo and Maksym. The results show effective viscosity of Bozo was increased from 41.28 to 49.45 mPa·s after 21 days of storage, vice versa Maksym's effective viscosity after 21 days of storage has been decreased from 27.55 to 18.61 mPa·s.

**Keywords:** Boza, Maksym, Fermented beverage, Rheological properties, Viscosity, Yield Stress

## INTRODUCTION

Fermented food products are very popular for human nutrition in many mid-Asian, Middle East, and African countries (Köse and Yücel, 2003). These products have many advantages such as destroying undesirable factors in the raw products, reducing the volume of the material, and providing a safer product. Besides improving organoleptic quality by fermentation, they are also superior in digestibility and nutritive value compared to their unfermented counterparts (Arici and Daglioglu, 2002). Kyrgyz nomad people consume various types of cereal-based lactic acid fermented beverages like Bozo, Maksym, and Jarma.

Bozo is a traditional low-alcohol fermented beverage made from cereals like millet, maize, wheat and rice (Arıcı and Daglıoglu, 2002). According to Turkish Standards, Boza is defined as "A product which is made by adding drinkable water to cereals, for example millet, maize, wheat, and rice". The sugar is then added to allow alcohol and lactic acid fermentation. Boza can be classified as sweet or sour boza depending on its acid content" (Standards of Turkey, TS 9778, 1992.). Boza is used as healthy and nutritious beverage, and its lactic acid content has positive effects on digestion and intestinal flora. The production method of Kyrgyz traditional beverage Bozo has it is own characteristics (Iskakova et al., 2016). According to this method, the Boza production could be summarized into several steps: (i) preparation of the raw materials, (ii) boiling, (iii) cooling and mashing with the addition of malt, filtration and (v) fermentation. Storage at 4-6 °C could last the good qualities of boza up to 21 days.

Another popular Kyrgyz traditional fermented drink, called Maksym is a non-alcohol beverage usually made from barley, millet, and corn using both lactic acid bacteria and yeast fermentation. Generally it is characterized as a thick, slightly sour, brownish, colloidal suspension with small particles of cereals. The traditional way of Maksym production is necessary to have main raw material called "Talkan" at the first step. For its preparation cereals need to be cleaned from impurities, washed with water. After drying, cereals are roasted at 170–180°C temperature. The readiness of roasted grain is determined by the color of the grain. Roasted grains are cooled to 30–40°C and peeled. Thus, grains are milled and sieved. For the preparation of beverage Maksym flour is roasted with mutton fat until golden brown color under continuous stirring. Thus, it is boiled in water with the addition of "talkan", then roasted and milled grains around 40-50 minutes. After cooling to 25-30°C, 2% (w/v) of sourdough or a previous Maksym batch is used as a starter culture. Fermentation is usually carried out at 25-30°C for 12-14 hours. Fermented beverage is cooled and stored at 5-7°C (Kodjegulova, 2007). Production method of Maksym shown in below Figure 1.

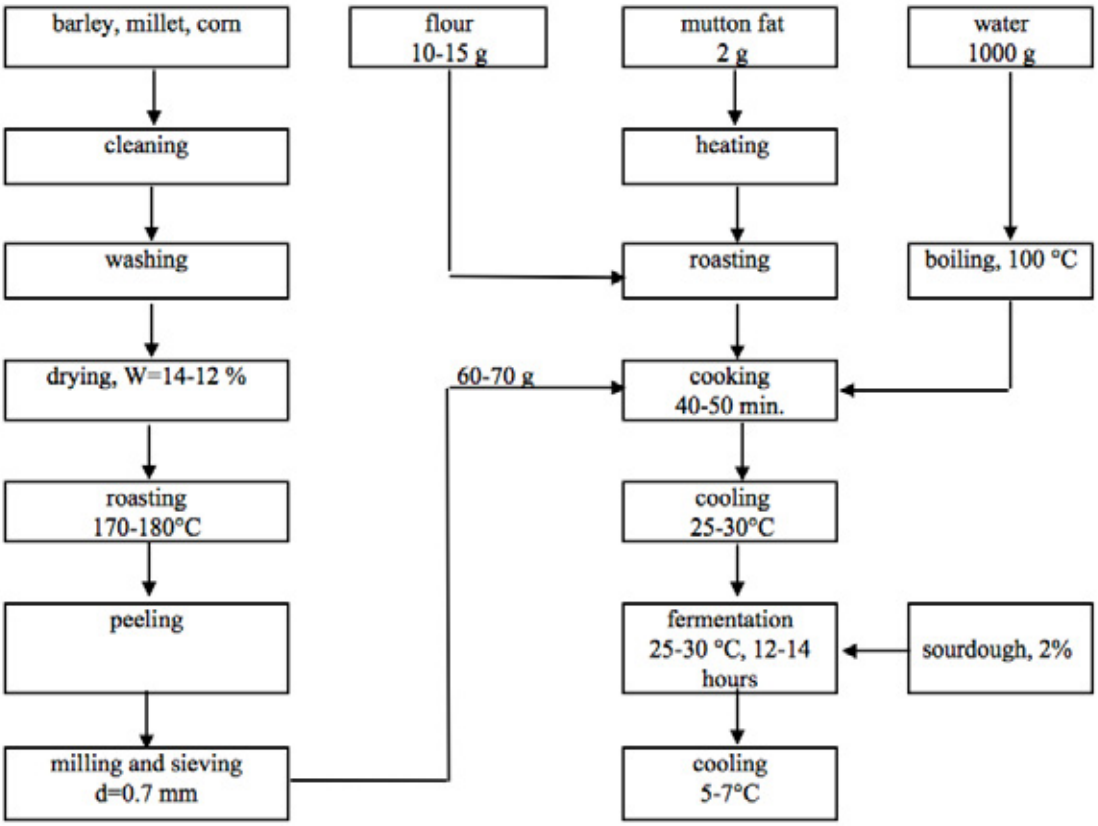



Figure 1. Production method of Maksym.

The rheological characteristics of a food product influence many aspects of the fluid performance during processing (flow behaviour, pumpability, droplet breakup in spray drying, emulsion formation, flow into molds, foamability, etc.) and of the finished product quality (texture, flavour release, stability, appearance) (Malkin,1994; Rao, 1996). Generally, an understanding of rheological properties of food structure has a direct effect on the optimization of processing stages like production, handling, and storage (Taghizadeh and Razavi, 2009). Many studies shown to analyse isolation and identification strains of lactic acid bacteria in Turkish Boza (Evliya, 1990, Hancioglu and Karapinar, 1997), in Bulgarian Boza (Velitchka, 2000; Enikova, 1985). However, studies on the rheological textural and sensory properties of Boza are very scarce. Some studies (Hayta et al., 2001; Genc et al., 2002) have been conducted rheological investigations of Boza, but the change of rheological behavior during storage have not investigated. The rheological parameters of Maksym were not determined before. Accordingly, the main objectives of this study were to investigate rheological behavior of Kyrgyz traditional beverages Bozo and Maksym during storage period.

## MATERIALS AND METHODS

For this experiment, both Bozo and Maksym samples were purchased from Kyrgyz local markets and stored at fridge temperature at 5°C.

During this study of rheological properties of Kyrgyz traditional beverages Bozo and Maksym have been storage period rotational and oscillatory measurements have been performed. Rheological measurements were carried out by using the rheometer MCR 302 (Anton Paar, Graz, Austria) with concentric cylinder geometry CC27. The data, obtained from the rheological measurements were analyzed with the supporting rheometer software Rheoplus 32 Multi 6 version 3.40.

The rotational measurement condition was used to obtain flow behaviors of Kyrgyz traditional beverages Bozo and Maksym by measuring steady shear viscosity (()) and shear stress (τ()) at 5°C. The measurements were performed in three intervals: i) interval 1, the shear rate was progressively increased linearly from 0.1 to 100 $s^{-1}$ over a span of 90 s; ii) interval 2, the shear rate was constant at shear rate 100 $s^{-1}$; iii) interval 3, the shear rate was progressively decreased from 100 to 0.1 $s^{-1}$.

In order to describe the rheological behavior of beverages the flow curves were modeled using equations such as Herschel-Bulkley, Casson, and Ostwald-De-Waele (Malkin,1994; Rao, 1996).

1) Herschel – Bulkley:

$$= {}_0 + k^{\cdot n} \tag{1}$$

where $\tau_0$ is yield stress, $k$ is the consistency index for Herschel-Bulkley model,  is shear rate.

2) Casson:

$$^{0,5} = {}_0^{0,5} + {}_{Ca}^{\cdot 0,5} \tag{2}$$

where $\tau_0$ is yield stress, $\eta_{Ca}$ is the Casson's coefficient of viscosity,  is shear rate.

3) Ostwald–de Waele (or Power-law):

$$= k^{\cdot n} \tag{3}$$

where k is the consistency index (Pa.sn) and n is flow behavior index.

**RESULTS AND DISCUSSION**

In order to obtain an evaluation of the rheological characteristics, flow curves (Figure 2 and 3), relativity shear rate () versus viscosity () were observed.

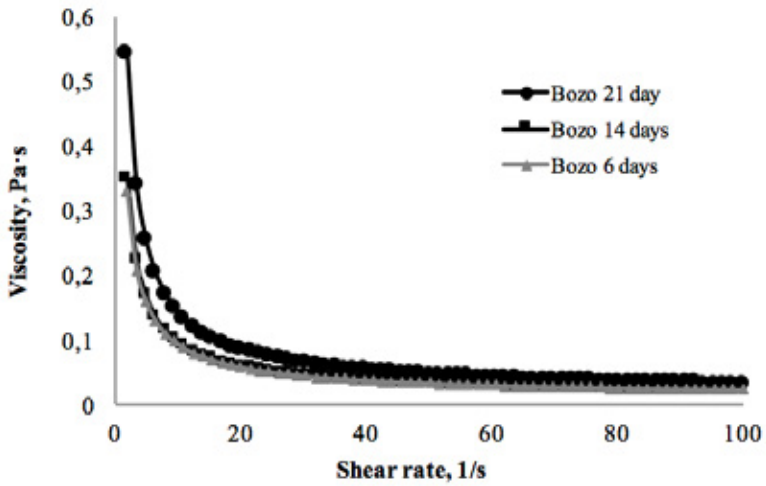



Figure 2. Shear rate dependence of the dynamic viscosity of Bozo at 5°C

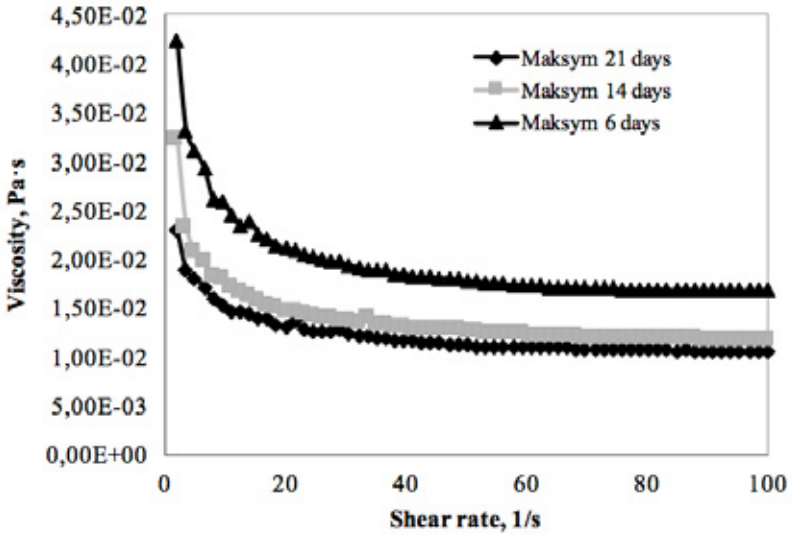



Figure 3. Shear rate dependence of the dynamic viscosity of Maksym at 5°C

The viscosity curves of Bozo were obtained at 5°C during various storage times: 7, 15 and 21 days. Shear rate dependence of dynamic viscosity for Bozo at 5°C shown in Figure 2. It was found that both beverages behaved as a non-Newtonian pseudo-plastic fluid with yield stress values. An initial region in which the apparent viscosity decreased with increase in shear rate, indicating shear-thinning behavior is characterized all the curves. These findings are in agreement with Genc et al. (Genc et al., 200), which showed that the apparent viscosity was decreased with an increase in the rate of shear. The curves were fitted to the Newton, Ostwald De-Wale and Casson models. The results are shown in the Table 1.

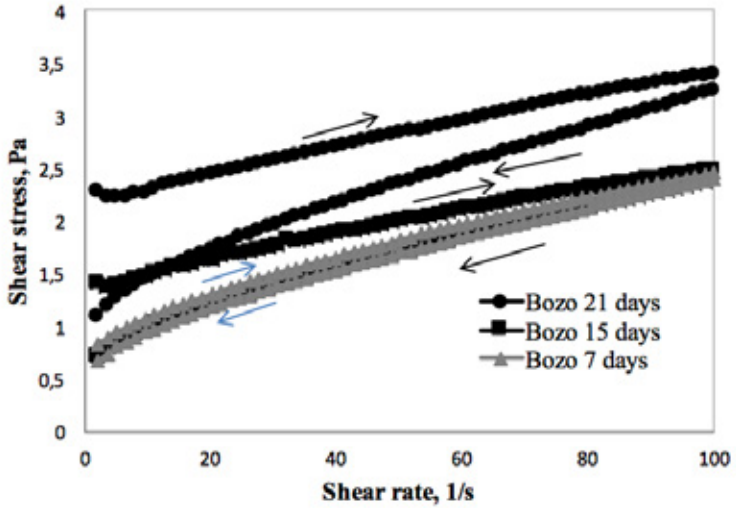



Figure 4. Time-Dependent Shear-Thinning (Thixotropic) Behavior of Bozo at 5°C

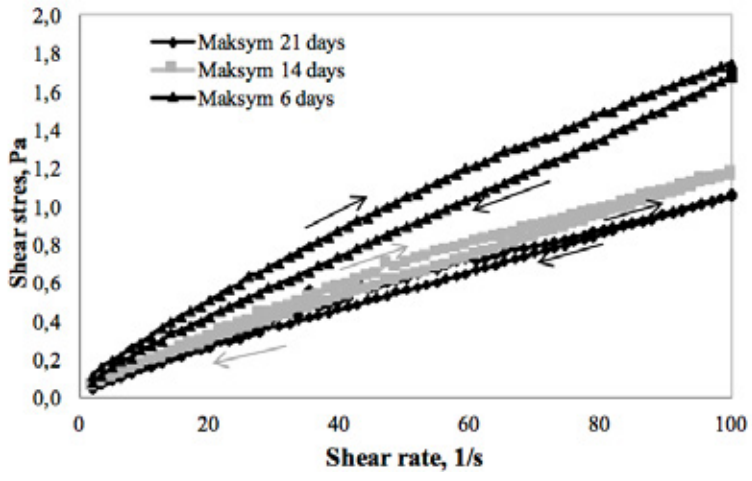



Figure 5. Time-Dependent Shear-Thinning (Thixotropic) Behavior of Maksym at 5°C

As shown in Figure 4, Bozo showed shear-thinning behavior at 5°C, the curve begins at the origin of the shear stress-shear rate plot, but is concave upward. Thus, an increasing shear rate gives a less than proportional increase in shear stress. Shear-thinning behavior occurs as a result of breakdown of structural units in Bozo due to the hydrodynamic forces generated during shear. Data for shear rate versus shear stress were obtained first in ascending order of shear rate and immediately afterward in descending order; the two curves were not overlaped and values of the latter become lower than those of the former, this is so called thixotropic behavior of Bozo (Figure 4). Repetition of the experiments was resulted in an equilibrium hysteresis loop (area). The thixotropic behavior of Bozo at 5°C became stronger with the increasing of storage time.

Thus, three models such as Herschel-Bulkley, Casson, and Ostwald-De-Waele were used to describe flow behavior of the samples. The Casson model was found the most appropriate to fit the flow curves of both experimented beverages with correlation coefficient $R^2$=0.9995–0.9999 for both Bozo and Maksym. The yield stress ($\tau_0$) and the Casson's coefficient of viscosity ($\eta_{Ca}$) values were obtained by fitting the rotational speed versus apparent viscosity data to a Casson model (Eq. 1), are presented in the Table 1.

Table 1. Adjustment of experimental data of beverages Bozo and Maksym to the Casson model n=0.5

| sample | days | $\tau_0$ (Pa) | $\eta_{pl}$ (Pa·s$^n$) | A (Pa/s) | R | $\eta_{eff}$ (mPa·s), $\dot{\gamma}$=50 s$^{-1}$ | SD |
|---|---|---|---|---|---|---|---|
| Bozo | 7 | 0.71 | 0.08 | 11.26 | 0.9999 | 41.28 | 0.01 |
| | 14 | 0.74 | 0.08 | 30.09 | 0.9998 | 40.66 | 0.01 |
| | 24 | 0.93 | 0.09 | 49.50 | 0.9995 | 49.45 | 0.01 |
| Maksym | 7 | 0.13 | 0.12 | 11.30 | 0.9996 | 27.55 | 0.01 |
| | 14 | 0.11 | 0.10 | 3.96 | 0.9999 | 20.42 | 0.01 |
| | 24 | 0.09 | 0.09 | 3.30 | 0.9995 | 18.61 | 0.01 |

*The rheological parameters are reported as mean and standard deviation (SD) of three independent measurements

The results show, effective viscosity of Bozo was increased from 41.28 to 49.45 mPa·s after 21 days of storage. Vice versa Maksym's effective viscosity after 21 days of storage was decreased from 27.55 to 18.61 mPa·s. The yield stress ($\tau_0$) values were increased from 0.71 to 0.93 Pa as the storage time increases. There is no significant difference in the Casson's coefficient of viscosity ($\eta_{Ca}$) of beverage Bozo was observed. The reason for change of the flow behavior is physicochemical reaction (such as gelatinization) in a sample. However, the viscosity of Maksym decreases with increasing storage time, which indicates hydrolysis of polysaccharides, like starch, dextrin etc.

## CONCLUSION

In this study, the technological production method of Bozo and Maksym were compared and the rheological behavior of them during storage period was first time investigated. The study shows that the effective viscosity, the yield stress ($\tau_0$), Casson's coefficient of viscosity ($\eta_{Ca}$) of Bozo were increased after 21 days of storage. Vice versa Maksym's rheological parameters after 21 days of storage were decreased. The reason for the flow behavior change is physicochemical reaction, such as gelatinization in Bozo and hydrolysis of polysaccharides in Maksym.

The next study is planned to determine the activation energy for flow to examine the dependence of the rheological parameters of boza on temperature, and find out relationships between other objective measurements such as pH, acidity and other sensory characteristics (flavour, odour and consistency).

## LITERATURE CITED

Arici, M., & Daglioglu, O. (2002). Boza: a lactic acid fermented cereal beverage as a traditional Turkish food. *Food Reviews International, 18*, 39-48.

Enikova, R.; Kozereva, M.; Ivanova, T.; Yang'ozova, Z. (1985). Sanitary Microbiological Analysis of Boza. *Khranitelnopromishlena Nauka,* 1, 73–81.

Evliya, B. A (1990). Traditional Turkish Fermented Drink Boza, *In proceedings of the International Conference on Biotechnology and Food Science Symposium, Stuttgart, Germany*.

Genc, M., Zorba, M., Ova G. (2002). Determination of rheological properties of boza by using physical and sensory analysis. *Journal of Food Engineering 52,* 95–98.

Hancioglu, O., Karapinar, M. (1997). Microflora of Boza, a Traditional Fermented Turkish Beverage. *Int. J. Food Microbiol., 3*5, 271–274.

Hayta, M., Alpaslan, M.,· Köse, E. (2001). The effect of fermentation on viscosity and protein solubility of Boza,

a traditional cereal-based fermented Turkish beverage. *Eur Food Res Technol 213,* 335–337.

Iskakova, J., Smanalieva, J., Kulmyrzaev, A., Fischer, P., & Methner, F-J. (2016). Comparison of rheological and colorimetric measurements to determine α-amylase activity for malt used for the beverage Bozo. *International Journal of Food Properties, 20* (9), 2060-2070.

Köse, E., & Yücel, U. (2003). Chemical composition of Boza. *Journal of Food Technology, 1* (4), 191-193.

Kodjegulova, D. (2007). *Scientific substantiation of the technology of production of the Kyrgyz national soft drink "maksym" on the basis of cereals (in Russian)*. Dissertation.

Malkin, Y. (1994). *Rheology fundamentals.* ChemTech Publishing.

Rao, M.A. (1996). *Rheology of fluid and semisolid foods. Principles and application.* Aspen Publishers, Inc.

Standards of Turkey, TS 9778, 1992.

Tabilo-Munizaga, G., & Barbosa-Canovas, G. V. (2005). Rheology for the food industry, *Journal of Food Engineering*, 67, 147–156.

Taghizadeh, M. & Razavi, S.M.A. (2009). Modeling Time-Independent Rheological Behavior of Pistachio Butter. *International Journal of Food Properties, 12,* 331–340.

Velitchka, G., Pandiella, S.S., Angelov, A., Roshkova, Z.G., Webb, C. (2000). Microflora Identification of the Bulgarian Cereal-Based Fermented Beverage Boza. *Process Biochem., 36,* 127–130.

Velitchka, G., Pandiella, S.S., Angelov, A., Roshkova, Z.G., Webb, C. (2001). Monitoring the Fermentation of the Traditional Bulfarian Beverage Boza. *Int. J. Food Sci. Technol. 2001, 36,* 129–134.

# О-98 КОЛИЧЕСТВЕННОЕ ОПРЕДЕЛЕНИЕ ОЧЕНЬ ТОКСИЧНЫХ ТЯЖЕЛЫХ МЕТАЛЛОВ - РТУТИ И МЫШЬЯКА В ВОДАХ РЕКИ НАРЫН.

**Кожобаев К.А.[1], Асанов Б.Д.[2], Исматиллаев С.П[3].**

kojkanik@gmail.com, asanovb.kg@gmail.com,ismatillaev@gmailcom.

1. КТУ «Манас», г.Бишкек, Кыргызская Республика;
2. АУЦА, г.Бишкек, Кыргызская Республика;
3. НАН КР, Институт химии и ХТ, г.Бишкек, Кыргызская Республика.

## АННОТАЦИЯ

В статье приведено количественное определение ртути и мышьяка - очень токсичных тяжелых металлов в водах реки Нарын на атомно-абсорбционном спектрометре «AAnalyst 800», краткое описание указанного спектрометра и методики работы на нем. Работа выполнена при участии авторов статьи в рамках проекта NATO SfP 983945 «Оценка трансграничного загрязнения воды в Центральной Азии», окончательный отчет по которому был принят в марте 2016г. В результате определения ртути и мышьяка в десяти различных точках реки Нарын – начиная от ее истоков и кончая точкой на выходе реки Нарын из Кыргызской Республики, установлено изменение их среднего содержания по сезонам года. Так, среднее содержание ртути незначительно снижается от весны (от 0,031 мкг/л) до лета (до 0,025 мкг/л) и резко - к осени (до 0,007 мкг/л). Также было установлено, что концентрация мышьяка в воде незначительно возрастает от весны (от 1,368 мкг/л) до лета (до 1,478 мкг/л) и снижается к осени (до 1,257 мкг/л). В целом концентрация мышьяка и ртути в реке Нарын, при их отдельном рассмотрении, не превышает ПДК для водохозяйственно-питьевого, культурно-бытового и рыбо-хозяйственного назначения.

Ключевые слова: содержание в воде, ртуть, мышьяк, река Нарын.

# QUANTITATIVE DETERMINATION OF VERY TOXIC HEAVY METALS - MERCURY AND ARSENIC IN THE WATERS OF THE NARYNRIVER.

Kojobaev K.A.[1], Asanov B.D. [2] Ismatillaev S.P. [3].

kojkanik@gmail.com, asanovb.kg@gmail.com, ismatillaev@gmailcom.

1. KyrgyzTurkishManasUniversity, Bishkek, Kyrgyz Republic;
2. AUCA, Bishkek, Kyrgyz Republic;
3. NAS of the Kyrgyz Republic, Institute of Chemistry and Chemical Technology, Bishkek, Kyrgyz Republic.

## ANNOTATION

The article gives a quantitative definition of mercury and arsenic - very toxic heavy metals in the waters of the Naryn River on the atomic absorption spectrometer “AAnalyst 800”, a brief description of this spectrometer and the method of operation on it. The work was carried out with the participation of the authors of the article in the framework of the NATO SfP 983945 project “Assessment of transboundary water pollution in Central Asia”, the final report of which was adopted in March 2016.As a result of the determination of mercury and arsenic at

ten different points of the Naryn River - from its sources to the point at the outlet of the Naryn River from the Kyrgyz Republic, a change in their average content over the seasons of the year has been established. Thus, the average mercury content decreases insignificantly from the spring (from 0.031 μg/l) to summer (up to 0.025 μg/l) and sharply to fall (to 0.007 μg/l). It was also found that the arsenic concentration in the water slightly increases from the spring (from 1.368 μg/l) to summer (up to 1.478 μg/l) and decreases by the autumn (up to 1,257 μg/l). In general, the concentration of arsenic and mercury in the Naryn River, when considered separately, does not exceed the maximum allowable concentration limit for drinking, cultural and household water and fishery-economic waters.

**Key words:** water content, mercury, arsenic, Naryn river.

**Введение.** В статье приведены данные по содержанию ртути и мышьяка в водах реки Нарын – по результатам выполнения проекта NATO SfP 983945 «Оценка трансграничного загрязнения воды в Центральной Азии» за 2013 и 2014 годы, в выполнении, которого активное участие принимали и авторы данной статьи. Проект выполнялся с июля 2011 года и окончательный отчет по нему был принят в феврале 2016 года. Наиболее активная и плодотворная фаза проведения полевых и лабораторных исследований, по результатам которых были получены наиболее надежные данные, пришелся на лето и осень 2013 и на весну, лето и осень 2014 года, поэтому в статье рассматриваются данные за эти периоды. В качестве объекта рассмотрения был выбраны элементы ртуть и мышьяк – одни из самых токсичных элементов, в последние годы нередко встречающиеся в природных, в том числе и питьевых водах.

**Методика исследований и описание атомно-абсорбционного спектрометра AAnalyst 800 и системы проточно-инжекционного анализаFIAS 100.**

Отбор проб воды для анализа на атомно-абсорбционном спектрометре содержания ртути и мышьяка в воде производился на 11 точках по реке Нарын (рис.1) - с марта по ноябрь месяцы. В зимние месяцы отбор проб не производился.

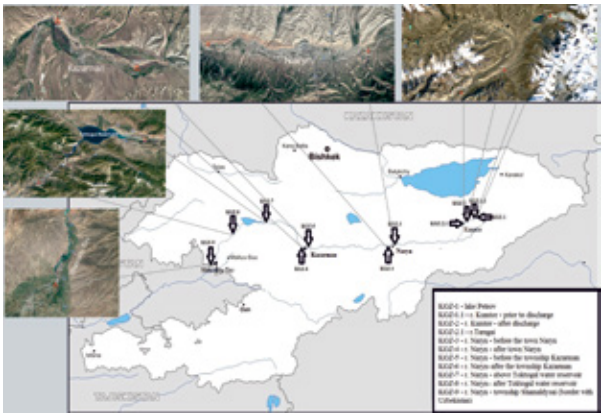


*Рис.1. Карта точек отбора проб воды по реке Нарын*

- Первой точкой отбора проб воды было озеро Пертова;
- вторая точка на реке Кумтор - до сброса в нее воды с хвостохранилища рудника «Кумтор»;
- третья точка на реке Кумтор - после сброса воды с хвостохранилища;
- четвертая точка на реке Тарагай, после смешения с ней вод реки Кумтор;
- пятая и шестая точки на реке Нарын - до и после города Нарын;

- седьмая и восьмая точки на реке Нарын – до и после села Казарман;
- девятая и десятая точки на реке Нарын – до и после Токтогульского водохранилища;
- одиннадцатая точка на реке Нарын на границе с Узбекистаном.

Пробы воды фильтровались на месте пробоотбора при помощи мембранного фильтра, затем консервировались азотной кислотой. В дальнейшем в лаборатории концентрация элементов в воде, включая мышьяк и ртуть, определялась с использованием системы проточно-инжекционного анализа FIAS 100 и спектрометра AAnalyst 800. Спектрометр «AAnalyst 800», один из самых современных и точных приборов подобного рода, является двухлучевым, собранным по схеме Литтрова с автоматическим выбором длины волны и ее сканированием. Спектральный диапазон прибора составляет 190–870 нм, номинальная линейная дисперсия – 1,6 нм/мм.В качестве детектора оптического излучения в приборе применен широкодиапазонный сегментированный полупроводниковый детектор, интегрированный с малошумящим массивом зарядовых усилителей.

Системы FIAS включают один или два независимо управляемых перистальтических насоса для потоков носителя, образца и реагентов, емкость для химических реакций, сепаратор газ/жидкость, кварцевую ячейку (для пламенной АА). Проба прокачивается насосом через дозировочную петлю и подается в канал, который постоянно промывается раствором-носителем (обычно, разбавленный раствор кислоты). Для получения летучих соединений гидридобразующих элементов или выделения паров ртути используются растворы восстановителей NaBH4 или SnCl2, которые смешиваются с пробой в емкости, а в сепараторе происходит отделение газообразного гидрида от матрицы пробы. Затем потоком аргона анализируемая часть пробы подается в аналитический блок.

Методика основана на том, что когда находящийся в невозбужденном (основном) состоянии поглощает энергию фотона определенной (характеристической) энергии и переходит в возбужденное состояние. Количество энергии характеристического излучения, поглощенное веществом, увеличивается вместе с ростом числа атомов определяемого элемента, находящихся на пути светового пучка. Зависимость между количеством поглощенного излучения и концентрациями элемента в стандартах с известной концентрацией может быть использована для определения концентраций в неизвестных образцах путем измерения абсорбируемого ими излучения. Для выполнения атомно- абсорбционного анализа требуется первичныйисточник характеристического излучения, источник атомов, спектрометр- монохроматор, выделяющий свет определенной длины волны, детектор, точно регистрирующий излучение, электроника для обработки данных и терминал или система подготовки отчетов для представления результатов. В качестве характеристического источника применяется высокочувствительная однолучевая оптическая схема с ртутной лампой низкого давления. Для каждого элемента используется отдельная лампа [1].

**Краткая эколого-геохимическая характеристика мышьяка и ртути.**

**Мышьяк.** В земной коре мышьяка немного — около $2{,}0*10^{-4}$% (то есть 2 мг/кг), примерно столько же, сколько германия, олова, молибдена, вольфрама или брома. Наиболее распространены минералы As(lll) —в виде сульфидов и As(V) — в виде арсенатов. Встречается мышьяк и в самородном состоянии. Добывают его в основном из арсенопирита FeAsS. В живом веществе мышьяка в среднем содержится $6{,}0*10^{-7}$%, то есть 6 мкг/кг. У человека мышьяк содержится в мозговой ткани, в мышцах, накапливается он и в волосах. Распределение мышьяка по разным регионам земного шара во многом определяется летучестью его соединений при высокой температуре, а также процессами сорбции и десорбции в почвах и осадочных породах. Мышьяк легко мигрирует, чему способствует достаточно высокая растворимость некоторых его соединений в воде. Во влажном климате мышьяк вымывается из почвы и уносится грунтовыми водами, а затем — реками. Среднее содержание мышьяка в реках и в других поверхностных водах — порядка 1 - 10 мкг/л. Например, в поверхностных водах Тибетского плато содержание мышьяка менялось от 1 и до 14 мкг/л, а в бассейнах тропических рек с преобладанием муссонов в юго-западной

Индии – в среднем 0,4 мкг/л [2;3]. В воде морей и океанов - всего около 1 мкг/л. Это объясняется сравнительно быстрым осаждением его соединений из воды с накоплением в донных отложениях, например в железомарганцевых конкрециях. Однако в области залегания мышьяковых руд, а также в вулканических районах в почве может содержаться очень много мышьяка - до 1%. В таких местах гибнет растительность, а животные болеют. Это характерно для степей и пустынь, где мышьяк не вымывается из почвы. В глинистых породах вчетверо больше мышьяка, чем в среднем в породах. Заметные количества мышьяка содержатся в некоторых минеральных водах.

Химики выяснили, что мышьяк в природных водах может находиться в разных формах. Это нужно учитывать при его анализе, изучении способов миграции, а также токсичности. Соединения трехвалентного мышьяка в 25-60 раз токсичнее, чем пятивалентного, так как они способны связываться с тиольными (сульфогидрильными) группами -SH цистеина и метионина в составе белков-ферментов (именно этим объясняется ядовитость мышьяка). Было показано, что мышьяк может выноситься из почвы не только водой, но и ветром! Для этого он должен сначала превратиться в летучие мышьякорганические соединения. Такое превращение происходит в результате так называемого биометилирования—присоединения метильной группы с образованием связи C-As; этот ферментативный процесс (он хорошо известен для соединений ртути) происходит при участии кофермента метилкобаламина — метилированного производного витамина B12 (он есть и в организме человека). Биометилирование мышьяка происходит как в пресной, так и в морской воде и приводит к образованию мышьякорганических соединений — метиларсоновой кислоты CH3A-sO(OH)2, диметиларсиновой (диметилмышьяковой) кислоты (CH3)2As(0)OH, триметил-арсина (CH3)3As и его оксида (CH3)3As0, которые также встречаются в природе. С помощью 4C-меченого метилкобаламина и 74Aэмеченого гидроарсената натрия Na2HAs04 было показано, что один из штаммов метанобактерий восстанавливает и метилирует эту соль до летучего диметиларсина. Токсичность различных соединений мышьяка снижается в ряду: арсины –арсениты - арсеноксиды- арсенаты - соединения As(V)-арсониевые соединения - металлический мышьяк. Проще всего определить в воде суммарное содержание мышьяка. Это можно сделать с помощью различных весьма чувствительных методов: пламенной атомно-абсорбционной спектрометрии, атомно-эмиссионной спектрометрии, масс-спектрометрии, атомно-флуоресцентной спектрометрии, нейтронного активационного анализа. Многие мышьяковые соединения анализируют так называемым гидридным методом - селективным восстановлением анализируемого вещества в летучий арсин. Неорганические арсениты восстанавливаются до AsH при pH 5-7, а при pH < 1 восстанавливаются как арсениты, так и арсенаты. В этих же условиях метиларсоновая ($CH_3AsO_3H_2$) и диметиларсиновая кислоты восстанавливаются до метил- и диметиларсина. Летучие арсины можно вымораживать в ампулу, охлаждаемую жидким азотом и медленно нагревая ее, добиться раздельного испарения разных арсинов. [4]

Ртуть**.** Ртуть – уникальный химический элемент, содержащийся во всех сферах окружающей среды: атмо-, гидро-, лито-, а также биосфере. Распространение Hg происходит в основном с атмосферным и водным переносом, а также по трофическим цепочкам. Ртуть характеризуется высоким коэффициентом водной миграции, что относит ее к гидрофильным элементам. Основной путь попадания ртути в водные экосистемы - сбросы сточных вод в виде гомогенных и коллоидных растворов и взвесей. Ртуть и ее органические и неорганические соединения – чрезвычайно токсичны и относятся к I классу опасности, и поэтому очень строго нормируются во всех компонентах окружающей среды. Важной и основной особенностью Hg является рассеянная форма ее нахождения в природе, повышенная миграционная способность, высокая биодоступность, а также широкий спектр негативного влияния на живые организмы, что является ключевыми моментами интереса экологов при изучении данного элемента в окружающей среде [5]

Ртуть — относительно редкий элемент в земной коре со средней концентрацией порядка 0,5-0,8 г/т. Однако ввиду того, что ртуть слабо связывается химически с наиболее распространёнными в земной коре элементами, ртутные руды могут быть очень концентрированными по сравнению с обычными породами. Наиболее богатые ртутью руды содержат до 2,5 % ртути. Основная форма нахождения ртути в природе — рассеянная, и только 0,02 % её заключено в месторождениях. Содержание ртути в различных типах изверженных пород близки между собой (около 100 мг/т). Из осадочных пород максимальные концентрации ртути установлены в глинистых сланцах (до 200 мг/т). В водах Мирового океана содержание

ртути - 0,1 мкг/л (порядка 0,1 мг/т). В поверхностных водах ртуть обычно тоже встречается в небольших количествах, например, по исследованиям Мюллера и др. [6] в реке Янцы пиковое содержание составило 0,03 мг/л, а среднее – 0,011 мг/л.

Важнейшей геохимической особенностью ртути является то, что среди других халькофильных элементов она обладает самым высоким потенциалом ионизации. Это определяет такие свойства ртути, как способность восстанавливаться до атомарной формы (самородной ртути), значительную химическую стойкость к кислороду и кислотам.

Ртуть присутствует в большинстве сульфидных минералов. Особенно высокие её содержания (до тысячных и сотых долей процента) устанавливаются в блёклых рудах, антимонитах, сфалеритах и реальгарах. Близость ионных радиусов двухвалентной ртути и кальция, одновалентной ртути и бария определяет их изоморфизм во флюоритах и баритах. В киновари и метациннабарите сера иногда замещается селеном или теллуром; содержание селена часто составляет сотые и десятые доли процента. Известны крайне редкие селениды ртути - тиманит (HgSe) и онофрит (смесь тиманита и сфалерита). Ртуть является одним из наиболее чувствительных индикаторов скрытого оруденения не только ртутных, но и различных сульфидных месторождений, поэтому ореолы ртути обычно выявляются над всеми скрытыми сульфидными залежами и вдоль дорудных разрывных нарушений. Эта особенность, а также незначительное содержание ртути в породах, объясняются высокой упругостью паров ртути, возрастающей с увеличением температуры и определяющей высокую миграцию этого элемента в газовой фазе.

В поверхностных условиях киноварь и металлическая ртуть не растворимы в воде, но при их наличии ($Fe_2(SO_4)3$, озон, пероксид водорода) растворимость этих минералов достигает десятков мг/л. Особенно хорошо растворяется ртуть в сульфидах щелочных металлов с образованием, например, комплекса HgS•nNa2S. Ртуть легко сорбируется глинами, гидроксидами железа и марганца, глинистыми сланцами и углями [7].

В природе известно около 20 минералов ртути, но главное промышленное значение имеет киноварь HgS (86,2% Hg). В редких случаях предметом добычи является самородная ртуть, метациннабарит HgS и блёклая руда — шватцит (до 17% Hg). На единственном месторождении Гуитцуко (Мексика) главным рудным минералом является ливингстонит $HgSb_4S_7$. В зоне окисления ртутных месторождений образуются вторичные минералы ртути. К ним относятся, прежде всего, самородная ртуть, реже метациннабарит, отличающиеся от таких же первичных минералов большей чистотой состава. Относительно распространена каломель $Hg_2Cl_2$. На месторождении Терлингуа (Техас) распространены и другие гипергенные галоидные соединения — терлингуаит $Hg_2ClO$, эглестонит $Hg_4Cl$.

**Результаты определения содержания ртути и мышьяка в водах реки Нарын.**

Для сокращения объема статьи, облегчения анализа, а также ввиду замеченной разницы в содержаниях мышьяка и ртути по сезонам года, данные были осреднены по сезонам года. Средние значения содержаний мышьяка и ртути в воде реки Нарын по временам года занесены в таблицу 1.

Таблица 1. Среднее содержание мышьяка и ртути за весенний, летний и осенний периоды 2013-2014 гг.

| Пункты отбора проб воды для анализа на содержание ртути и мышьяка в воде | | Средние значения за летний период 2013 года, мкг/л | | Средние значения за осенний период 2013 года, мкг/л | | Средние значения за весенний период 2014 года, мкг/л | | Средние значения за летний период 2014 года, мкг/л | | Средние значения за осенний период 2014 года, мкг/л | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **As** | **Hg** | **As** | **Hg** | **As** | **Hg** | **As** | **Hg** | **As** | **Hg** |
| 1 | озеро Пертова; | 1,455 | 0,038 | 1,467 | 0,010 | 1,443 | 0,032 | 1,588 | 0,035 | 1,379 | 0,010 |
| 2 | река Кумтор - до сброса в нее воды с хвостохранилища рудника «Кумтор»; | 1,705 | 0,034 | 1,700 | 0,009 | 1,553 | 0,034 | 1,863 | 0,031 | 1,699 | 0,009 |
| 3 | река Кумтор - после сброса воды с хвостохранилища; | 1,521 | 0,031 | 1,476 | 0,005 | 1,358 | 0,029 | 1,593 | 0,020 | 1,319 | 0,004 |
| 4 | река Тарагай, после смешения с ней реки Кумтор; | 1,456 | 0,034 | 1,435 | 0,007 | 1,446 | 0,034 | 1,437 | 0,029 | 1,250 | 0,007 |
| 5 | река Нарын - до города Нарын | 1,279 | 0,046 | 1,149 | 0,010 | 1,186 | 0,079 | 1,206 | 0,043 | 1,014 | 0,010 |
| 6 | река Нарын - после города Нарын; | 1,318 | 0,044 | 1,210 | 0,011 | 1,149 | 0,023 | 1,255 | 0,022 | 1,001 | 0,011 |
| 7 | река Нарын - до села Казарман | 1,309 | 0,030 | 1,213 | 0,005 | 1,204 | 0,024 | 1,286 | 0,019 | 1,045 | 0,005 |
| 8 | река Нарын - после села Казарман; | 1,464 | 0,035 | 1,418 | 0,008 | 1,437 | 0,024 | 1,529 | 0,020 | 1,249 | 0,009 |
| 9 | река Нарын - до Токтогульского водохранилища; | 1,441 | 0,029 | 1,404 | 0,004 | 1,438 | 0,027 | 1,495 | 0,018 | 1,279 | 0,004 |
| 10 | река Нарын - после Токтогульского водохранилища; | 1,463 | 0,032 | 1,577 | 0,009 | 1,393 | 0,029 | 1,613 | 0,019 | 1,445 | 0,009 |
| 11 | река Нарын - на границе с Узбекистаном. | 1,400 | 0,024 | 1,338 | 0,003 | 1,362 | 0,029 | 1,422 | 0,019 | 1,189 | 0,003 |
| Значения максимального среднего содержания по сезонам года | | 1,705 | 0,046 | 1,700 | 0,010 | 1,553 | 0,079 | 1,863 | 0,043 | 1,699 | 0,011 |
| Значения минимального среднего содержания по сезонам года | | 1,279 | 0,024 | 1,149 | 0,003 | 1,149 | 0,023 | 1,206 | 0,018 | 1,001 | 0,003 |
| Значения среднего содержания по сезонам года | | 1,437 | 0,0346 | 1,399 | 0,007 | 1,360 | 0,034 | 1,481 | 0,025 | 1,261 | 0,008 |

Из таблицы видно, что максимальное среднее содержание мышьяка в воде в летний период немного выше по сравнению с весенним и осенним периодами. Средние значения мышьяка по точкам отбора проб, тоже не сильно колеблются, так разница между максимальным значением и минимальным значением в летний период 2013 года всего в 1,3 раза, а в летний период 2014 года максимальное значение

больше минимального значения в 1,5 раза. Влияния на концентрации этих двух элементов сброса вод с хвостохранилищ крупнейшего разрабатываемого золоторудного месторождения золота «Кумтор» не заметно, наоборот можно заметить небольшое снижение концентрации после сброса в нее воды с хвостохранилища рудника «Кумтор», которое можно связать с разбавлением вод реки Кумтор.

Из таблицы 1 также можем видеть, что содержание ртути в воде реки Нарын резко снижается к осени, как в 2013, так и в 2014 гг. Содержание ртути весеннего периода 2014 года в более чем 4 раза больше, чем в осенний период.

Тем не менее, самый высокий осенний средний показатель содержания ртути (0,079 мкг/л) и мышьяка (1,863 мкг/л) в реке Нарын не превышает ПДК для питьевых вод централизованного водоснабжения [8], и ПДК для вод рыбо-хозяйственного и культурно-бытового назначения [9]. Разница данных содержания металлов в воде р. Нарын по сезонам года, видимо связанная с выносом элементов при таянии снегов, является новым и интересным научным фактом, требующий дальнейшего изучения и анализа.

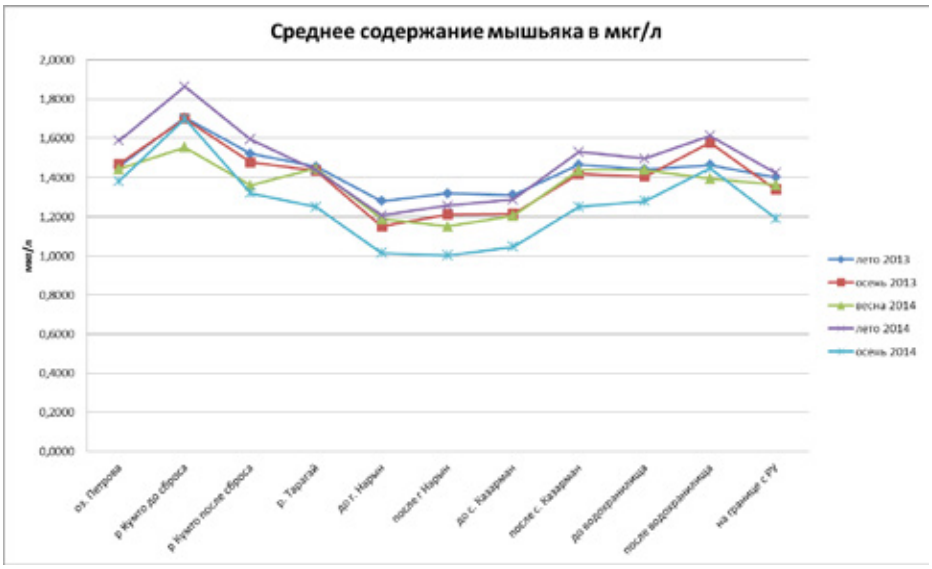



*Рисунок 2. Содержание мышьяка в мкг/л в весенний, летний, осенний периоды 2013-2014 гг..*

Из рисунка 2 видно, что содержание мышьяка вниз по течению реки снижается от начала до города Нарын, затем обратно повышается лишь очень незначительно и монотонно. Хорошо видно, что изменения содержания по точкам отбора проб изменяются по временам года почти с одинаковой разницей.

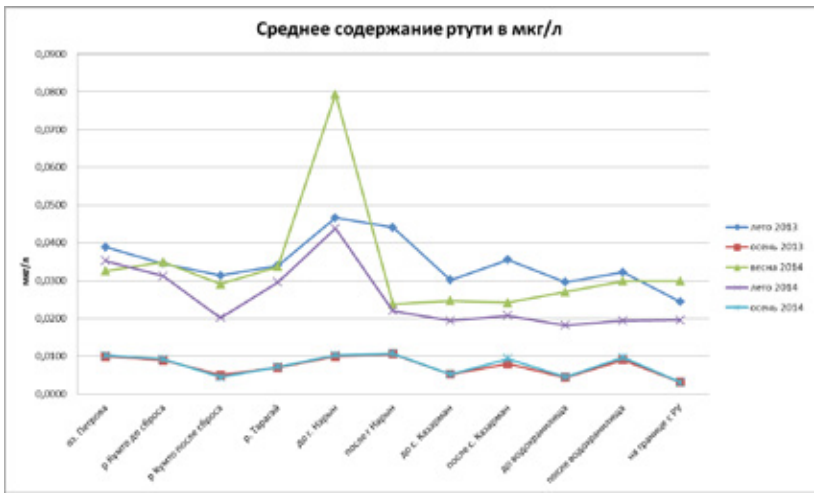



*Рисунок 2. Содержание ртути в мкг/л в весенний, летний, осенний периоды 2013-2014 гг..*

Из рисунка 3 видно, что содержание ртути в отличие от мышьяка вниз по течению реки повышается незначительно до города Нарын, затем обратно снижается лишь очень незначительно. Хорошо видно, что среднее содержание ртути в летний период 2014 года незначительно выше того же периода 2013 года, а осенние значения за эти два года почти одинаковы. Из чего можем сделать вывод, что содержание ртути в воде мало меняется с течением времени.

**Заключение.** Анализ полученных данных по определению содержания ртути и мышьяка в водах реки Нарын, от ее истоков до границы Кыргызстана с Узбекистаном, на чувствительном современном спектрометре с системой проточно-инжекционного анализа FIAS 100 позволяет сделать следующие выводы:

1. Содержание ртути и мышьяка вниз по течению реки Нарын меняется лишь незначительно и незакономерно.

2. Среднее содержания ртути и мышьяка в водах реки Нарын особо не отличается от их содержания в других реках мира, незначительно меняется по сезонам года и заметно минимальное содержание отмечается в осеннее время.

3. По данному исследованию деятельность крупного золоторудного месторождения «Кумтор» не оказывает влияния на содержание в водах р. Нарын ртути и мышьяка.

4. В целом содержания ртути и мышьяка в водах реки Нарын, не превышают ПДК для вод питьевого, рыбо-хозяйственного и культурно-бытового назначения.

**Использованные источники информации**


1. Бестереков У.Б., Гончаров В.В. Определение концентрации тяжелых металлов в воде методом атомно-абсорбционного анализа с использованием спектрометра AAnalyst 800. Методическая инструкция. Шымкент-2012.
2. Zhangdong Jin, Chen-Feng You, Tsai-Luen Yu, Bo-Shian Wang. Sources and flux of trace elements in river water collected from the Lake Qinghai catchment, NE Tibetan Plateau.// Applied Geochemistry 25 (2010) 1536–1546
3. G. P. Gurumurthy & K. Balakrishna & M. Tripti & Stéphane Audry & Jean Riotte & J. J. Braun & H. N. Udaya Shankar. Geochemical behaviour of dissolved trace elements in a monsoon-dominated tropical river basin, Southwestern Indiaю// Environ Sci Pollut Res (2014) 21:5098–5120
4. Леенсон И.А.. Вода, мышьяк и последствия.//«Химия и Жизнь», Декабрь 2004 N 12. - С. 40-43.
5. Ермаков В.В. Биогенная миграция и детоксикация ртути // Материала международного симпозиума «Ртуть в биосфере: эколого-геохимические аспекты». М.: ГЕОХИ РАН, 2010. с. 5–14.
6. Beat Müller, Michael Berg, Zhi Ping Yao, Xian Feng Zhang, Ding Wang, August Pfluger. How polluted is the Yangtze river? Water quality downstream from the Three Gorges Dam.// SCIENCE OF THE TOTAL ENVIRONMENT. 402 (2008) 232-247.
7. Вольфсон Ф. И., Дружинин А. В. Главнейшие типы рудных месторождений. М., «Недра», 1975, 392 с
8. СанПиН 2.1.4.002-03. Питьевая вода. Гигиенические требования к качеству воды централизованных систем питьевого водоснабжения. Контроль качества. Санитарно-эпидемиологические правила и нормативы. Минздрав Кыргызской Республики. Бишкек, 2004.
9. СанПиН 2.1.5.980-00 и ГН 2.1.5.1315-03. Предельно-допустимые концентрации веществ в водных объектах рыбо-хозяйственного и культурно-бытового назначения. Москва, 2010.

# О-100 ВЛИЯНИЕ ОТХОДОВ АК-ТЮЗСКОГО ГОРНО-ОБОГАТИТЕЛЬНОГО КОМБИНАТА НА ПОЧВЕННУЮ МИКРОФЛОРУ

Тотубаева Н.[1], Кожобаев К.[2], Абдыкадырова Рахат[3], **Токпаева Жийде[4], Туратова Толгонай[5], Садыр уулу Эрулан[6]**

[1,2,3,4,5,6]- **Кыргызско-Турецкий университет Манас**

**Ключевые слова**: Почвенная микрофлора, тяжелые металлы, торий, хвостохранилища.

**Введение:**

**Ак-Тюз** находится в 145 км от столицы Кыргызстана города Бишкек на высоте 2,300 м над уровнем моря [4]. На территории п.г.т. Ак-Тюз Кеминского района находятся 3 законсервированных и одно действующее хвостохранилище №4.Основными отходами (хвостами) при добыче и переработке полиметаллических и редкоземельных руд являются радиоактивный торий, соли тяжелых металов кадмия, молибдена, свинца, цинка, бериллия, а также оксиды гафния и циркония [8]. Химический состав отходов: Th – 0,038%, Pb - до 0,12%, Zn - до 0,07%, $Th_2O_3$ – (0,11-0,15)%, $Y_2O_3$ - до 0,02%, $ZrO_2$ – (0,2-0,5)%, Mo - до 0,007%, F - до 0,1%, Cu - до 0,015% [14]. О**ценка влияния тяжелых металлов и радиоактивных элементов на окружающую среду в частности на почву, являются одним из самых важных и актуальных вопросов охраны окружающей среды и безопасности человечества.** Изучением влияния Ак-Тюзского горно-обогатительного комбината на окружающую среду занимались многие ведущие ученые Кыргызстана и зарубежья [4,7,8,9]. Согласно их исследований, деятельность Ак-Тюзского ГОК, его отходов сказывается на здоровье жителей Кичи-Кеминской долины. По данным НИИ онкологии и радиологии КР, показатели заболеваемости новообразованиями в Кеминском районе в 2005-2010гг. составляют порядка 145 - на 100 тыс. человек населения, тогда как эти показатели для соседнего Иссык-Атинского района составляют порядка 105, а в целом по стране – около 90 [4].

Почва является сложной полидисперсной системой, которая выполняет важные экологические функции. Практически нет почвенного процесса, в котором микрофлора не принимала бы участия. Под влиянием антропогенных воздействий в почве происходят различные изменения воздушного, водного, питательного режимов. Почвенная микрофлора по разному реагирует на различные изменения в почве и может использоваться в качестве индикаторов экологического состояния почв.

В связи с вышеуказанными целью настоящей работы было проведение оценки влияния деятельности Ак-Тюзского горно-обогатительного комбината на почвенную микрофлору.

**Материалы и методы исследований.**

Объектом исследования явились почвенные образцы отобранные в хвостохранилищах Ак-Тюзского горно-обогатительного комбината расположенного в Кеминском районе Чуйской области (рисунок 1).

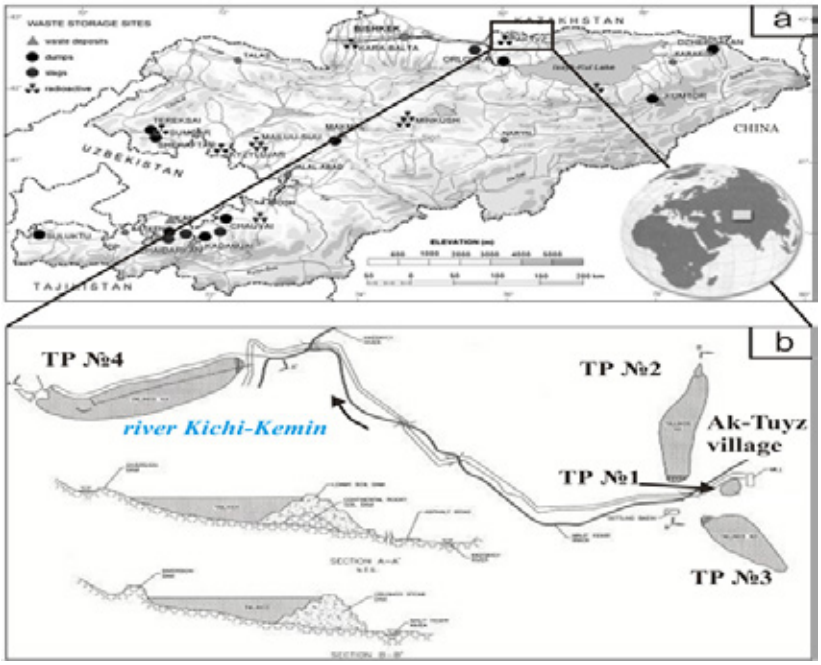



Рис. 1. Карта хвостохранилищ на территории Кыргызстана: a) местоположение посёлка Ак-Тюз; b) Ак-Тюзские хвостохранилища №1-4 в долине реки Кичи-Кемин.

Образцы почв были отобраны общепринятыми методами отбора почвенных проб [2] непосредственно в четырех хвостохранилищах расположенных на территории комбината, весной и осенью 2010-2014гг. и весной 2017г. В качестве контроля была отобрана проба на расстоянии 10 км в селе Кичи-Кемин.

Биоиндикационные исследования образцов почв проводились на сообществах микроскопических грибов, бактерий и актиномицетов, представляющих важнейший компонент почвенной биоты. Исследовались общие и структурные индексы (общая численность, наличие меланизированных темно-окрашенных видов). Численность микроорганизмов определяли общепринятым методом разведения с последующим высевом на питательные среды: бактерии, усваивающие органические формы азота - на мясо-пептонном агаре с гидролизатом кильки (МПА), микроорганизмы, усваивающие минеральный азот, в т.ч. актиномицеты - на крахмалло-аммиачном агаре (КАА), микромицеты - на среде Чапека и на картофельном агаре (pH=5,6).

Навески образцов (1 г) переносили в колбы с 100 мл стерильной воды и суспензии обрабатывали на ультразвуковом диспергаторе. Посев проводили в 5-кратной повторности из 2-3-х экспериментально подбираемых разведений. Посевы инкубировали при 25-27 °С в течение 2-3 недель. Подсчитывали общее число колоний, выросших на данной среде, и определяли их общую численность в колониеобразующих единицах (КОЕ) на 1 грамм. Кроме того, проводили дифференцированный учет колоний по макроморфологическим типам.

При установлении видового состава бактерий и актиномицетов, пользовались «Определителем бактерий и актиномицетов» Н. Красильникова [10], кратким определителем бактерий Берги [11], «Определителем актиномицетов» Г.Гаузе [5], для определения микромицетов определителем Н.Пидопличко [15].

Статистическая обработка прводилась с помощью пакета компьютерных программ SPSS.

Результаты исследования и их обсуждение

Результаты исследования микробиологического разнообразия в районе хвостохранилищ Ак-Тюзского ГОК показало, что тяжелые металлы оказывают ингибирующее действие на рост и развитие почвенной микробиоты, на диаграмме 5,6,7 показано изменение КОЕ по сравнению с контрольным вариантом и их вариация в разных хвостохранилищах. В хвостохранилищах №2 и №4 отмечается увеличение числа почвенных стрептомицетов и почвенных бактерий по сравнению с контрольным вариантом, но это не биологическое разнообразие видов, а доминантное увеличение резистентных форм.

Так, представители актиномицетов рода Streptomyces были представлены преимущественно секциями Al-

bus и Cinereus (диаграмма 8), что говорит об их устойчивости к воздействию тяжелых металлов, что было отмечено и другими исследователями [17]. На участке хвостохранилища №4 нами были выделены помимо представителей секции Albus и Cinereus представители секции HelvoloFlavus и Azureus, которые отсутствовали на других участках.

Микромицетное разнообразие было представленовидами Aspergillus, PenicilliumTrihoderma, Fuzarium и Mucor.

На участке хвостохранилища №1 было отмечено наименьшее разноообразие микроскопических грибов. Наиболее устойчивыми к высокому уровню загрязнения тяжелыми металлами в почве были виды Aspergillus и Penicillium (диаграмма 9), что также было отмечено другими исследователями [1, 12]. На исследованной территории отмечалось преобладание темноокрашенных грибов, что также подтверждает об резистентности меланиноокрашенных видов грибов к повышенной радиации и тяжелым металлам [6].

Диаграмма 5

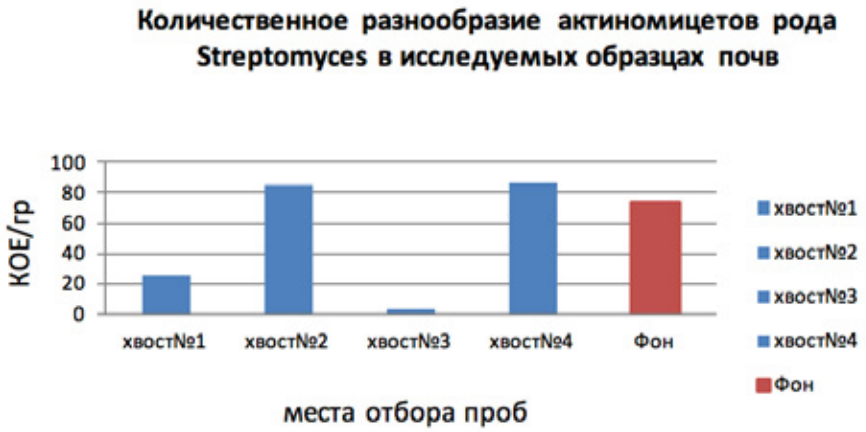



Диаграмма 6

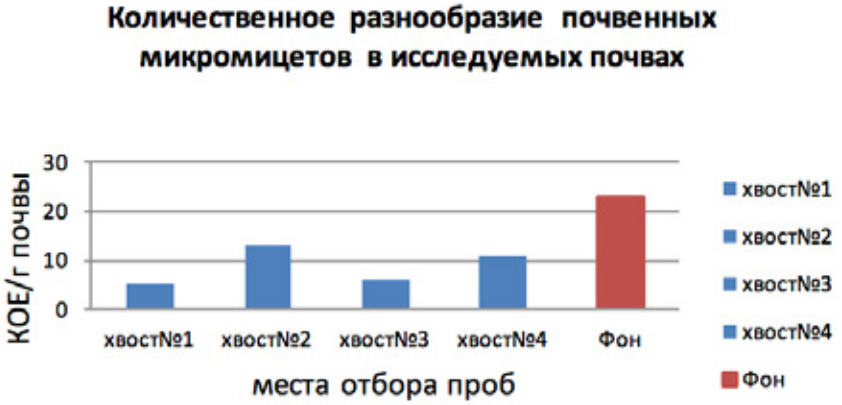



Диаграмма 7

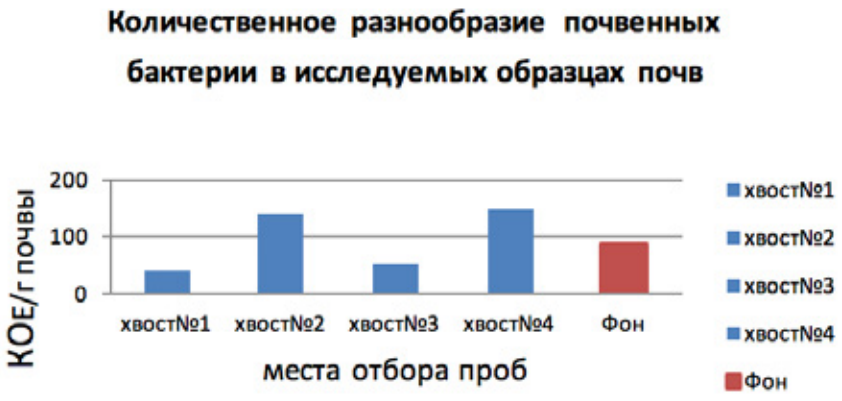
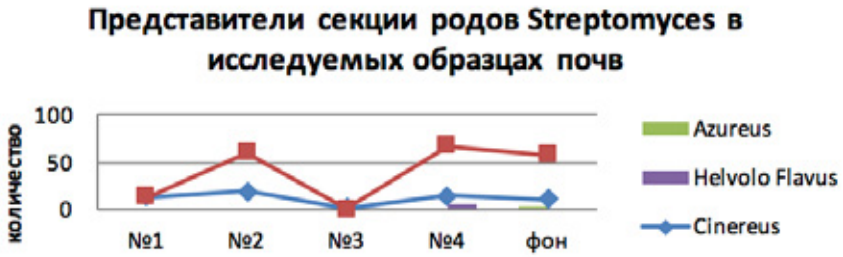
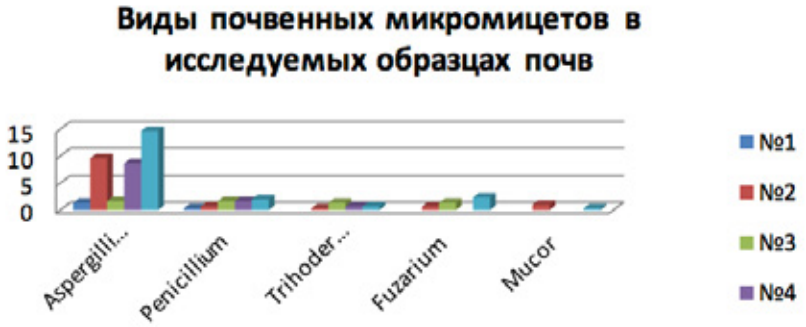


Диаграмма 8




Диаграма 9




Таким образом проведенные исследования микробиологического разнообразия техногенной экосистемы Ак-Тюзского ГОК показало, что почвенная микробиота исследуемого объекта представлена в основом видами устойчивыми к воздействию тяжелых металлов и радиоактивного тория и отмечалось увеличением КОЕ бактерий и актиномицетов рода Streptomyces, при минимальном видовом разнообразии, что является индикатором деградирующей экосистемы. Экосистема тем устойчивее к воздействию техногенных факторов, чем вышее ее видовое разнообразие, что по видимому относится и к почвенной микробиоте.

**Список использованной литературы**


1. Isolation and Selection of a Highly Tolerant Microbial Consortium with Potential for PAH Biodegradation from Heavy Crude Oil-Contaminated Soils //Water, Air, & Soil Pollution, 02/2014
2. Romero-Freire, A., García, I., Sim on, M., Martín, F., 2016. Long-term toxicity assessment of soils in a recovered area affected by mining spill. Environ. Pollut.208, 553e561
3. Арустамова Э.Л. Безопасность жизнедеятельности. 2002
4. Боконбаев К.Ж., Грошев А.К., Детыненко Л.А. и др. Техногенная геохимия Кичи-Кеминской долины. Журнал «Геохимия» АН СССР. М., 1991, №7, с.1004-1013.
5. Гаузе Г.Ф., Преображенская Т.П. и др. Определитель актиномицетов. Роды Streptomyces/ М: Наука, 1983г.
6. Жданова Н. Н.,Васильевская А. И., Артышкова Л. В., Гаврилюк В. И. Видовой состав микромицетов загрязненных радионуклидами почв // Микология и фитопатология. 1990а. Т. 24, №3. С.293-308.
7. ***Кожобаев К.А.,****Молдогазиева Г.Т., Тотубаева Н.Э., Оторова С.Т.. Геоэкологические проблемы, связанные с деятельностью горнодобывающих предпритятий Кыргызской Республики.//Горный журнал. № 8 (2229)* 2016г., *стр. 32-37.*
8. ***Кожобаев К.А.,***Аманов К.А., Сарногоев А.К., Молдогазиева Г.Т., Атыкенова Э.Э., Карамышева Н.Ч. «Тяжелые металлы и радионуклиды в Кичи-Кеминской долине Кыргызской Республики». //Мат. 4-й межд.конф.«Тяжелые металлы и радионуклиды в окружающей среде» г.Семипалатинск, Респ. Казахстан. 2006г.Том 1. стр.227-233.
9. Кожобаев К.А., Аманов К.А., Рыскулов У.Д., Молдогазиева Г.Т., Касиев А.К. Состояние и пути решения проблем радиоактивных отходов севера Кыргызской Республики//
10. Красильников Н.А. Определитель бактерий и актиномицетов М., 1949 г.
11. Краткий определитель бактерий Берги \ Под ред.Хоуст Дж., М., Мир, 1980 г., 495с.
12. Лебедева Е.В, Канивец Т.В Микромицеты почв, подверженных влиянию отходов горно-металлургического комбината // Микология и фитопатология.1991.Т.25.Вып.2.С.111-115
13. Малый атлас прогнозирования чрезвычайных ситуаций на территории Кыргызской Республики/А.М.Айталиев, А.В.Мелешко,

Ш.Э.Усупаев, А.Б.Джуманалиев, Е.П.Кравченко, Г.А.Абдрахманова, В.А.Брежнева при участии Б.Д.Молдобекова, А.К.Сарногоева, С.А.Ерохина/ Бишкек 2003, - 51с.

14. **Определение уровня суммарного загрязнения почв Санкт-Петербургского региона.** Российский государственный педагогический университет им. А.И. Герцена. **Кафедра геологии и геоэкологии**

15. Пидопличко Н.М. Грибы-паразиты культурных растений\ определитель\Киев, 1972г.

16. ***Торгоев И.А., Алешин Ю.Г. Геоэкология и отходы горнопромышленного комплекса Кыргызстана. Бишкек.: Илим, 2009.-240с.***

17. **Тимофеев М.А., Терехова В.А., Кожевин П.А., Биотестирование почв при загрязнении кадмием. Вестник Москв.Ун-та: серия 17, почведение.2010 №4 С.44-47.**

# O-101 Micropropagation Studies on Critically Endangered Mediterranean Knapweed (*Centaurea tchihatcheffii* Fisch Et. Mey)

**Hanife Özler Arpaguş[1], F. Yeşim Okay[1], Cevdet Gümüş[2],** Şeküre Şebnem Ellialtıoğlu[1]

[1]Ankara University, Faculty of Agriculture, Ankara, TURKEY

[2]Bartin University, Bartin, TURKEY

## Abstract

The flora of Turkey possesses approximately 9000 plant species, of which 3000 are endemic. One of them is *Centaurea tchihatcheffii* Fisch et. Mey. *Centaurea tchihatcheffii* is an endangered plant and previous studies emphasize that the low germination rate of its seed is primarily due to deep seed dormancy. Therefore, the determination of the propagation techniques of this plant, such as in vitro micropropagation, will have great importance for germplasm conservation and commercial production. This species has a great potential for use as ornamental plants because of their attractive flowers.

The stem node explants of *C. tchihatcheffii*, obtained from *in vitro* germinated seedlings, were cultured on different nutrient media supplemented with various concentrations of plant growth regulators. Large numbers of adventive shoots were regenerated (over 10 shoots/explant) from node explants on Murashige and Skoog medium supplemented with 1 mg/L 6-benzylaminopurine and 0.50 mg/L indole-3-butyric acid after 30 days of culture initiation. The new node explants were subcultured to the fresh media. Regenerated shoots were transplanted to a potting mixture and were acclimatized in the growth chamber.

**Key words:** *Centaurea*, stem node, micropropagation, endemic

ellialti@agri.ankara.edu.tr

## Introduction

Turkey, especially the Mediterranean region, is generous in many plant families. One of which is the genus Centaurea of the Asteraceae family. More than 700 species of Centaurea are found in this region, only about 178 are found in Turkey [1]. Of these species, 12 are endangered and require appropriate germplasm conversation [2, 3]. Generally, plants of the genus Centaurea have attractive flowers and they have significant applications in traditional medicine [4].

*Centaurea tchihatcheffii* has dark or pale pinkish-red marginal florets that take on an iridescent shimmer in the sun and wind; hence the vernacular name 'Yanardoner', meaning 'iridescent flower'. The peak flowering period is mid-May and in past years, it was sold in some quantity by street florists in Ankara. This species is a steppic annual, possessing some unique features absent in other Centaureas. It occurs only as a local endemic in the province of Ankara, in central Anatolia, west Gölbaşı, a district 20 km south of the capital [5]. Koca et al. [4] studied on the medicinal properties of this plant and they evaluated the ethanol extracts of the flowers, leaves, and stems of *C. tchihatcheffii* for their medicinal activities in male Swiss albino mice. Their results support the use of *C. tchihatcheffii* in traditional medicine in Turkey for their anti-inflammatory and analgesic properties.

*C. tchihatcheffii*, which is a critically endangered annual endemic species growing wildly in limited areas in Ankara [3], has fertile seeds that require long vernalization or stratification treatment to break dormancy [2]. They disperse soon after ripening, and ants play an important role in seed dispersal. On the other hand, the ripe fat achenes are a delight for pigeons, which settle down to feed in large flocks [5]. Because of the difficulties in collecting its seeds and its germination problem, it is very important to optimize new and useful methods for its propagation and ex situ conservation. Conventional methods are slow and the propagation rate is low.

*In vitro* propagation techniques can ensure the availability of plant material throughout the year and micropropagation by tissue culture represents a big potential to propagate this plant. In a study by Tipirdamaz et al. [6], the seeds of *C. tchihatcheffii* were cultured in the Murashige and Skoog (MS) medium containing 6 different concentrations of agar in a range of 6-9 g/L for germination. Moreover, the shoot explants taken from the in vitro

developed seedlings were incubated in MS and half strength MS media containing 9 g/L agar, supplemented with 1 mg/L gibberellic acid ($GA_3$) + 0.225 mg/L benzylaminopurine (BA). The results showed a 40.7% shoot regeneration frequency. In the half strength MS medium, 42.3% of the explants formed shoots, and 38.4% continued to develop by themselves with 2.27 shoots per explant on both media. Ozel et al. [7] used different explant types for the clonal micropropagation of *C. tchihatcheffii*. Shoot regeneration was obtained from floral shoot explants, but a hyperhydricity and chlorosis problem was also encountered. Adventitious shoot regeneration from immature zygotic embryos was the best way to propagate the plants by using the in vitro technique. Perica [8] studied another *Centaurea* species (*C. rupestris*). Young in vitro seedlings obtained from in vitro germinated seeds were used as the explant source. In vitro seedlings were separated from their roots and inoculated on shoot multiplication medium. In a 4 week-culture-period, 11.88 shoots per explant were achieved in the third subculture on modified MS medium. This study attempts to develop an effective method for in vitro propagation, rooting, and acclimatization of the endemic species *C. tchihatcheffii.*

## Materials and methods

The seeds of *Centaurea tchihatcheffii* were collected from their natural habitat in Gölbaşı, near Ankara. The seeds were kept in the refrigerator at +4 °C for 4 weeks in closed jars. The seeds were surface sterilized with 15% commercial bleach for 25 min, followed by three 5- min sterile distilled water rinses. The seeds were inoculated in test tubes (15 × 2 cm) filled with 15 mL MS [9] basal nutrient medium. For the second replication of the inoculation, MS medium supplemented with 1.0 mg/L $GA_3$ was used. Single node explants from Centaurea shoots obtained from in vitro germinated seedlings were placed into the multiplication media containing MS mineral salts, vitamins, BA, indole-3-butyric acid (IBA) and $GA_3$. The hormone combinations (1 mg/L BA; 1 mg/L BA + 1 mg/L $GA_3$; 1 mg/L BA + 3 mg/L $GA_3$; 3 mg/L BA + 1 mg/L $GA_3$; 3 mg/L BA + 3 mg/L $GA_3$; 1 mg/L BA + 0.5 mg/L IBA; 1 mg/L BA + 1 mg/L IBA) were selected from our results in previous studies (data not shown).

The multiplication rate, that is, the average number of shoots after 4 weeks in the culture, was determined for 20 explants per medium, through 3 subcultures (Table 1). After 3 subcultures, the shoots were separated and transferred to the half-strength MS medium without hormones for rooting. The rooted plantlets were acclimatized in plastic containers filled with sterile vermiculate in a climate controlled room for 4 weeks, at which time, they were transferred to a greenhouse. Mean values, standard deviations, and Duncan's test were used for analysis and interpretation of the data.

## Results

The sterilization procedure with commercial bleach was successful; after 15 days on MS basal medium, 94% of the inoculated seeds were free of contamination and 20% of the seeds had germinated. The germination rate was 43% at the end of 4th week, and was 55% at the end of the 8th week. The germination rates on the MS basal medium containing 1 mg/L $GA_3$ were higher than the medium without the $GA_3$. The rates were 49%, 84%, and 88%, respectively.

After plantation of the stem node explants, shoots began to elongate from the axillary buds of each explant. The highest multiplication rate, 10.45 shoots/explant, was achieved in the first initiation medium on MS medium supplemented with 1 mg/L BA+ 0.5 mg/L IBA (Table). The number of shoots induced on this medium in the first subculture was statistically higher than the number of shoots induced on the other media in the same subculture. However, this medium was good in the 2nd and 3rd subcultures too (9.36 and 9.88 shoots/explants).

Table 1. Effect of plant growth regulators on the shoot multiplication of *C. tchihatcheffii* during 3 subcultures.

| BA (mg/L) | $GA_3$ (mg/L) | IBA (mg/L) | 1st subculture | 2nd subculture | 3rd subculture |
|---|---|---|---|---|---|
| 1 | - | - | 5.66 ± 2.33 [bc] | 6.32 ± 2.78 [b-d] | 5.43 ± 2.07 [c] |
| 1 | 1 | - | 4.00 ± 2.83 [bc] | 4.97 ± 3.05 [cd] | 4.53 ± 2.93 [cd] |
| 1 | 3 | - | 3.18 ± 1.07 [cd] | 3.06 ± 2.55 [de] | 3.63 ± 1.92 [de] |
| 3 | 1 | - | 2.31 ± 1.96 [d] | 3.73 ± 2.36 [d] | 3.51 ± 2.54 [de] |
| 3 | 3 | - | 3.13 ± 2.71 [cd] | 4.05 ± 2.15 [cd] | 2.53 ± 3.12 [e] |
| 1 | - | 1 | 6.73 ± 3.42 [b] | 7.13 ± 2.81 [bc] | 7.91 ± 2.44 [ab] |
| 1 | - | 0.5 | 10.45 ± 3.73 [a] | 9.36 ± 2.75 [a] | 9.88 ± 1.76 [a] |

Rooting was obtained from half-strength MS medium without hormones at the rate of 62% (average of all of the multiplication media as sources of the shoots). Plantlets with roots were transferred to *ex vitro* conditions. The survival rate was 64%, and normal-looking plants were successfully acclimatized. The stages of the study is shown in the Figure 1.

## Discussion

This study investigated the possibility of in vitro propagation of *Centaurea tchihatcheffii,* which is an endemic plant for Turkey. Media containing MS salts were used for the tissue culture of this plant. MS medium has been recommended for the culture of most Asteraceae species [9, 10]. The highest multiplication rate was achieved on MS medium supplemented with 1 mg/L BA+ 0.5 mg/L IBA, in all 3 subcultures. Perica [8] obtained 11.88 shoots/explant from *C. rupestris* in MS medium containing BA and $GA_3$. In our study, the BA and $GA_3$ combinations gave shoot multiplication but not the best values.

Propagating *Centaurea tchihatcheffii in vitro* can ensure a continuous supply of enough replications for further experiments on polyploidy treatments using colchisine.

## References


[1] Seçmen, Ö., Gemici, Y., Görk, G., Bekat, L., Leblebici, E. 1995. Systematics of seed plants (4th Ed.). Turkey. Aegean University Press, pp. 301-396 (in Turkish).

[2] Özel, C.A. 2002. *In vitro* propagation of *Centaurea tchihatcheffii*. Gazi University, Institute of Natural and Applied Sciences, MSc Thesis. 83p, Ankara (in Turkish).

[3] Ekim, T., Koyuncu, M., Vural, M., Duman, H., Aytac, Z., Adıgüzel, N. 2000. Red Data Book of Turkish Plants *(Pteridophyta* and *Spermatophyta)*. Turkey's Nature Conservation Association and the Van University Publication, Ankara.

[4] Koca, U., Toker, G., Küpeli Akkol, E 2009. Asessment of the extracts of *Centaurea tchihatcheffii* Fisher for anti-inflammatory and analgesic activities in animal models. Tropical J.of Pharmaceutical Research 8(3): 193-200.

[5] Tan, K., Vural, M. 2007. *Centaurea tchihatcheffii* Fischer & C.A. Meyer (Asteraceae). Plant Syst Evol 263: 203-207.

[6] Tipirdamaz, R., Özkum, D., Özbek, N., Ellialtioglu, S. 2006. *Centaurea tchihatcheffii* Fisch. et Mey.'s researches on the production through tissue culture. In: Bosgelmez A (Ed.), Golbasi Mogan Lake, Andesite Bowl, *Centaurea tchihatcheffii*, Our Office Press-Ankara, Turkey, pp. 569-579.

[7] Ozel, C.A., Khawar, K.M., Mirici, S., Özcan,S., Arslan, O. 2006. Factors affecting in vitro plant regeneration of the critically endangered Mediterranean knapweed (*Centaurea tchihatcheffii* Fisch et. Mey). Naturwissenschaften 93: 511-517.

[8] Perica, M.C. 2003. *In vitro* propagation of *Centaurea rupestris* L. Acta Botanica Cracoviensia Series Botanica 45(2): 127-130.

[9] Murashige, T., Skoog., F. 1962. A revised medium for rapid growth and bioassays with tobacco tissue cultures. Physiologia Plantarum 15: 473-497.

[10] George, E.F., Sherrington, P.D. 1984. Plant Propagation by Tissue Culture. Exegetics Ltd., Eversley.

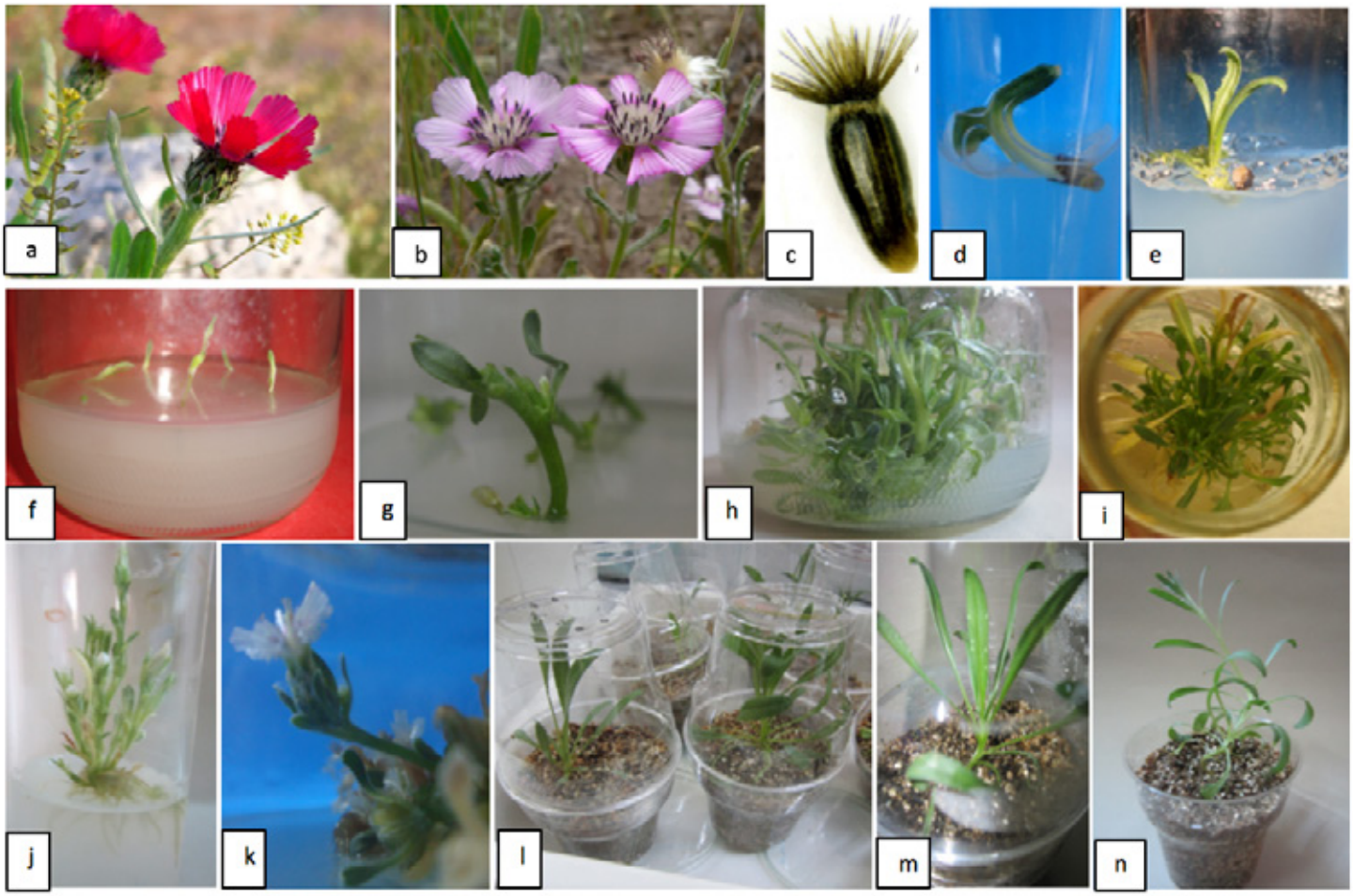



Figure 1. a. and b. Flowers of *Centaurea tchihatcheffii*, c. Seed of *C. tchihatcheffii,* d. and e. *In vitro* germination of the seeds, f. Shoot-tip explants, g. Single nod explants, h. and i. Shoot proliferation, j. and k. Flowering *in vitro*, l. and m. Acclimatization, n. Regenerated plant.

## O-105 Intensification of fodder production through the planting of intermediate triticale

**Aibek Karabaev[1], Nurlan Mamatov[2], Mustafa PAKSOY[3]**

[1]Kyrgyz-Turkish "Manas" University, Faculty of Agriculture, Department of "Horticulture and Agronomy" Ph.D.

[2]Kyrgyz-Turkish "Manas" University, Faculty of Agriculture, Department of "Animal Sciences"Ph.D.

[3]Kyrgyz-Turkish "Manas" University, Faculty of Agriculture, Department of "Horticulture and Agronomy" Professor, Doctor

***Key words:*** *forage production, triticale, phytomass*

***Annotation:*** *considered advantages of* ***i****ntermediate planting*

Planting of winter-hardy, drought-resistant, decease-resistant, and pest-resistant fodder crop is the most important aspect of the agricultural fodder-producing sector in the Kyrgyz Republic. In this case, Triticale can become the most important crop species that can be most widely planted. Triticale is a crop species that has all the necessary nutritive elements for increasing the production capacity of dairy cattle. Triticale was discovered by a German professor, Wilhelm Rimpau, in 1888. Professor Rimpau crossbred rye with wheat. As a result of this crossbreeding between rye and wheat, he got Triticale. In contemporary society, Triticale can be used as a green-fodder crop and for baking purposes. Triticale has been scientifically proven to be the most fertile fodder crop for agricultural purposes. Triticale's level of frost resistance is considerably higher than the frost resistance of winter wheat, and is equal to that of winter rye. For this reason, Triticale saves more crop plants than winter wheat per unit of land area during harvesting. Triticale is recommended to be used as a feed crop before it enters the ear initiation phase.

### Material and Research Method

There were two domestic varieties of triticale used as a research material. These two varieties of triticale are called Alesha and Missim. Alesha and Missim were created by the Kyrgyz-international cooperation an Open Joint Stock Company MIS and SIMMIT. Alesha is winter triticale which was extracted from Kissa through selective cross breeding. Alesha's features are described as follows: Hexaploid, white ear, prismatic, wide, and dense. Its color is red-brown and its stem is rigid. Its thickness is 8 diameters. Plant height is 43-45 inches. The mass of one thousand pieces of wheat triticale weighs from 0.083 to 0.093 lbs. Natural weight is 1.59 lbs. Alesha consists of 13.2 % protein. It is precocious and decease-resistant. Triticale's vegetation period is 240 days. Grain yield at maturity during harvesting period is 85-90 cwt per hectare. It is recommended for feed milling.

Missim is winter triticale. This crop variety was created through double generic, selective cross breeding. Missim's features are described as follows: Hexaploid, length of ear is 5.91-6.31 inches. Missim consists of 25-26 pieces of spicas. Its color is red-brown and is decease-resistant. Plant height is 47-51 inches. The mass of one thousand pieces of wheat triticale weighs from 0.10 to 0.11 lbs, which is larger than Alesha. Natural weight is 1.70 lbs. Grain yield at maturity during the harvesting period is 87-96 cwt per hectare. Missim consists of 12.2 % protein. Its vegetation period is 235-240 days.

### Research results

According to Rayimkulov's research (1986), growing of Triticale for green fodder crop purposes can be beneficial, since Triticale can contribute to the growth of fodder crop production capacity. Triticale has nutrients which are obtainable for livestock during the period of mowing rye and perennial rye grasses. Triticale can also be used for human consumption as a flour product having important vitamins, minerals, and protein. Its cellulose content increases during the stem growth phase through the complete ear initiation phase. The highest yield of Triticale's green mass is obtainable upon harvesting during the process of the ear initiation phase. The green mass of Triticale in the ear initiation phase comprises 181 lbs protein, 0.61 % feed unit, 5.02 ashes, 30.27% cellulose, 15.01 % carotene (Rayimkulov, 1986).

Comparative research has been done on two different sites with two different crop varieties of Triticale.

Table1. Structure of new triticale varieties

| Variety | No. of stems | | Productive tillerings | Plant height (inches) | Spica height (inches) | Mass 1000 pieces of grains (lbs) |
|---|---|---|---|---|---|---|
| | Before harvesting | No. of sprouts | | | | |
| Alesha | 212 | 620 | 2.93 | 47 | 6 | 0.09 |
| Missim | 217 | 628 | 2.90 | 49 | 6.3 | 0.093 |

As shown in the table 1, Missim possesses the most productive tillering, more numbers of grains in the spica, and heavier mass of 1000 grains. Missim has a higher number of spicas than Alesha. Alesha and Missim varieties have almost the same survival rate. Alesha and Missim have large and long-lancet leaves which increase their phyto-mass during the process of tillering. They tiller well and produce 3-5 stems in the tillering process. According to Kuzenko's comparative research between Triticale and rye, the phytomass of Triticale increases more slowly, its stem does not roughen for a long period of time, and its life-cycle is longer Kuzenko (2011). Sechnyak and Sulim (1984) state that Triticale's phytomass possesses more protein, lysine, and carbohydrates compared to wheat and rye (Sechnyak and Sulim, 1984). For this reason, Triticale used for cattle feeding in its ear initiation phase is easily consumed and easily digested by cattle. This enables cattle to increase their production capacity, particularly, dairy cattle's production capacity.

Urazaliev (2005) states that cattle can obtain 0.23 lbs of protein after consuming 2.20 lbs of harvested Triticale phytomass in the milk-wax stage of ripeness. Cattle obtain 0.02 ounces of protein and 0.02 ounces of Lucerne after consuming hay. This means cattle would obtain more nutrients from consuming Triticale than they would obtain from other crop species (Urazaliev, 2005). Bubicz and Macik-Baranska (1983) state that Triticale is a high protein content crop. Triticale comprises more carotene when compared to rye and wheat (Bubicz and Macik-Baranska, 1983). Sechnyak and Sulima (1984) confirm that Triticale's high sugar content improves cattle's consuming ability and provides good forage conservation compared to rye (Sechnyak and Sulima, 1984). Triticale contains less cellulose compared to rye, particularly, in the autumn harvesting period when Triticale is harvested for feeding cattle.

All of the above described advantages of Triticale used for cattle feeding enable dairy cattle to increase dairy production capacity and fat content percentage. Such a high quality fodder crop that is abundant with nutrients attracts farmers to feeding their cattle in the spring time, when fodder resources are limited. Biochemical content and plant mass of Triticale residues which remain after harvesting get mineralized by microorganisms. For this reason, planting of Triticale can be used as a green fertilizer.

Table 2. Triticale green mass yield, (predecessor of Lucerne), center per hectare

| Variety | Ear initiation phase | Height | Yield | Deviation |
|---|---|---|---|---|
| Winter Triticale Alesha | May 21 | 39 inches | 470 cwt | Standard deviation |
| Winter Triticale Missim | May 19 | 45 inches | 510cwt | +40 |
| Triticale (a crop species of Tasa, Republic of Kazakhstan) | May 23 | 42 inches | 500cwt | +30 |
| Winter Triticale (a crop species of MAR-73) | May 20 | 43 inches | 421,7 cwt | -48,3 |
| Winter wheat(a crop species of Djamin) | May 18 | 39 inches | 410 cwt | -60 |

Missim's height reaches 45 inches long, usually by the end of May and is harvested during the ear initiation phase. In this time period, Missim obtains well-developed tillering ability and high-yield capacity of green phytomass. As shown in table 2, Missim yield during the ear initiation phase comprises 510 cwt per hectare, which means Missim yield capacity exceeds Alesha by 40 cwt per hectare. Missim yield also exceeds a crop species of Tasa by 30 cwt per hectare. For this reason, Missim can be recommended to farmers for planting as the highest-yield green crop in the Kyrgyz Republic.

Table 3. Bio-productivity of Triticale used for forage and grain purposes

| № | Variety | Root depth | | | Crop residues | Total |
|---|---|---|---|---|---|---|
| | | 0-10 iches | 10-20 inches | 0-20 inches | | |
| Phytomass of Triticale grain after harvesting period (cwt per hectare) | | | | | | |
| 1 | Alesha | 69,2 | 27,3 | 96,5 | 16,2 | 112,7 |
| 2 | Missim | 70,1 | 28,1 | 98,2 | 17,3 | 115,5 |
| 3 | Maize | 84,2 | 13,3 | 97,5 | 6,3 | 103,8 |
| Phytomass of Triticale used for green forage purposes (cwt per hectare) | | | | | | |
| 1 | Alesha | 65,6 | 23,5 | 89,1 | 15,8 | 104,9 |
| 2 | Missim | 68,4 | 24,2 | 92,6 | 16,6 | 109,2 |
| 3 | Maize for silage | 77,9 | 11,2 | 89,1 | 5,2 | 94,3 |

Due to the wealth of Triticale's crop plants and its phytomass saved before harvest per unit of land area, Triticale's yield of green fodder crop mass increases to 21% higher than winter wheat. The fertility rate of Triticale is better than the fertility rate of wheat. Planting of Triticale prevents the soil from wind and water erosion. Varieties of Missim and Alesha effectively develop their phytomass, luxuriant stems, and large stems. Missim also saves a large amount of vegetable and root mass, which is important for crop fertility and growth. Triticale varieties of Missim and Alesha are similar parental plants of wheat and rye. They have two types of roots: primary and secondary. The root system of the two varieties consists of separate rootlets and fibrils, which spread under the soil. Sprouted grains of Missim and Alesha cause primary roots to appear. Triticale has 4-6 primary roots which enable it to better adapt during the initial growth period. Adult plants of Triticale generate a branchy mass of secondary roots which penetrate deeply into the soil to expand the areal extent and rhizosphere of Triticale. However, Triticale's seeds demand as much moisture as the seeds of wheat would consume. This should be taken into consideration when planting Triticale on the irrigable lands of the Kyrgyz Republic.

According to statements by Sulima and Sechnyak (1984), the developed root system of Triticale enables it to grow successfully on infertile soils, compared to wheat's root system (Sulima and Sechnyak, 1984). The green mass of Triticale grows slowly; it does not roughen, and is easy consumed by cattle during the stem growth phase up through the complete ear initiation phase and milk-wax stage of ripeness. The harvesting period of winter Triticale used for feeding dairy cattle is usually from April 25$^{th}$ to May 10$^{th}$ in the Kyrgyz Republic.

The green mass of Triticale has a higher nutritional value compared to wheat and rye since it possesses higher feed rates and digestive protein. Also, the period of harvesting time is conducive for feeding dairy cattle that need nutrients to increase dairy production capacity when feed resources are very limited in the Kyrgyz Republic. Post harvest residues used for cattle feeding purposes comprise 15.8-16.6 fresh residues cwt per hectare and 89.1 – 92.6 fresh root mass cwt per hectare. We should note here that Triticale harvested in the ear initiation phase leaves behind fresh vegetable roots and crop residues. These crop residues, decomposed by micro-organisms in the soil, can be green fertilizers in the soil-climatic conditions of the Kyrgyz Republic.

The soil where winter Triticale is planted and harvested for cattle feeding purposes is moist and a different crop species can then be planted. During this period, favorable temperature, air, and soil moisture regimes are normally present. Micro-biologic activity of the soil intensifies in such favorable climatic conditions. Hence, favorable climatic conditions cause the effective mineralization of crop residues, and have a positive effect on soil fertility. So the post harvest crop residues of Triticale left behind in soil provide it with nutritive elements for the following planted crops on the same soil during its vegetation period. Triticale used for a green fodder crop can also be used for hay reproduction.

Table 4.Green mass and hay productivity of winter Triticale and its total cost

| Variety | Green mass, cwt per hectare | Hay, cwt per hectare | Bundle, pieces per hectare (1 bundle 55.12 lbs.) | Price 1 bundle, USD | Hay, USD per hectare |
|---|---|---|---|---|---|
| Alesha | 470 | 106,7 | 426 | 1.74 | 740 |
| Missim | 510 | 117,3 | 469 | 1.74 | 816 |

Triticale used for cattle feeding purposes in the ear initiation phase gets dried and used also as hay. In other words, Triticale gets pressed and moved away from plantation sites. Winter Triticale harvested for hay reproduction provides a high quality hay of106.69-117.3 cwt per hectare. Such an effective hay production capacity has a great effect on cattle production capacity. Total income of hay made out of Triticale is 740-816 USD per hectare. The cost comprises 494-506 USD per hectare. Net profit from harvesting a species of Alesha is 245USD and net profit from harvesting a species of Missim is 310 USD per hectare. So, the profitability for both crop varieties is 49.5% and 61.2%. Due to the aforementioned, Triticale's high rate of phytomass accumulation during the vegetation period earns a high recognition.

Conclusions:

1. Planting of winter Triticale enables farmers and enterprises to generate incomes and increase their feed recourses.
2. Intermediate winter Triticale is a top priority crop species to be considered for crop rotation purposes with monocultures such as potatoes, kidney-beans and other crop species. Winter Triticale can improve the soil nutrient regime and phyto-sanitary conditions of agricultural fields.
3. Winter Triticale causes the reduction of soil pollution and increase of crop fertility rate.

# O-106 The Application Of Mathematical Methods In Improving The Quality Of The Lint Of Kyrgyz Breed On The Example Of Open Joint-Stock Company "Mis"

Nurlan MAMATOV[1], Aibek KARABAEV[2], Kadyrbai Chekirov[3]

1. Department of Animal Sciences, Faculty of Agriculture,Kyrgyz-Turkish Manas University

2. Department of Horticulture And Agronomy, Faculty of Agriculture, Kyrgyz-Turkish Manas University,

3. Department of Biology, Faculty of Natural Sciences, Kyrgyz-Turkish Manas University,

## ABSTRACT

In this article mentioned the application of mathematical methods as a tool to improve the quality of the lint of Kyrgyz breed kept at the Joint – Stock Company MIS. The results are shown in the tables bellow explains each data information and its outcome. Kyrgyzstan possesses mountains and its breeds adapted to the local weather conditions. Domestic breeds were bred by the local scientists. Also as a wild cattle here yaks on the mountains at the three thousand meters above the sea level. Yaks ecological clean their meat delicious and useful for the human health. Their milk is fat and possess all vitamins. Open Joint –Stock Company is the only company in the country which regulates and follows all the recommendations provided from the experts in the agriculture. All their recommendations applied the praxis.

**Key words:** Yak, Chicken, cattle production, sheep production.

## INTRODUCTION

Kyrgyzstan is a mountainous agriculture country, where livestock is the main sector of agriculture. Livestock is represented in sheep production, cattle production, horse production, yak production and chicken production. Breeding is agricultural value and it is leading sector of livestock as its shared of the account for more than half of the cost of the animal products. In the Republic breed cattle - Alatau and Aluetinskaya, well adapted to local climatic circumstances, creates a new Kyrgyz breed black-and-patchwork of cattle [1]. One of the main ways to enhance the effectiveness of dairy cattle breeding is targeted selection on the improvement of existing and the establishment of a new and more productive and cost-effective livestock species. Bearing in mind the fact that at the present time in the world " Europarallel-Friscal breed value and characterized not only as the most milk productive, but also as the most healthcare stable that it as no other breed responds to the wide application of mechanization and automation of the milking cows, as well as taking into account the extremely high rate of growth of Goldstein cows and its productivity in many countries of the world including in Kyrgyzstan was launched targeted crossing local cattle with the Goldstein breed to breed the new more productive genotypes black-and-patchwork cattle. In 1981, the pilot agriculture project was done at the "MIS" from the Kaliningrad region was imported 117 black-and-vibrant heifers and at the same time initiated use of sperm bulls black-and-patchwork of livestock for crossbreeding with Ala-Tau native species. The saturation of blood on Goldstein accompanied by the stable growth of breast productivity. In the herd experienced agriculture Kyrgyz "MIS" high productive (7/8) were characterized by milking 5260±138 kg milk that more compared with 81 and 3/4 - blood daughters [2]. Today the development of livestock, the technics and tribal work in livestock is impossible without the use of mathematical methods. The application of mathematical methods allows you to solve important technics-genetic task. Many of the methods of Genetic-statistical analysis in livestock are based on the calculation of indicators such as the arithmetic average, average weighted, variance, standard deviation, variability. coefficient of correlation, regression, indicators of reliability, etc. These indicators are the average value of the symptom, their variability, variability, links between signs and etc..

The purpose of this work was to examine the genetic-statistical parameters of the cows of Goldstein breed, slaughtered in "MIS" [3].

**The structure of genealogical breeds have been established to ensure the herd of supplies to Lines**

The structure of genealogical herds presented the world lines " Europarallel-Freesia suited the bulls, widespread in all climatic zones of the planet.

The largest number of the pure lines - this line of UES - 792 cows, then line – Reflection Sovereign - 685 cows, Montweak Cheaftein - 329 cows, Silinge Tridejuna Rokita - 149 cows, hews -73 cows., V. B. The LED - 71 cows.

The highest milk productivity from birth daughters Innsbruck 5539 (Canada) - 5180 kg, then the first birth - daughters Persuadera 4973 (Germany) - 4973 kg, then the daughters of the bull from Israel - Awsha notes on 4810 kg from each first birth caw [13].

**Table 1**

**Productivity of daughters from bull producers of 1st lactation**

| Name of the bulls | Place of the birth of bull producer | Number of daughters | Productivity daughters | | Live weight | Productivity of mothers | |
|---|---|---|---|---|---|---|---|
| | | | Milk | Fat | | Milk | Fat |
| Durman 361 | Russia | 1 | 4194 | 3,94 | 465 | 4156 | 4,01 |
| Estamp 776 | Russia | 36 | 4274 | 3,96 | 485 | 4172 | 3,86 |
| Bellfast 5032 | Switzerland | 19 | 4289 | 3,96 | 480 | 4339 | 3,92 |
| Marvud 2293604 | USA | 20 | 4352 | 3,97 | 500 | 4119 | 3,92 |
| Santal101 | Canada | 6 | 4628 | 4,04 | 485 | 4189 | 3,89 |
| Lido23677 | FRG | 7 | 3903 | 3,04 | 475 | 4007 | 3,83 |
| Caffe3481 | Israel | 14 | 4292 | 3,97 | 475 | 4412 | 3,92 |
| Herzog 119 | Canada | 5 | 4450 | 3,87 | 454 | 4534 | 3,81 |
| Atlas 7032 | Switzerland | 20 | 4612 | 3,95 | 475 | 4359 | 3,93 |
| Craft 66270 | Canada | 10 | 4757 | 3,91 | 495 | 3858 | 3,95 |
| Europio 92012 | Italy | 23 | 4588 | 3,91 | 495 | 3858 | 3,95 |
| Insbruk 5539 | Canada | 10 | 5180 | 3,94 | 495 | 4341 | 3,85 |
| Lin 482495 | England | 6 | 4301 | 3,9 | 485 | 4416 | 3,95 |
| Persuader 13064124 | FRG | 5 | 4973 | 3,91 | 500 | 5358 | 3,81 |
| Patsil 3421 | Israel | 14 | 4161 | 3,91 | 485 | 4350 | 3,92 |
| Choice 30634 | USA | 1 | 3717 | 4,1 | 495 | 4843 | 4,09 |
| Shammi 1029 | Italy | 1 | 4143 | 3,83 | 500 | 5074 | 3,78 |
| Avsha3651 | Israel | 21 | 4810 | 3,9 | 475 | 3997 | 3,83 |
| Total | | 251 | 4411 | 3,95 | 484 | 4195 | 3,77 |

In the last recent years, from 2003, the availability of seed material is only through the Central Asian Breeding Service, which does not have a specific diversity lines Bulls - producers " Europarallel - lactation breed [14].

## MATERIAL AND METHODS OF RESEARCH

As a material for research served as the data of the tribal and awarded with Lenin Award (card tribal cow form 2-month) at 100 cattle breed Goldstein various lines in the slaughter of the farm of Open Joint-Stock Company "MIS". Studied the basic genetic - statistical parameters (X ±m, σ, CV r, r, h td ) such basic household- mineral breeding grounds, as: high quality raw milk for a lactation, the content of fat, per kilogram of dairy fat, live weight, Tools- period and etc [10]. Biometric processing of experimental data have been on the methods described, N. A. Plohinskim (1986), Lakinym (1990), i.e., Merkurievoy (1970, 1991) using the known formulas as well as using a PC computer program Microsoft Excel 98.

### The results of the research

Productivity - the main commercial property of the agricultural business of animals, and therefore it is the basis of all methods of selection for the integrated gender.

The animals on the productivity of the selection taking into account the variability of the quantitative and qualitative indicators [9]. The average are composed from three layers - the variability of signs are characterized by the following indicators: live weight of adult cows - 12-15%, of high quality raw milk for 305 days of lactation - 20-30%, fat content of the Milk - 9%, protein -4-8%, speed of milk giving **- 10-15%.** Milk productivity - the complex quantitative symptom caused by the many genes and factors in the external environment has a large amplitude variability in the range from 1000 to 25 000 kg of milk from the COW for the year [20].

The tremendous potential of improving breast productivity is raising number of cows with high milk productivity. One of the first world records for 365 days was of high quality raw milk cow Goldstein Segis-Pieterdgi-sheet (US, 1921) - 16 956 kg. High quality raw milk another Goldstein cow Bitcher Ellen (USA) for 365 days III lactation - 25 247 kg of milk boldness 3.33%. In 1981 the daily of high quality raw milk Cuban cow - hybrid Goldstein and Zebu - Ubre Blanca (White udder) was 110.9 kg of milk. This unique cow had 4 calves and for the IV a lactation it received 26 500 kg of milk [15].

As can be seen from the table data level breast productivity from cows голштинской breed tribal factory MMS heavily varies. The most simple rate variability this symptom is the value of the limit is the absolute difference between the maximum and minimum values of the symptom (lim=, xmax-xmin). In this case the spiritistic animals limit the level of breast productivity amounted to:

on 1 - lactation - 6405 - 3010 = 3395 kg;

on 2 - lactation - 7310 - 2370 = 4940 kg;

on 3 - lactation - 7986 - 3117 = 4869 kg.

It is said that the very broad range of variation of this symptom [22].

For a more complete study of the extent of expression and variability of the symptom we have calculated and other statistical parameters of the average values and variability. The data are presented in table 2.

Table 2.

The average values and indicators of climate variability on the Live Earth and therefore they sacrifice unto their net from cows Goldstein breed (n=66)

| Parameters | Live weight, kg | Milk for 1st lactation, kg | Milk for 2nd lactation, kg | Milk for 3rd lactation, kg |
|---|---|---|---|---|
| Average.arithmetic. X | 505,36 | 4641,89 | 5082,393939 | 5127,046154 |
| Average square deviation.s | 30,55 | 609,37 | 751,20 | 895,83 |
| Average arithmetic mistakes $m_X$ | 3,76 | 75,01 | 92,47 | 111,11 |
| Coefficient variation Cv | 6,04 | 13,13 | 14,78 | 17,47 |
| Coefficient correlation, r | | 0,18 | | 0,71 |
| Mistake coefficient correlation, | | 0,12 | | 0,60 |
| Recreation coefficient, R | | 0,01 | | 0,60 |

According to Table 2 which shows that the average of high quality raw milk on the studied group (n=66) cows of Goldstein breed the first lactation is 4641,89± Kg and there has been a gradual increase in and the 3-lactation is 5127,04±111,11 kg. and difference of milking between the 1st and 3rd release milk amounted to 486 kg. There is also an increase in the rate of variations, cow 3-release milk of a very high level of variation of this symptom - CV = 17,47% [11].

In analyzing the indicators of the live weight can be noted that the average for the studied group is 505,36±3.76kg. Rate Variability (CV) is 6.04%, said that the low variability of the symptom. When examining the Live Earth with breast productivity is low, weak positive and imperfection of correlation between r ±mr =0.18±0.12. It is said that with the increase in live weight of the studied groups of cows in parallel increases the value of milk productivity[4].

## CONCLUSIONS

1. During examining the breast productivity found that the average of high quality raw milk on the studied group (n=66) cows Goldstein breed the first lactation is 4641,89± Kg and there has been a gradual increase in and the 3-lactation is 5127,04±111,11 kg. When examining the Live weight with breast productivity is low, weak positive and imperfection of correlation between r ±mr =0.18±0.12 [12].

2. The average rate of live weight on the studied group of cows is 505,36±3.76kg. Rate Variability (CV) is 6.04%, said that the low variability of the symptom. It is established that there is a trend toward reducing the duration of the service period of the growing priority calving. So the animals after 3-calving on average have the duration of the service period 96.4 days that is more close indicator of the optimum. Coefficient of Variation Cv the studied animals is very high and is 38,82, 40.1 and 54,31 % depending on priority calving [16].

3. The genetic-statistical data on live weight and therefore they sacrifice unto their net show that daughters have a higher live ground (173,10) than the mother (160,43), the coefficient of variation is 14,38 % from the daughters and maps show the % to mothers. The correlation coefficient between the Live Earth mothers and daughters amounted to r± mr= 0.59±0.21 that shows the positive unidirectional connection symptom between mothers and daughters. When the analysis of the milk productivity for lactation consultant found that in all 3-recorded lactations daughters

had higher rates than the mother. By 1st and 2nd lactations daughters are reliably high content of fat (p=0.999). When examining the content of fat in milk between mothers and daughters on the 2nd and 3rd lactation is weak negative correlation [17].

4. When examining the live weight youngsters the highest coefficient of variation detected at birth - earnings per share were 14.74%. In the rest of the periods of development of the 6-up to 12 months the variability of this symptom was more stable and was from 9 up to 8.25% [18].

5. The highest levels of dairy productivity differ from cow breed cheaftein - 4680,85 kg of milk for lactation and lowest milk productivity cow line Sovereign - 4403,2 kg. The difference between the value of milk production between lines is 276 kg. The high level of variability value of milk production has cow line Rokita (17,08%), and the cow line Sovereign differed more stable value milk production. In all cases in different combinations compared line of each other are not significantly, as confirmed by the low value calculated from the criterion of the credibility of the cow [19].

## References


1. **Brunori G., Jiggins J., Gallardo R., Schmidt O.** The Second SCAR Foresight Exercise, Synthesis Report, 'New challenges for agricultural research: climate change, food security, rural development, agricultural knowledge systems', EU Commission Standing Committee on Agricultural Research (SCAR) 105, 2008

2. **Deuffic P., Candau J.** Farming and landscape management: how French farmers are coping with the ecologization of their activities. J. Agric. Environ. Ethics 19, 563–585, 2006

3. **Gandini G. C., Villa E.** Analysis of the cultural value of local livestock breeds: a methodology. J. Anim. Breed. Genet. 120, 1–11,2003

4. **Gura S.** Industrial livestock production and its impact on smallholders in developing countries. Consultancy report to the League for Pastoral Peoples and Endogenous Livestock Development, Germany 25-56, 2008

5. **Hare E., Norman H. D., Wright J. R.** Trends in calving ages and calving intervals for dairy cattle breeds in the United States. J. Dairy Sci. 89 365–370, 2006

6. **Hayes B. J., Bowman P. J., Chamberlain A. J., Goddard M. E.** Genomic selection in dairy cattle: progress and challenges. J. Dairy Sci. 92 433–443, 2009

7. **Herrero M.,** et al. Drivers of change in crop–livestock systems and their potential impacts on agro-ecosystems services and human well-being to 2030. Study commissioned by the CGIAR Systemwide Livestock Programme *(*SLP*)*. Nairobi, Kenya: ILRI. 459-489,2009

8. **Herrero M.,** et al. Smart investments in sustainable food production: revisiting mixed crop-livestock systems. Science 327. 822–825, 2010

9. **Kiers E. T., Leakey R. R. B., Izac A.-M., Heinemann J. A., Rosenthal E., Nathan D., Jiggins J.** Agriculture at a crossroads. Science 320, 320–321, 2008

10. **King J. M., Parsons D. J., Turnpenny J. R., Nyangaga J., Bakara P., Wathes C. M.** *a*Modelling energy metabolism of Friesians in Kenya smallholdings shows how heat stress and energy deficit constrain milk yield and cow replacement rate. Anim. Sci. 82. 705–716,2006

11. **King D. A., Peckham C., Waage J. K., Brownlie J., Woolhouse M. E. J.** *b*Infectious diseases: preparing for the future. Science 313. 1392–1393, 2006

12. **Lawrence A. B.** Applied animal behaviour science: past, present and future prospects. Appl. Anim. Behav. Sci. 115, 2008

13. **Lawrence A. B.** What is Animal Welfare? Fish welfare (ed. Branson E., editor. ). Oxford, UK: Blackwell. 122-135,2009

14. **Lawrence A. B., Conington J., Simm G.** Breeding and animal welfare: practical and theoretical advantages of multi-trait selection. Anim. Welfare 13, 191–196, 2004

15. **Leakey R.,** et al. Impacts of AKST (Agricultural Knowledge Science and Technology) on development and sustainability goals. In Agriculture at a crossroads (eds McIntyre B. D., Herren H. R., Wakhungu J., Watson R. T., editors. ), Washington, DC: Island Press 145–253, 2009

16. **Lewin H. A.** It's a bull's market. Science 323, 478–479,2009

17. **Neumann C. G.,** et al. Animal source foods improve dietary quality, micronutrient status, growth and cognitive function in Kenyan school children: background, study design and baseline findings. J. Nutr.133, 3941S–3949S,2003

18. **Perry B., Sones K.** Global livestock disease dynamics over the last quarter century: drivers, impacts and implications. Rome, Italy: FAO; (Background paper for the SOFA 2009) 133-154, 2009

19. **Reid R. S., et al.** Fragmentation of a peri-urban savannah, Athi-Kaputiei Plains, Kenya. InFragmentation in semi-arid and arid landscapes (eds Galvin K. A., Reid R. S., Behnke R. H., Hobbs N. T., editors. ), Dordrecht, The Netherlands: Springer 195–234, 2008

20. **Takma C. Akbas Y:** Comparison of fitting performance of random regression models to test day milk yield in Holstein Fressians. Kafkas Univ. Vet Fak Derg, 12(2): 261-266,2009

21. **Galic A, Kumlu S:** Application of a random regression model to estimation of genetic parameters of test day milk yield of Turkish Holstein Firesians. Kafkas. Univ Vet Fak Derg, 18(5): 719-724,2012

22. **Takma** Ç, Akbaş Y**:** Variance components and genetic parameter estimates using random Regression models on test day milk yields of Holstein Friesians. Kafkas Univ Vet Fak Derg. 15(4): 547-551, 2009

# O-118 SAFFLOWER (*Carthamus tinctorius* l.) AS A FOOD AND ENERGY PLANT AND TURKEY EXAMPLE

Fikret AKINERDEM[1]

[1-] Selçuk University, Head of Biofuels Research and Applied Center

*fakiner@selcuk.edu.tr*

**ABSTRACT**

With the increasing value of agriculture as well as at environment, food and energy countries have begun to provide energy for the country. For this reason, they have made an effort to search for food and energy as raw materials within the framework of the potentials of countries with no food and energy capacity. Turkey is among the countries that are in this search. Turkey does not have enough production about oilseed plants besides energy. For this reason, it pays about 50-60 billion US Dollars in foreign markets per year to meet the needs of both issues. On the other hand, these two sectors are able to address and 5 million hectares of land in the country are included with drought resistant plant that can be grown in the fallow field and one of them safflower, originated in Anatolia. In this respect, 5 million hectares of fallow field has the chance to grow safflower plant with about 6 million tons of safflower seeds. From this amount, 2 million tons of vegetable crude oil and 4 million tons of cake can be obtained from the safflower seed so that it can be partially saved from the energy dependence and totally food dependence as food raw materials. Within this framework of thoughts, our working in the beginning of 2000s has been successful. So, safflower production was 18 tonnes in our country formerly and today, safflower production is 70.000 tonnes recently. Our national future target is to increase safflower production.

**Keywords:** Energy, Food, Safflower, Turkey.

## GİRİŞ

Artan dünya nüfusunu beslemek için yapılan üretim girdileri, sanayi ve teknolojik gelişmelere bağlı olarak yaşanan çevresel sorunlar, bölgesel ve ülkesel boyutları aşarak küresel problem haline gelmiştir. Bu değişim olayları ülke ve bölge politikalarında yer almakla birlikte devletler yenilenebilir enerji kaynaklarına olan politikalarını değiştirmiş durumdadır (Akınerdem ve Coşge, 2014). Dünya nüfusu sürekli artmaktadır. Buna bağlı olarak değişik kesimlerce farklı boyutlarda olsa da gıda ihtiyacı miktar ve kalite bakımından yükselen bir değerde talep görmektedir. Artan nüfusu beslemek amacıyla gıda hammaddelerinde üretim ve kalite artışı için yapılan girdiler, sanayi ve teknolojik gelişme trendindeki yükselmelere bağlı olarak yaşanan çevresel sorunları günümüzün önemli bir problemi haline getirmiştir. Bu kaynaklar hükümetin yenilenebilir enerji kaynaklarına bakışını da değiştirmiş durumdadır (Akınerdem ve ark., 2013).

Enerji tarımı ve aspir ifadesi ilk defa ciddi manada 15 sene evvel ülke hayatında yer almıştır. Bu zamanda yeni bir hükümet ile birlikte yeni bir anlayış gündemimize girmiş ve biyoyakıtlar Türkiye enerji tarımına bağlı olarak DPT'den alınan bir proje çerçevesinde yer almıştır. 2006'dan itibaren hem yemeklik yağ, hem de biyodizel ihtiyacımızı karşılamak amacıyla en uygun iki bitki olan Aspir ve Kolza (kanola) Türk tarımına kazandırılmış, aspir bitkisini kurak, kolza bitkisini ise sulu alanlarda yetiştirilmeye başlanmıştır.

Marjinal alanlar yani kırsal kesimlerde (kuraklık bitkisi) yetiştirilme şansı bulan aspir bitkisi, üreticileri ekonomik olarak tatmin etmek üzere devletçe yüksek oranda desteklenmesi yapıldı ve kısmen de olsa üretici gündemine getirilmiş oldu. Aspir yağının linoleik yağ asiti yüksektir ve CLA (Concugated Linoleik Acid) bulundurur. Kışlık ve yazlık yetiştirilebilen, üretiminde çok özen istemeyen, yağı tokoferoller bakımından zengin olan, zeytinyağı gibi yağı soğuk pres yöntemi ile rafine edilmeden tüketilebilen, çiçekleri gıda ve kumaş boyamasında kullanılan aspir ülkemizde soğuk pres yöntemi ile elde edilmesi sebebi ile çiftçilerimiz tarafından çokça tercih edilmektedir. Gelişmiş ülkelerde tamamlayıcı gıda olarak her yerde CLA'nın talep gördüğünü, bunun da en çok aspirden elde edildiği gerçeği ile bu konuda ne kadar şanslı bir ülkede olduğumuz bir gerçektir.

Aspir (*Carthamus tinctorius* L.), Compositeae familyasından yazlık karakterde ve ortalama 110-140 gün arasında yetişebilen tek yıllık bir uzun gün yağ bitkisidir. Su faktörünün kısıtlayıcı etkisinden dolayı nadas uygulaması yapılan kuru tarım alanlarımızda kurağa ve soğuğa dayanıklılığının diğer yağ bitkilerine oranla daha yüksek olması bu bitkinin yakın bir gelecekte öneminin daha da artacağı ve tarımının gelişeceği umudunu vermektedir (Baydar ve Gökmen, 2003).

Ülkemizin bitkisel yağ üretimini arttırmak ve varolan açığı kapatmak için alternatif yağ bitkileri arasında, kurak koşullara dayanıklılığı ve ekiminden hasadına kadar mekanizasyona uygun oluşu ile önemli bir yere sahip olan aspir bitkisinin üreticilere tanıtılması ve veriminin arttırılması amacıyla yapılacak çalışmalara verilen önem arttırılmalıdır (Dalgıç, 2011).

**NEDEN ASPİR?**

Her bitkinin kendine özel avantajı ve dezavantajı vardır. Ancak aspir özellikli bir bitkidir. Zira üretimi ve işleme teknolojisi çok kolaydır. Aspir hakkında genel olarak şunları söyleyebiliriz;

1.Orijinlerinden biri Anadolu olan bir yağ bitkisidir. Yazlık ve kışlık formları vardır ve kuraklığa en dayanıklı bitkilerden biridir.

2. Yağ yüksek kalitededir ve yüksek oranda Linoleic yağ asidi (Omega-6) içerir. Linoleik asit şeker ve kolesterol kontrolü yaptığı gibi yüksek CLA içeriği ile de zayıflamaya yardımcı olur. Temel besin maddelerinden olan yağlar, beslenme zinciri içerisinde mutlaka yer alması gereken ana besin maddelerindendir. İnsan vücudundaki hücre, doku ve organların yapılarında yer aldıklarından, yaşamın sürdürülebilmesi ve vücudun değişik işlevlerini sağlıklı bir şekilde yerine getirebilmesi için, mutlaka alınması gereken maddelerdir (Akınerdem, 2011). Aspir yağı diğer bitkisel yağlardan özellikle yüksek linoleik asit (omega-6) içeriği ile ayrılmaktadır. Ortalama %75 linoleik asit içeren aspir yağında ayrıca antioksidan etkisi ve E vitamini değeri yüksek olan tokoferoller bulunmaktadır. Bu nedenlerle aspir yağı kalp ve damar hastalarının uyguladıkları diyetlerde kullanılmakta ve antikolesterol etkisi nedeniyle büyük önem taşımaktadır (Pongracz vd., 1995).

3.Yağı dinçlik ve enerji verir, bağışıklık sistemini güçlendirir, kadınlar için özel günlerde rahatlama yapar, doğum çatlaklarının kapatılmasında yardımcı olur. Yemeklerde, salatalarda ve kızartmalarda kullanılarak tüketildiği gibi kozmetikte güneş kremi olarak da kullanılabilir.

4. Çiçekleri safran yerine gıdalarda boyama ve lezzet vermek amacıyla tüketildiği gibi çiçekleri ayrıca kaynatılarak içilirse vücutta şeker kontrolü yapar.

5.Sapları ve yağı alındıktan sonra kalan küspesi iyi bir hayvan yemidir. Yağı ayrıca biyoyakıt (biyodizel) üretimine de uygundur.

Ülkemizde bin yıldır bilinmekte olan aspirin ilk bilimsel çalışmaları 1930'lu yıllarda başlamış ve bugüne kadar yerli 10 kadar çeşidimiz tescil edilmiştir. Doğu-Güneydoğu Anadolu bölgelerimizde çiçekleri tatlı ve pilavlara katılmakta, Orta Anadolu'da tohumları kavurga olarak tüketilmektedir. Batıda geleneksel usullerle alınan yağı yemeklik olarak kullanılmaktadır.

Aspir, ülkemizde olduğu gibi dünyanın birçok bölgesinde de kullanım alanları bulmuştur. Etiyopya'da çok ince olarak öğütülen aspir tohumlarının su ile karıştırılmasıyla "fitfit" adı verilen bir içki yapılmıştır. Etiyopya ve Sudan'da genellikle, kavrulmuş aspir tohumları nohut, buğday ve arpa ile karıştırılarak çerez olarak tüketilmektedir. Gıda maddesi olarak bazı Ortadoğu ve Asya ülkelerinde çiçekleri pilav, çorba, sos, ekmek ve turşulara katılarak onların sarı ve parlak turuncu renk almaları sağlanmıştır. İran'da, aspir tohumlarından elde edilen salça kıvamındaki madde, peynirin mayalanmasını hızlandırmak için kullanılmıştır. Bu maddenin, beyaz peynire hoş bir koku ve yumuşaklık verdiği bildirilmektedir. Hindistan, Pakistan ve Burma'da, genç yapraklar ve genç aspir fidecikleri, yeşil salata yapımında kullanılmakta, haşlanarak yenmekte veya sebze yemeği olarak pilavla tüketilmektedir (Babaoğlu, 2007). Batı Avrupa, Japonya ve Latin Amerika ülkelerinde, dikensiz çeşitleri kesme çiçekçilikte kullanılmaktadır (Ekin, 2005).

Aspir bitkisinin mekanizasyona uygun olması, yetiştirilmesi önerilen yerlerde önemli hastalık ve zararlısının olmaması nedeniyle kıraç alanlarda üretilebilmektedir. Tarımında en önemli avantajı, hububat tarımında toprak hazırlığından ürünün depoya alınmasına kadar geçen sürede kullanılan bütün alet-ekipmanın bu bitkinin tarımında kullanılabilmekte, herhangi bir makine değişikliğine gerek olmamasıdır. Yağı alındıktan sonra geriye kalan küspe, içerdiği %22-24 ham protein değeri ile iyi bir hayvan yemi olarak değerlendirilmesidir (Babaoğlu, 2007).

Aspirin dünya pazarlarındaki durumu, yağlarının ve küspelerinin kalitesi, yetiştirme tekniklerinin ve adaptasyonlarının uygunluğu tarım alanlarımız için potansiyel oluşturmaktadır. Aspir adaptasyon sınırlarının geniş olması nedeniyle farklı ekolojilerde yetiştirilebilmektedir. Ayrıca köklerinin toprağın derin katmanlarına inebilmesi ve dikenli bitki oluşu kurağa ve sıcağa toleransını artırmaktadır. Bu özel-

likleri ile aspir, kuru tarım alanlarında ekim nöbetinde yer alabilecek bir yağ bitkisi olarak önem kazanmaktadır. Ülkemizde nadas-buğday sisteminin yaygın olarak uygulandığı İç Anadolu Bölgemizin kurak ve yarı kurak alanlarında aspir buğday ile ekim nöbetinde yer alabilir. Dünya yağlı tohumlar üretiminde soyadan sonra ikinci sırada yer alan kolza, yemeklik sıvı yağ, küspe ve biyodizel üretiminde kullanılan bir yağ bitkisidir.

Aspir, ülkemiz yağ açığını kapatma, hayvan beslenmesi, biyodizel gibi birçok alanlarda kullanılmasının yanı sıra çiçek taç yaprakları gıda, tekstil ve yemeklerde renk verici olarak kullanılmaktadır. Yalancı safran olarak bilinen, aspir çiçeğinin, taç yapraklarından sarı-kırmızı renkli boyar madde içeren Kartamin (%0,3-0,6) elde edilir. Aspir taç yapraklarından elde edilen Kartamin tıbbi olarak kadınların menapoz problemlerinde, kalp damar hastalıkları ve incinmeye bağlı şişliklerde kullanıldığı, ayrıca hipertansiyonu ve kolesterolü düşürüp, kan akışını hızlandırdığı bildirilmektedir (Dajue ve Mündel, 1996).

Aspir bitkisi Türkiye'ye ilk olarak, Bulgaristan'dan gelen göçmenler tarafından Balıkesir ve çevresine getirilmiş ve Türkiye'nin çeşitli illerinde ( Eskişehir, Konya, Isparta, Kütahya, Bursa ) öncelikli yetiştirilme amacı yerel tüketim olmuştur (Nas ve ark. 2001). Ülkemizde aspir bitkisi ile ilgili ilk çalışmaları 1930'lu yıllarda Eskişehir Zirai Araştırma Enstitüsü yapmış, 1931, 1977,2005 ve 2011 yıllarında 4 aspir çeşidinin tescilini gerçekleştirmiştir. Sırasıyla bu çeşitler; Yenice Dinçer Remzibey 05 ve Balcı olmuştur Türkiye de kullanılan aspir çeşitlerinin tamamı yerlidir. Üretimi oldukça ucuz ve kolaydır. Ürün desteklemelerden en yüksek payı alır. Her iki bitkiden aynı miktarda verim alınmasın halinde milli ekonomiye katkısı buğdayın 3 katı kadardır. Türkiye açısından aspir bitkisinin iki türlü faydasından bahsedebilir, bunlar;

1. Ulusal ekonomiye faydaları
2. Toplum sağlığına faydaları.

Ulusal ekonomiye faydalarını, yetersiz yağış nedeniyle üretimde kullanılamayan arazilerde üretime alınması ile enerjide ve bitkisel yemeklik yağda dışa bağımlılığımızı azaltmaktadır. İyi bir münavebe bitkisidir, kendisi gibi yetişme alanı bulan buğday ve arpaya zarar vermez.

Toplum sağlığı açısından önemi, çağımızın en büyük hastalığı olan obeziteyi önlemek üzere yağında bulunan ve zayıflatıcı etkisi olan CLA'dır. Kozmetik olarak tüm vücudu besleyen, güneş kremi ve saç beslenmesinde kullanılan, organik olması ile kozmetiklerinde yan etkisi olmayan, yağı yarı kuruyan yağlardan olduğu için çabuk kuruyan bir yağa sahiptir.

Çiçekleri safran ve şeker düşürücü, çayı içilerek tüketilen gıda boyası, sapları yakacak ve selüloz sanayinde, yağı alındıktan sonra küspesi hayvan yemi olarak kullanılır. Doğu ülkelerinde çiçekleri ve yağı bazı bitkilerle karışım halinde geleneksel tüketimlerde yer alır.

**DÜNYA VE TÜRKİYEDE ASPİR**

Orijini Anadolu'dan başlayıp Afganistan'a kadar uzanan bir hat olduğu için Afganistan, İran, Bangladeş, Kazakistan, Hindistan, Pakistan ve Çin de üretilmekteydi. Sonraları Avustralya, Ukrayna, Meksika, ABD, Arjantin, Etiyopya, Tanzanya gibi daha çok ülkeye yayılmıştır. Yıldan yıla değişmekle beraber dünyada yaklaşık 1 milyon hektar alanda, 750 bin ton aspir üretilmekte, Meksika 144 bin ton ile lider ülkeyken, Kazakistan 135 bin ton, Hindistan'da 113 bin ton ABD de 95 bin ton, Rusya da 80 bin ton ve Türkiye 60 bin ton ile altıncı sırada yer almaktadır. Bu ülkeler dünya aspir üretiminin % 90 'ını karşılamaktadır.

2015 yılında, dünya genelinde 812.195 ha ekim alanı, 708.677 ton üretimi ve 96 kg/da verimi bulunmaktadır (Anonim, 2017a). Türkiye'de 1960'lı yılların başında 70 da olan aspir ekim alanı 1970'li yıllarda 117 da üzerine çıkmıştır. Ekim alanı 2000 yılında 300 da iken 2006 yılına gelindiğinde 4.300 da'a yükselmiş, 2013 yılında ise 29.290 da'a kadar yükseldiği bildirilmiştir. Bununla birlikte, ülkemizde 2017 yılı için 39.571 ha ekim alanı, 58.000 ton üretimi ve 147 kg/da tohum verimi bulunmaktadır (Anonim, 2017b).

Ülkemizdeki aspir üretiminin iyileşmesinde en önemli etkenler; "alım garantili sözleşmeli üretim ve yüksek destekleme politikaları" olmuştur. Türkiye'de aspir tarımının gelişmesinde önemli uygulamalardan biri de gerek tıbbi aromatik bitki, gerekse de yağ bitkileri kategorisinde yer almasıyla her iki yönlü üretim uygulamasından destekleme almıştır. Desteklemeler alet-makine bölümünde olduğu kadar üretim uygulamalarında da önemli bir desteğe sahip olmuştur. Yeni haliyle bile üretim masraflarının neredeyse tamamı devlet tarafından destekleme almaktadır. Desteklemelerin yüksekliği birim alandan alınan verime bağlı olarak artmaktadır. 2017 yılı için serbest piyasada aspir 1 TL/Kg olan fiyata satılmaktadır. Ayrıca devlet tarafından,55 Krş/Kg üretim desteği verilmekte ve bu destek verime göre artış göstermektedir. 15 TL/Da mazot ve gübre, 4 TL/Da sertifikalı tohumluk desteği verilmektedir. Bu destekler sabittir. Dekara 100 kg verim alan bir çiftçi: 174 (100+55+15+4) TL/Da destekle beraber toplam para alırken, dekara 200 kg verim alınması durumunda ise: 329

(200+110+15+4) TL/Da toplam para almaktadır. Türkiye'de dekara ortalama üretim giderlerinin 70 TL/Da olarak hesaplandığı durumda verimin 100 kg/Da olması ile dekara 100 TL, 200 kg olması durumunda ise 255 TL gelir elde edilmektedir.

Yine ülkemizde aspirin yetiştirilmesi için üreticilere verilen teşvikler; sözleşmeli tarım, tohumluk, gübre+mazot ve ürün desteklemeleridir. İç pazarda yaklaşık kg'ı 1 liraya satılan aspir tohumunun desteklerle beraber çiftçinin eline yine kg başına 1.7 TL kadar para geçmektedir. Bunun anlamı üretim maliyetinin neredeyse tamamı devlet desteği olarak verilmekte, ham satış değeri de çiftçiye kalmaktadır. Diğer bir ifadeyle 100 kg/Da ürün alan çiftçinin eline 100 TL/Da kalmakta iken diğer bir ifadeyle 300 kg/Da buğdaydan elde edilen gelire denk düşmektedir.

Türkiye'nin aspir üretim potansiyeli bunun çok üzerindedir. Ülkemizde 5 milyon hektar aspir yetiştiriciliğine uygun alan vardır. Bu alanda üretim yapılması ile en az 6 milyon ton aspir tohumu, bundan da 2 milyon ton ham yağ, 4 milyon ton küspe elde edilebilir. Bu değerde bir üretimin ülke ekonomisine katkısının 10 milyar USD kadar olabileceği tahmin edilmektedir. Bu bir hedeftir, aspir için üzerinde durulacak en önemi konu da budur.

Aspir bu ülkenin öz malıdır. Bu nedenle de ülkemiz şartlarına en uygun, üretimi en ekonomik, hiçbir ilave yatırıma ihtiyaç duymadan üretilebilen, ekiminden hasadına kadar mekanize olabilen ve de "pazarı hazır" bir bitkidir.

Aspir Türkiye'de yağışı yeterli olmayan nadas alanlarının yoğun bulunduğu Orta Anadolu ve Geçit Bölgelerinde yetiştirilmektedir. Ankara başta olmak üzere, Yozgat, Kırşehir, Eskişehir, Nevşehir, Konya, Aksaray, Kırıkkale, Amasya, Kütahya, Kayseri, Afyon ve Muş yetişme alanları olarak sayılabilmektedir.

Aspir Türkiye için stratejik bir bitkidir. Bunun nedeni kendisi ile aynı ekolojide yetişen hiçbir bitkiye zarar vermediği gibi tam aksine ikili- üçlü münavebe sistemi içinde yetiştirilme alanı bulma kapasitesine sahip olmasındandır.

Bunun yanında yıllık yağışı 300-350 mm olan yerler için de son derecede uygun olduğu gibi aşırı kuraklık ortamında arpa-buğday gibi bitkilerin biçilemeyecek derecede zarar görmesi yanında aspir en azından tarlada kalmamakta, dekara 50 kg verim alınması durumunda bile üreticinin zararını önleyecek durumda olmaktadır. Beklentimiz, potansiyelimiz olan 5 milyon hektar nadas alanın tamamında olmasa da hiç değilse üçlü münavebe sistemi ile 1/3 ünün aspir üretimine alınması durumunda bile toplam 2-3 milyon ton aspir alınması mümkün olacaktır.

## SONUÇ

Orijini Anadolu, en kırsal kesimde bile en düşük masraf ve teknoloji ile yetişen, pazar payı olan, devletten en yüksek desteği alan; kaliteli yağından, çiçeklerinden, saplarından istifade edilen bu nedenle de ülkemiz için en çok döviz ödediğimiz enerji ve bitkisel yemeklik yağ ihtiyacımıza cevap veren bu bitkinin üretilmesi, üreticilerimiz için üretme, devletimiz için doğru politika belirleme zorunluluğunu ortaya koymaktadır. Son birkaç yıldır "jet yakıtı" projesinde kullanılacak bir bitki olması ile konu hakkında oluşturulan proje ekibinin kısa zamanda bu projeyi gerçekleşmesi ümidindeyiz.

Ülke olarak 10 yıl kadar kısa bir sürede dünyada istatistiklere dahi girmeyen aspir bitkisinin istikrarlı politikalarla, bu artış hızıyla kısa sürede dünyada bir numaraya yerleşeceği tahmin edilmektedir. Mevcut durumda dış ülkelere tohumluk ve ham yağ satışımız olması bu ümidimizi daha da artıran etkenler arasındadır.

## KAYNAKLAR

Akınerdem, F., Coşge, B. (2014). 2. Tarım ve Biyoyakıtlar Paneli. Bozok Üniversitesi, Erdoğan Akdağ Kültür Merkezi, Yozgat.

Akınerdem, F., Ada, R., Öztürk, Ö. (2013). Biyoyakıtlar: EPDK Kararları, Bugünü ve Geleceği. 1. Tarla Bitkileri Kongresi, 10-13 Eylül, 2013, Konya.

Akınerdem, F. (2011). Stratejik ve Ekonomik Değeri Yüksek Bir Tarım Alanı: Yağ Bitkileri ve Üretim Politikaları. Gübretaş"la Verim Dergisi, Mart-Nisan, 24.

Anonim, (2017a). TÜİK. http://www.tuik.gov.tr/Start.do

Anonim, (2017b). Food and Agricultural Organization. http://www.fao.org/faostat/en/#home

Babaoğlu, M. (2007). Aspir Tarımı.Trakya Tarımsal Araştırma Enstitüsü Yayınları, Edirne.

Baydar, H., Gökmen, O. Y. (2003). Hybrid Seed Production in Safflower (Carthamus tinctorius L.) Following the Induction of Male Sterility by Gibberellic Acid. Plant Breed., 122: 459-461.

Dalgıç, H. (2011). Farklı bitki sıklığı ve yabancı ot mücadelesi uygulamalarının aspirde verim ve kaliteye etkisi, Selçuk Üniversitesi Fen Bilimleri Enstitüsü Yüksek Lisans Tezi, 50.

Ekin, Z. (2005). Resurgence of safflower (Carthamus tinctorius L.) utilization: A Global View. Journal of Agronomy 4 (2): 83-87.

Nas, S., Gökalp, Y. H., Ünsal, M. (2001). Bitkisel Yağ Teknolojisi. Atatürk Üniversitesi, Ziraat Fakültesi. Yayın No: 312, Ders Kitabı No: 64, s.48-50, Erzurum.

Pongracz, G., Weiser, H., Matzinger, D. (1995). Tocopherole, Antioxidation der Natur. Fat. Sci. Technol., 97, 90-104.

# О-122 Продуктивность пшеницы озимой в зависимости от обработки почвы в условиях Региона Центральной Анатолии Турции

**Н**. **Акгюн**[1], Т. Маракоглу[2] **и** К.**Чарман**[2]

[1]Селчукский Университет, Селскохозяйственний Факултет,Отдел Полевых Культур

[2] Селчукский Университет, Селскохозяйственний Факултет,Отдел Машин Земледелия

**РЕЗЮМЕ**

Наибольшие урожаи пшеницы возможны при соблюдении технологии, один из основных элементов которой – обработка почвы. Цель наших исследований – определение роли обработки почвы в повышении урожайности пшеницы озимой в Регионе Центральной Анатолии. Работу проводили в стационарном опыте на полях Земледелческого предприятия – Конуклар к Главной дирекции земледелческих предприятий (ТИГЕМ), расположенных в южном районе Региона, в 2006-2009 гг. Почва опытного участка песчаная-глинистая малогумусная (1,60-1,85% гумуса). Приемы по обработке почвы были традиционный, минимальный, нулевый (no till) и нулевый + гербицид. Содержание гравиметрической влаги по приемом в среднем составило: по традиционному 21,42%, по минимальному – 21,69%, по нулевому и нулевому + гербицидом – 23,01%. Урожайность пшеницы озимой по обработкам по традиционной колебалась от 33.19 до 22.90 ц га$^{-1}$, по минимальной – от 29.96 до 22.65 ц га$^{-1}$, по нулевой– от 39.36 до 36.15 ц га$^{-1}$, по нулевой + гербицидом – от 35.28 до 30.07 ц га$^{-1}$. Наименьшее количество расходов в посевах пшеницы озимой отмечено по обработкам нулевой и нулевой + гербицидом (12606,26 и 13226,23 Mj га$^{-1}$), наибольшее – по традиционной и минимальной (14803,40 и 13335,08 Mj га$^{-1}$). Наименьшее количество доходов отмечено по традиционной и минимальной (37812,81 и 38125,54 Mj га$^{-1}$), наибольшее – по нулевой и нулевой + гербицидом (53173,82 и 47006,68 Mj га$^{-1}$). В нулевой и нулевой + гербицидом длина колоса, число полосков в колосе, количество зерен в колосе, сухой вес зерна с колоса, индекс урожайности и объемная масса зерна значительно увеличились, а высота растений, количество продуктивных стеблей и масса тысячи зерен статистически неизменились. Меньше всего объемных масс зерна отмечали по традиционному и по минимальному (72,50-72,27 кг 100 л$^{-1}$), по нулевому и нулевому + гербицидом их количество достигало 74,35-73,05 кг 100 л$^{-1}$.

Ключевые слова: пшеница озимая, обработка почвы, урожайность.

# Productivity of winter wheat depending on soil cultivation under Central Anatolian Region conditions of Turkey

N. Akgun[1], T. Marakoglu[2] and K. Carman[2]

[1]Selcuk University, Agricultural Faculty, Departement of Field Crops, Konya, Turkey

[2]Selcuk University, Agricultural Faculty, Departement of Agricultural Machineries and Tecnologies Engineering, Konya, Turkey

**ABSTRACT**

The highest yields of wheat are possible by keeping of technology, one of the main elements of which is the soil cultivation. The aim of our research was the definition of the role of tillage in improving the yield of winter wheat in the Region of Central Anatolia. The work was carried out in the stationary experiment on the margins of Farm Enterprise - Konuklar to the General Directorate of Farm Enterprises (TIGEM), located in the southern area of the region in 2006-2009. The soil of pilot area is sandy-clay with little humus (1.60-1.85% humus). Techniques for soil treatment were traditional, minimum, no till and no till + herbicid. The content of gravimetric moisture by taking the average was as follows: 21.42% for the traditional, the minimum - 21.69%, the no till and no till + herbicid - 23.01%. Yields of winter wheat in the traditional treatments ranged from 3,319 to 2,290 t ha$^{-1}$, at a minimum - from 2,996 to 2,265 t ha$^{-1}$, at no till from 3,936 to 3,615 t ha$^{-1}$, at no till + herbicid from 3,528 to 3,007 t ha$^{-1}$. The least amount of expenditure in crops of winter wheat was recorded in treatments of no till and no till + herbicid (12606.26 and 13226.23 Mj ha$^{-1}$), the highest - in the traditional and minimal (14803.40 and 13335.08 Mj ha$^{-1}$). The smallest amount of income was recorded in the traditional and minimal (37812.81 and 38125.54 Mj ha$^{-1}$), the largest - at no till and no till + herbicid (53173.82 and 47006.68 Mj ha$^{-1}$). In the no till and no till + herbicid spike length, number of spikelets per spike, number of kernel per spike, kernel weight per spike, harvest index and test weight increased significantly, and the plant height, the number of productive stems and thousand kernel weight statistically unchanged. The lowest volume of test weight celebrated by the traditional and the minimum (72,50-72,27 kg 100 l$^{-1}$), the test weight of no till and no till + herbicid reached to 74,35-73,05 kg 100 l$^{-1}$.

**Keywords**: winter wheat, soil cultivation, yields.

## ВВЕДЕНИЕ

В результате исследований, проведенных учеными Чен и др. (2004), Барут и Челик (2008), Айкас и Юнал (1999), Йалчин и др. (2005), Унгер и др. (1988) а также и учеными Зауралья Курлов и др. (2013) и Немченко и др. (2015) - установлена эффективность безотвального способа обработки почвы, особенно в комбинированных

сочетаниях со вспашкой и поверхностными приемами, что позволило применить систему безотвального земледелия на больших площадях. Сегодня на полях нашего региона широко применяются ресурсо- и влагосберегающие агротехнологии возделывания зерновых культур, включающие мульчирующие приемы обработки, осваиваются элементы нулевой технологии, где проводится прямой посев с минимальным нарушением поверхностного слоя почвы. При этой системе обработки возникает много нерешенных вопросов, касающихся условий питания растений, фитосанитарного состояния, водно-физических свойств, плотности почвы, возможности выращивания тех или иных культур, набора и ассортимента техники и других.В связи с этим в нашем университете, начиная с 2006 года, в бессменных посевах пшеницы проводятся исследования по разработке технологии выращивания озимой пшеницы на основе нулевой системы обработки, признанной в мире как no-till. Альтернативой служат традиционная технология с ежегодной вспашкой на 20-22 см и минимальная с осенней поверхностной обработкой почвы на 6-8 см. При традиционной технологии пар готовится по типу черного (вспашка и 4-5 культиваций в период парования), при минимальной – поверхностная осенняя, при нулевой – химическим способом, который включает обработка грамоксоном (паракват) 3 л га$^{-1}$. Исследования проведены в 2006-2009 гг. в стационарном опыте на полях Земледелческого предприятия – Конуклар к Главной дирекции земледелческих предприятий (ТИГЕМ) в центральной природно-климатической зоне региона Анатолии на почве со следующими агрохимическими характеристиками: содержание гумуса 1,60-1,85%, фосфора – 14.58-15.94 мг кг$^{-1}$ почвы и pH – 7.60-7,72 **(табл.1).**

Таблица 1. Характеристика почвы опытных полей.

| Способы посева | Традиционный | Минимальный | Нулевый и нулевый + гербицид |
|---|---|---|---|
| Гравиметрическая влага (%) (0–20 **см**) | 21.42 | 21.69 | 23.01 |
| pH | 7.69 | 7.72 | 7.60 |
| **Органическое вещество** (%) | 1.60 | 1.30 | 1.85 |
| **Известь** (%) | 13.1 | 15.8 | 15.2 |
| **Фосфор** (**мг кг**$^{-1}$) | 15.94 | 15.09 | 14.58 |
| **Калий** (**мг кг**$^{-1}$) | 542.4 | 568.64 | 510.96 |

Погодные условия в период исследований 2006-2009 гг. характеризовались как засушливые, отличались высоким температурным режимом, неравномерным выпадением осадков и даже полным их отсутствием в наиболее критические для роста и развития растений фазы **(табл. 2).**

Таблица 2. *Погодные условия вегетационного периода*.

| Месяцы | Температура воздуха, ºC | | | | Осадки (мм) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2006-2007 | 2007-2008 | 2008-2009 | Среднемноголетная | 2006-2007 | 2007-2008 | 2008-2009 | Среднемноголетная |
| октябръ | 3.8 | 12.8 | 11.4 | 12.3 | 46.0 | 10.0 | 30.0 | 29.3 |
| ноябръ | 2.0 | 7.8 | 8.2 | 6.4 | 16.0 | 67.5 | 21.0 | 31.4 |
| декабръ | -0.7 | 1.0 | 0.5 | 1.8 | - | 37.0 | - | 40.8 |
| январъ | -2.2 | -3.8 | 4.6 | -0.2 | 32.0 | 6.0 | 41.4 | 39.3 |
| февралъ | -0.2 | -3.2 | 3.6 | 1.5 | 23.0 | 20.0 | 23.9 | 31.4 |
| mart | 5.4 | 9.0 | 4.5 | 5.4 | 18.0 | 22.0 | 22.0 | 29.8 |
| апрелъ | 7.7 | 12.9 | 9.5 | 11.1 | 14.0 | 11.5 | 32.7 | 31.0 |
| май | 18.3 | 14.5 | 14.4 | 15.8 | 2.0 | 17.5 | 48.5 | 45.5 |
| июнь | 21.1 | 20.9 | 20.3 | 19.9 | 3.0 | 9.0 | 6.0 | 25.0 |
| июль | 24.3 | 23.2 | 23.2 | 23.2 | - | - | 20.7 | 6.5 |
| среднее | 8.0 | 9.5 | 10.0 | 11.5 | - | - | - | - |
| сумма | - | - | - | - | 154.0 | 200.5 | 246.2 | 310.0 |

**МАТЕРИАЛ И МЕТОД**

По вспашке и поверхностной осенней обработке пшеницу высевали дисковой сеялкой, по стерне – сеялкой прямого посева с дисковыми сошниками. На вариантах с прямым посевом стерневой фон обрабатывали до посева гербицидом (паракват 3 л га$^{-1}$) сплошного действия **(Рис.1**). В период кущения на всех вариантах технологий применяли баковые смеси гербицидов против двудольных и злаковых сорняков.


Рисунок 1. Способы посева.

Система удобрений включала два этапа: первый осенью с внесением сеялкой минерального азота 40 кг и фосфора 90 кг д.в. на гектар, второй – с внесением поверхностно весной минерального азота 60 кг д.в. на гектар. Срок посева – вторая-третья декада октября. Норма высева пшеницы при посеве – 5,0 млн. всхожих зерен на гектар. Повторность в опыте четырехкратная. Уборку проводили комбайном.

**РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ**

Для центральной Анатолии, где за год выпадает в среднем 300-325 мм осадков, очень важно иметь хорошие весенние запасы влаги в почве, что гарантирует получение дружных всходов. Результаты исследований показывают, что при нулевой технологии за счет стерни и растительных остатков, по сравнению с традиционной, где применяется глубокая вспашка, или минимальной с поверхностной обработкой почвы, больше накапливалось и сохранялось к посеву продуктивной влаги. В период всходов пшеницы содержание гравиметрической влаги по приемом в среднем составило: по традиционному 21,42%, по минимальному – 21,69%, по нулевому и нулевому + гербицидом – 23,01%. Посев в необработанную почву с сохранением стерни позволял в засушливые годы существенно уменьшить непродуктивные потери влаги и создать растениям более комфортные условия по влагообеспеченности в наиболее критические для них фазы развития **(табл. 1).**

Наблюдение за фитосанитарным состоянием посевов показало, что основным сорным компонентом в агроценозах на вариантах с нулевой системой обработки почвы являлись однолетние мятликовые и двудольные сорняки, которые составляли от 80 до 100% массы сорных растений в посевах даже пшеницы по пару. Применение системы гербицидов, включающей паракват и группы 2,4-Д за три года позволило практически полностью очистить поля от многолетних видов сорняков.

Принято считать, что с переходом на нулевую систему обработки почвы повышается опасность поражения зерновых культур корневыми гнилями. Однако в нашем опыте такого не произошло. Урожайность пшеницы озимой по обработкам по традиционной колебалась от 33.19 до 22.90 ц га$^{-1}$, по минимальной – от 29.96 до 22.65 ц га$^{-1}$, по нулевой– от 39.36 до 36.15 ц га$^{-1}$, по нулевой + гербицидом – от 35.28 до 30.07 ц га$^{-1}$.

Таблица 3**.** Значения хозяйственных признаков по способам посева *озимой пшеницы и группы НСР,* среднее по опыту за 2006-2009 гг.

| *Признаки* | 1 | 2 | 3 | 4 | **НСР** |
|---|---|---|---|---|---|
| Урожайность, *ц* га$^{-1}$ | 26.61 b | 26.83 b | 37.42 a | 33.08 a | 4.46** |
| Высота растений, см | 80.58 | 79.32 | 80.32 | 78.53 | ns |
| Длина колоса, см | 7.41 b | 7.41 b | 7.77 ab | 8.42 a | 0.74** |
| Число полосков в колосе, шт | 15.01ab | 14.78 b | 15.75 ab | 16.23 a | 1.44** |
| Количество зерен в колосе, шт | 25.36 b | 27.21 b | 29.64 a | 30.54 a | 2.28** |
| Сухой вес зерна с колоса, г | 0.75 b | 0.70 b | 0.89 a | 0.99 a | 0.11** |
| Количество продуктивных стеблей, шт м$^{-2}$ | 650 | 636 | 677 | 663 | ns |
| Индекс урожайности , % | 27.03 b | 26.67 b | 28.40 ab | 29.20 a | 1.77* |
| Масса ١٠٠٠ зерен, г | 28.93 | 28.91 | 26.94 | 28.76 | ns |
| Объемная масса зерна, кг 100л$^{-1}$ | 72.50 b | 72.27 b | 74.35 a | 73.05 ab | 1.47* |

**: P<0.01; *:P< 0.05; ns: отсутствие связи; 1- традиционный, 2- минимальный, 3- нулевый, 4-нулевый + гербицид.

Наибольшая средняя урожайность пшеницы получена по нулевой обработке 37.42 ц га$^{-1}$, по химической обработке урожайность пшеницы приблизилась к уровню урожайности по нулевой обработке **(табл. 3).**

В нулевой и нулевой + гербицидом длина колоса, число полосков в колосе, количество зерен в колосе, сухой вес зерна с колоса, индекс урожайности и объемная масса зерна значительно увеличились, а высота растений, количество продуктивных стеблей и масса тысячи зерен статистически неизменились.

Меньше всего объемных масс зерна отмечали по традиционному и по минимальному (72,50-72,27 кг 100 л$^{-1}$), по нулевому и нулевому + гербицидом их количество достигало 74,35-73,05 кг 100 л$^{-1}$. **(табл. 3 и 4).**

Таблица 4. *Результаты дисперсионного анализа* способов посева *озимой пшеницы*.

| *Признаки* | Источник вариации | | | |
|---|---|---|---|---|
| | A (год) | B (способ) | AXB | Вариация, % |
| Урожайность | ** | ** | ** | 13.14 |
| Высота растений | ** | ns | ns | 6.41 |
| Длина колоса | ** | ** | ns | 8.65 |
| Число полосков в колосе | ** | ** | ns | 8.39 |
| Количество зерен в колосе | ** | ** | ** | 7.52 |
| Сухой вес зерна с колоса | ** | ** | ** | 12.74 |
| Продуктивных стеблей | ** | ns | ns | 15.57 |
| Индекс урожайности | ** | * | * | 7.67 |
| Масса 1000 зерен | ** | ns | ns | 9.65 |
| Объемная масса зерна | ** | * | ** | 2.42 |
| **: P<0.01 ; *:P< 0.05; ns: отсутствие связи. | | | | |

Одной из главных задач наших исследований является экономическая оценка новых технологий. Цена, в свою очередь, зависит от себестоимости, поэтому основной задачей сельхозтоваро-производителей становится снижение затрат на производство. На табл. 5 и 6 приведены данные по экономической эффективности результатов урожайности в опытах.

Таблица 5. **Эквивалентности энергии.**

| *Признаки* | **Единица** | **Эквивалентность энергии** (Mj **единица**$^{-1}$) | **Рекомендация** |
|---|---|---|---|
| А. Расходы | | | |
| Рабочая сила | час | 1.87 | Смил, 1983. |
| Трактор | кг | 92.5 | Шолц и Каулфус, 1995 |
| Механизация | час | 62.7 | Ердал и др., 2007 |
| Топливо-масло | литр | 41.0 | Райнхард, 1993 |
| Химикат | кг | 120.0 | Чанакчи и др.,2005; Мандал и др., 2002 |
| N | кг | 47.1 | Калтшмит и Райнхард, 1997 |
| P | кг | 15.7 | Калтшмит и Райнхард, 1997 |
| Семена | кг | 25.0 | Озкан и др., 2004 |
| **Б**. Доходы | | | |
| Урожай | кг | 14.21 | Пиментел, 1980 |

Таблица 6. **Баланс энергии и параметры** (Mj **га**$^{-1}$) **урожая** *озимой пшеницы.*

| Способы посева | Традиционный | Минимальный | Нулевый | Нулевый + гербицид |
|---|---|---|---|---|
| А. Расходы | | | | |
| Рабочая сила | 7.98 | 6.32 | 3.39 | 3.71 |
| Трактор | 182 | 175.28 | 93.95 | 102.91 |
| Механизация | 220.3 | 212.17 | 113.73 | 124.57 |
| Топливо-масло | 2928.22 | 1476.41 | 930.29 | 1170.14 |
| Химикат | 360 | 360 | 360 | 720 |
| N | 4521.6 | 4521.6 | 4521.6 | 4521.6 |
| P | 1083.3 | 1083.3 | 1083.3 | 1083.3 |
| Семена | 5500 | 5500 | 5500 | 5500 |
| Сумма расходов | 14803.4 | 13335.08 | 12606.26 | 13226.23 |
| Б. Доходы | | | | |
| Урожай | 37812.81 | 38125.54 | 53173.82 | 47006.68 |

Анализ показывает, что наименьшее количество расходов в посевах пшеницы озимой отмечено по обработкам нулевой и нулевой + гербицидом (12606,26 и 13226,23 Mj га$^{-1}$), наибольшее – по традиционной и минимальной (14803,40 и 13335,08 Mj га$^{-1}$). Наименьшее количество доходов отмечено по традиционной и минимальной (37812,81 и 38125,54 Mj га$^{-1}$), наибольшее – по нулевой и нулевой + гербицидом (53173,82 и 47006,68 Mj га$^{-1}$). В большей степени на себестоимость влияют способ обработки почвы и применение средств химизации.

**ВЫВОДЫ**

Таким образом, в центральной природно-климатической зоне региона Анатолии, где часто повторяются майско-июньские засухи, применение нулевой технологии дает возможность больше сохранять продуктивной влаги к посеву. Нулевая технология в засушливые годы стабилизировала урожайность пшеницы и увеличивала выход зерна с гектара, при этом себестоимость снижалась. Уменьшить себестоимость зерна пшеницы при возделывании по нулевой технологии возможно за счет снижения стоимости химикато и азотных удобрений, цены на которые сегодня достаточно высоки для производителей.

**ЛИТЕРАТУРА**


Айкас, Е., Йалчин, Н. & Чакир, Е. (2003). Günümüzde koruyucu toprak işleme ve doğrudan ekim. *Koruyucu Toprak İşleme ve Doğrudan Ekim Çalıştayı*, 1–8, İzmir.

Айкас, Е. & Юнал, İ. (2008). Effect of different tillage seeding and weed control methods on plant growth and wheat yield. 7. *International Congress on Mechanization and Energy in Agriculture*, 26-27 May, Adana, Turkey.

Барут, З.Б. & Челик, И. (2008). Anıza doğrudan ekim yöntemlerinin buğday/mısır döngüsünde bitki gelişimine etkileri. *Anıza Doğrudan Ekim Çalıştayı*, 16-17 Aralık, Eskişehir.

Ердал, Г., Есенгюн, К., Ердал, Х. & Гюндюз, О. (2007). Energy use and economical analysis of sugar beet production in tokat province of Turkey. *Energy*, 32: 35–41.

Калтшмит, М. & Райнхард, А. (1997). Nachwachsende Energieträger. *Grundlagen, Verfahren, Okologische Bilanzierung.* Vieweg Verlag Braunschweig, Wiesbaden.

Курлов, А. П., Гилев, С. Д., Замятин, А. А. & Степных, Н. В. (2013). Перспективы нулевой технологии возделывания яровой пшеницы в Центральной лесостепи Зауралья, Земледелие. *№ 1*.

Мандал, К.Г., Саха, К.П., Гош, П.К., Хати, К.М. & Бандопадйай, К.К. (2002). Bioenergy and economic analysis of soybean-based crop production systems in Central India. *Biomass Bioenergy* 23(5): 337–345.

Немченко, В. В., Кекало, А. Ю., Филиппов, А. С. & Заргарян, Н. Ю. (2015). **Изменение фитосанитарной обстановки посевов пшеницы при минимизации обработки почвы в условиях зауралья**. ***Аграрный вестник Урала № 6,*** 136.

Озкан, Б., Акчаоз, Х. & Ферт, Дж. (2004). Energy input–output analysis in Turkish Agriculture. *Renew Energy* 29: 39–51.

Пиментел, Д. (1980). *Handbook of Energy Utulization in Agriculture*. CRC Press, Inc., Florida.

Райнхард, Г.А. (1993). Energie und CO2Bilanzierung nachwachsender Rohstoffe. 2nd. Edition Vieweg, Braunschweig/Wiesbaden.

Смил, В. (1983). Energy analysis and agriculture. An application to US. *Corn Production. Boulder, CO: Westview Press*.

**Унгер**, **П**. **В**., **Лангдал**, **Д.В.** & **Папендик**, Р.И. (1988). Role of crop residues– improving water conservation and use. *Cropping strategies for efficient use of water and nitrogen,* vol. 51 (ed. W.L. Hargrove): 69-100. Madison, WI: American Society of Agronomy.

Чанакчи, М., Топаечи, М., Акинджи, И. & Озмерзи, А. (2005). Energy use pattern of some field crops and vegetable production: Case study for Antalya Region, Turkey. *Energy Convers Manage* 46: 655–66.

**Чен**, **Й**., Те**сиер**, С.& **Ървин**, **Б.** (2004). Drill and crop performances as affected by different drill configurations for no-till seeding. *Soil and Tillage Research,* 77: 147-155.

Шолц, В. & Каулфус, П. (1995). *Energiebilanz für Biofestbrennstoffe. Forschungsbericht 1995/3 des Insituts für Agrartechnik Bornim e.V.* (ATB) Postdam.

**Ялчин**, **Х**., **Чакир**, Е. & **Айкас**, Е. (2005). Tillage parameters and economic analysis of direct seeding, minimum and conventional tillage in wheat. *Journal of Agronomy*, 4: 329-332.

# O-123 Determination of Yield and Yield Component of Red Lentil (*Lens culinaris* Medik.) Varieties Grown Under Harran Plain Condition

**Hasan ASLAN[1*] and Mahmut GAYBERİ[1]**

[1]GAP Agricultural Research Institute, Sanliurfa, Turkey

*hasanaslan@tarim.gov.tr

**Abstract**

Lentil which is indispensable plant of arid areas of South East Region comes into questions due to its nutritional value and importance in terms of health so new researches have been needed. In this study, it was aimed to determine the high yield red lentil varieties suitable for Sanliurfa conditions and an experiment was carried out with 11 registered red lentil varieties (Kafkas, Özbek, Çiftçi, Fırat 87, Seyran 96, Yerli Kırmızı, Çağıl, Altıntoprak, Şakar, Tigris, Evirgen) as field experiment and performance (Plant height, thousand kernel weight and yield) of varieties and phenological measurements (Flowering day counts and maturating day counts) were evaluated. According to the results of the variance analysis, there were significant differences in the characteristics of the varieties evaluated. According to the results of one-year trial, performance of the Tigris variety came to the forefront with yield and the earliest maturating days and production of high vegetative biomass.

**Keywords:** Red lentil, Sanliurfa, lentil yield, yield components

## Introduction

Consumption of cereals in Turkey is at the first rank in the world; however, consumption of meat is at the last rank. Human beings need foods being rich in terms of carbohydrate in order to supply essential necessities to survive and they need foods which are rich in terms of protein because protein contains basic structure of tissue (Akçin, 1988). Lentil, chick-pea, bean, broad bean, pea, cowpea contain edible legumes that are important for human nutrition, agricultural economy and sowing cereals alternately (Yıldız, 2007).

Lentil domesticated with start of agriculture are diploid (2n=14), productive itself and one year legume plant (Yağmur and Kaydan, 2004). Lentil contain 26 % protein ratio and mostly consist of thiamine and niacine (Akçin, 1988; Şehirali, 1988). Lentil seeds also contain some amino acids such as alpha hydroxyornithine, alpha-hydroxyarginine and homoarginine which other seeds don't contain (Sulser and Sager, 1974).

Increase in world population raised the need for more food, in spite of that there are no raise in agricultural fields. Thus, countries need more productive and high yield varieties in order to meet nutrient consumption demands of people. Moreover, decrease in yield loss result from harvest technique, bad weather condition and variety selection is important for profitable production (Yağmur and Kaydan, 2004). In this study, we have investigated individual yield and some technical properties of different red lentil varieties registered under Harran Plain condition.

## Material and Method

This study was conducted at Talat Demiroren Research Station of GAP Agricultural Research Institute during 2015- 2016 production season. Station is 34 km out of Sanliurfa Province. Altitude of the plot area is 410 m and 36º 42' North and38º 58 East point of global place. Soil was taken up for chemical and physical analyses and result of analyze was given on Table 1.

Table1.Chemical and Physical Properties of Experiment Soil

| Year | Soil depth (cm) | EC (dS/m) | Carbonate Cont. (%) | pH | Avail. P (kg/da) | Avail. K (kg/da) | Organic M (%) | Saturation (%) |
|---|---|---|---|---|---|---|---|---|
| 2015-2016 | 0-30 | 1075 | 28.4 | 7.64 | 2.62 | 119.5 | 1.74 | 70 |

Precipitation of research station is 330 mm according to long term measurement (1979-2015). Spring last frozen is between 31 March and 10 April, autumn early frozen is between 20 to 30 November. Meteorological data which belongs to production period of 2015-2016 was given on table 2 (DMI, 2016).

Table 2. Meteorological Data of Experiment Station

| Aylar | Temperature Values (ºC) | | Precipitation Values (mm) | |
|---|---|---|---|---|
| | 2015-2016 average temp. | 1950-2015 average long term temp. | 2015-2016 Precipitation | 1979-2015 Long term precipitation |
| October | 21.70 | 20.10 | 22.40 | 19.00 |
| November | 14.00 | 12.70 | 10.40 | 41.30 |
| December | 8.70 | 7.50 | 6.50 | 53.20 |
| January | 4.70 | 5.60 | 75.80 | 62.40 |
| February | 11.50 | 7.00 | 24.20 | 57.50 |
| March | 13.60 | 10.90 | 16.60 | 48.40 |
| April | 20.40 | 16.20 | 28.70 | 26.70 |
| May | 23.20 | 22.10 | 16.40 | 19.90 |
| June | 29.80 | 28.10 | 0.00 | 3.00 |
| July | 32.90 | 31.90 | 0.00 | 0.00 |
| August | 33.40 | 31.30 | 0.00 | 0.00 |
| September | 26.50 | 26.80 | 1.00 | 2.20 |

Eleven different red lentil varieties (Kafkas, Özbek, Çiftçi, Fırat 87, Seyran 96, Yerli Kırmızı, Çağıl, Altıntoprak, Şakar, Tigris, Evirgen) were used as experiment material registered by different institutions. Experiment was conducted with randomized block experiment design with 5 m tall and six raw and 20 cm inter raw space as four replicate. Sowing of seeds took place with seeder where 300 plant occurred in a plot at 23.11.2015. Harvest of plots were taken place with harvest machine.

Flowerings 50 % days, physiologic maturation days, plant height, thousand kernel weight and grain yield data were collected during phenological stage of plants. Collected data were statistically analyzed with JUMP statistic software and comparison of mean values provided with LSD multiple comparison method.

## Result and Discussion

Red lentil varieties' flowering days were found statistically important at $P<0.01$ significant level (Table 3) which were grown under Sanlıurfa condition during 2015-2016 production period. Longest flowering day is belong to Çiftçi variety with 87 days and lowest flowering day is belong to Şakar variety with 80.3 days. Kafkas, Özbek, Çiftçi, Fırat 87 and Yerli Kırmızı varieties have the highest flowering days and Şakar variety has the lowest flowering day.

Table 3.Phenological and Individual Properties of Red Lentil Varieties Used in Experiment

| Varieties | Flowering Day Count (Day) | Maturation Day Count (Day) | Plant Height (cm) | Thousand Kernel Weight (g) | Grain Yield (kg/da) |
|---|---|---|---|---|---|
| Kafkas | 86 a | 135.5 a | 38.6 de | 39.8 bc | 95.4 de |
| Özbek | 86.3 a | 131.0 a | 36.1 ef | 35.4 de | 86.8 e |
| Çiftçi | 87 a | 121.0 b | 41.3 bc | 40.5 b | 75.6 f |
| Firat 87 | 86 a | 135.3 a | 44.2 a | 41.0 b | 62.6 g |
| Seyran 96 | 83.3 b | 116.5 bc | 38.8 cde | 38.7 c | 48.8 h |
| Yerli Kırmızı | 86.0 a | 135.5 a | 42.5 ab | 40.6 b | 47.8 h |
| Çağıl | 83.3 | 117.5 bc | 35.6 f | 35.4 de | 101.3 cd |
| Altıntoprak | 82.0 b | 113.0 c | 34.6 f | 36.3 d | 115.9 ab |
| Şakar | 80.3 c | 115.0 c | 40.0 bcd | 46.0 a | 103.0 cd |
| Tigris | 82.5 b | 114.0 c | 35.3 f | 33.5 f | 119.0 a |
| Evirgen | 82.5 b | 113.0 c | 35.3 f | 33.8 ef | 109.4 bc |
| CV | 0.89 | 1.99 | 4.82 | 3.03 | 6.8 |
| LSD | 0.92 | 4.53 | 2.67 | 1.7 | 8.6 |

Biçer and Şakar (2004) point out that Sakar variety is the earliest lentil specie which was produced in South East Anatolia Region. Aydoğan et al. (2005) conducted three location (Haymana, Esanboga and Kadınhanı) variety experiment with Firat 87 and Seyran 96 species and they revealed that Firat 87 and Seyran 96 varieties are the latest maturating lentil species for Central Anatolia Region.

Maturating days of lentil varieties were found statistically important at $P<0.01$ significant level (Table 3). The highest maturation days of lentil variety is belong to Kafkas and Yerli Kırmızı with 135.5 days and the lowest maturation day is belong to Altıntoprak and Evirgen specie with 113 days. Öktem (2016) suggested that early flowered lentil varieties are maturating early, So that, Early maturating properties are useful for hot regions such as South East Anatolia Region. the weather condition of Harran Plain changes suddenly and temperature of Plain increase after April 15. According to this changing environment maturation of lentil seeds are taken place rapidly.

Thousand kernel weight of lentil varieties were found statistically important at P<0.01 significant level (Table 4). The highest thousand kernel weight of lentil variety is belong to Şakar specie with 46.0 g and the lowest thousand kernel weightis belong to Tigris specie with 33.5 g. Singh et al. (1990), Varshney (1992), Bozoğlu and Pekşen (1997), Karadavut et al. (2001) and Toğay (2002) revealed that thousand kernel weight of different lentil species are change with location. Tantekin (2008) stated that the highest thousand kernel of specie is Sakar, however, the lowest thousand kernel weight specie is Altıntoprak for his research. Similarly, Oktem (2016) point out that the highest thousand kernel weight belong to Sakar specie and the lowest thousand kernel weight belong to Tigris and Evirgen species in Sanlıurfa conditions.

Plant height of lentil varieties were found statistically important at $P<0.01$ significant level (Table 3). The highest plant height of lentil variety is belong to Firat 87 specie with 44.2 cm and the lowest plant height is belong to Altıntoprak specie with 34.6 cm. Yıldız (2007) stated that the highest plant height value belongs to 45.87 cm for Fırat-87 specie in Diyarbakır condition. Oktem (2016) revealed that the highest plant height value belongs Fırat-87 specie and the lowest belongs to Kafkas specie for Sanlıurfa condition. Togay (2002) point out that plant height value related with plant genetic properties.

Grain yield of lentil varieties were found statistically important at $P<0.01$ significant level (Table 3). The highest grain yield of lentil variety is belong to Tigris specie with 119kg/da and the lowest grain yield is belong to Çiftçi specie with 75.6 kg/da. Aydoğan et al (2005) revealed that grain yield of 21 lentil varieties are between 75.0 to 258 kg/da for Harran Plain condition. Yılmaz et al. (1996) stated that grain yield of used varieties in Siirt condition are very low with 23.5 to 52.5 kg/da. Türket al. (1998)stated that grain yield of lentil varieties which was grown under Diyarbakır condition are between 156 - 247 kg/da. Çokkızgın et al. (2005) revealed that grain yield of Kafkas and Çiftçi species have the highest value for Kahramanmaraş condition. Oktem (2016) stated that the highest grain yield belong to Altıntoprak, Şakar, Tigris

and Evirgen species and the lowest grain yield belong to Yerli Kırmızı specie for years experiment under Sanlıurfa Condition.

**Conclusions**

Eleven red lentil varieties which were used as experiment materials has different yield characteristics and the lowest grain yield belong to Kafkas, Özbek, Çiftçi, Seyran 96,Fırat 87 and Yerli Kırmızı. Also, Firat 87 and Yerli Kırmızı varieties are sowed by farmer mostly. As result, adaptation experiment and our results revealed that new lentil varieties which are rarely produced in Harran region must use such as Çağıl, Altıntoprak, Şakar, Tigris and Evirgen in order to get profitable production.

**References**


Akçin, A., 1988. Edible Grain Legumes. Lecture Book. Selcuk University Publistion No: 43, Agriculture Faculty Publication No 8, Konya (in Turkish).

Aydoğan, A., Karagül, V. & Bozdemir, Ç., 2005. Adaptation of winter lentil varieties Central Anatolia Region Condititon. 4th GAP Agriculture Congress, 820-825, Şanlıurfa (in Turkish).

Biçer, B.T. & Şakar, D., 2004. Evaluation Of Some Lentil Genotypes At Different Locations InTurkey. International Journal of Agriculture & Biology. Vol: 6(2), p. 317-320.

Bozoğlu, H. & Pekşen, E., 1997. Effects of different inter row space on grain yield and some agronomic properties of red lentil. 2nd Field Crops Congress, 595-597, Samsun (in Turkish).

Çokkizgin, A.,Çölkesen, M., Kayhan, K & Aygan, M. (2005). A research on different lentil (Lens CulinarisMedic.) varieties' yield and Yield Characteristics. Akdeniz University, Agriculture Faculty Journal, 18(2), 285-290 (in Turkish).

DMİ, 2016. Turkish Government Meteorology Directory. 2015-2016 years whether condition data, Şanlıurfa

Karadavut, U., Erdoğan, C., Özdemir, S. & Şener, O., 2001. Effects of grain amount of lentil yield and yield characteristics 4. th Field Crops Congress Vol I:385-390, Tekirdağ (in Turkish)..

Öktem, A.G. (2016). Determination of yield and yield characteristics of lentil varieties grown under Sanlıurfa Condition. Nevşehir Science and Technology Journal. Vol 5(1) 27-34 2016 (in Turkish).

Sing, K., Sing, S., Jain, A. & Sing, P. P., 1990. Effect of Sowing Date and Row Spacing on the Yield of Lentil Varieties (*Lens culinaris*Medic. ). Lens Newsletter 1990; 17 (1), 9-10.

Sulser, H. & Sager, F., 1974. Identification Of Uncommon Amino Acids In The Lentil Seed (*Lens culinarisMed.).*Experientia 32: 422-423.

Şehirali, S., 1988. Edible Grain Legumes. Ankara University, Agriculture Faculty Publication No: 1089, Levture Book No:314, Ankara (in Turkish).

Tantekin, M. (2008). A research on some red lentil varieties' effects of row and inter row spaces on yield and yield characteristics under Diyarbakır Ecological Condition. Cukurova University, Science Institute, Department of Field Crops, MSc Thesis, Adana (in Turkish).

Toğay, N., 2002. Effects of row and inter row spaces on yield and yield characteristics under Van Condition. Yüzüncü Yıl University, Science Institute, Field Crops Department, PhD thesis, Van (in Turkish).

Türk, Z., Ş. Alkan, H. Kılıç &T. Polat. 1998. Determination of high yield lentil varieties under South East Anatolia Condition. Harran University Agriculture Faculty Journal. Vol 2 (4): 65-70 (in Turkish).

Türk, Z. & Atikyılmaz, N., 1999. Determination of high yield lentil varieties under Diyarbakır Condition. Harran University Agriculture Faculty Journal. Vol 3 (3-4): 67-72 (in Turkish).

Varshney, J.G., 1992. Effect of Sowing Dates and Row Spacing on the Yield of Lentil Varieties. Lens Newsletter 1992; 19 (1), 20-21.

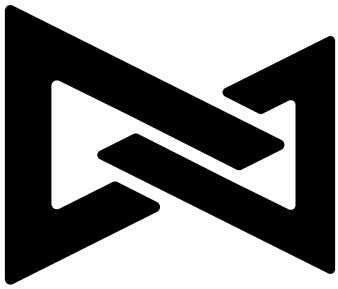
Yağmur, M. & Kaydan, D., 2004. Effects of Foliar fertilization on grain Yield and yield characteristic of Lentil. Yüzüncü Yıl University, Agriculture Faculty, J. Agric. Sci., 15(1): 31-37 (in Turkish).

Yildiz, E. (2007). Determination of Individual and Agricultural Properties of some red lentil varieties grown under Diyarbakır Condition. Cukurova University, Science Institute, Department of Field Crops, MSc Thesis, Adana (in Turkish).

Yılmaz, N.,Kulaz, H. & Erman, M. 1996. A research on yield and adaptation of lentil varieties grown under Siirt Ecological Condition. Yüzüncü Yıl University, Agriculture Faculty, J. Agric. Sci., 6: 1-9 (in Turkish).

**Acknowledges**

This research was funded by General Directorate of agricultural research and policy of Ministry of Food, Agriculture and Livestock of Turkey and project number is TAGEM/TA/09/12/02/001.



# THE EURASIAN
# AGRICULTURE AND NATURAL SCIENCES CONGRESS

KYRGYZSTAN - 20 - 23 SEPTEMBER 2017

**20-23 SEPTEMBER 2017**
Bishkek, KYRGYZSTAN

## POSTER PRESENTATION

# P-1 BAZI BİTKİ EKSTRAKTLARININ FARKLI NEM VE SICAKLIKTA DEPOLANMIŞ BİBER TOHUMLARININ FİDE GELİŞİMİNE ETKİSİ

**B. B. KENANOĞLU[1], E. S. KOPTUR[1]**

[1]: Bahçe Bitkileri Bölümü, Ziraat ve Doğa Bilimleri Fakültesi, Uşak Üniversitesi, Uşak, Türkiye

e-mail:burcu.kenanoglu@usak.edu.tr

Özet

Bu çalışmada; bu büyüme ortamlarına alternatif olarak domates, roka ve marul gibi sebzelerin yaprak ekstraktları, iki yıl -18 ve 25 $^0$C de, %3 ve 5 nemde depolanmış biber tohumlarından elde edilen fidelerin gelişimi süresince uygulanarak değerlendirilmiştir. Bitki yaprak ekstraktları; belirtilen bitkilere ait yapraklar üretim sezonu sürecince toplanmış ve parçalanarak bir gün süresince oda sıcaklığında çeşme suyunda bekletilerek elde edilmiştir. Biber tohumlarında nem ayarlanması; LiCl doygun tuz çözeltisinde ilk nemlerinden %3 ve %5 nem seviyelerine kadar düşürülerek gerçekleştirilmiş ve belirtilen sıcaklıklarda depolamaya alınmıştır. Fide büyüme süresince sulama suyu (çeşme suyu/kontrol grubu) alternatifleri olarak domates, marul ve roka bitki ekstrakları haftada bir kez uygulanmıştır. Deneme süresince bitki boyu (1.), gövde genişliği (2.), gerçek yaprak sayısı (3.) ve yaprak aya genişliği (4.) gibi kriterler ölçülmüştür. Sonuçlara göre; -18 $^0$C ve %3 nemde depolanan tohumların marul suyu uygulamasındaki fide ölçümlerinde en iyi sonuç 1., 2. ve 3. kriterlerden alınmıştır. -18$^0$C ve %5 nemde depolanan tohumların fide ölçümlerinde 2., 3., ve 4. kriterlerde roka suyundan, 25 $^0$C ve % 5 nemde depolanan tohumların fide ölçümlerinde 1. ve 2. kriterlerde domates ve roka suyundan en iyi sonuç alınmıştır. Genel olarak; uygulamalar 1. ve 2. Kriterler için kontrol grubuna göre avantajı bulunmuştur ve en yüksek değerler canlılığı uzun süre koruyan -18$^0$C ve %3 nem grubundan alınmıştır.

**Anahtar kelimeler:** Biber, Bitki yaprak ekstraktları, Tohum depolama

## GİRİŞ

Biber, gerek dünyada gerek ülkemizde yaygın olarak ve çok fazla tüketilen sıcak iklim sebze türüdür. Domates ve patlıcan gibi Solanaceae familyasından ve *Capsicum* cinsi içindedir. En çok tüketimi yapılan tür *Capsicum annuum* L.'dur. Ülkemizde açık ve örtüaltı alanlarında yaygın olarak yetiştirilen biberin ekonomik değeri yüksektir. Genelde en yaygın üretilen meyve tipleri sivri, çarliston, dolmalık ve kapya (yağlık) biberdir. Açıkta yetiştiricilikte, Yalova, Antalya, Eskişehir, Menemen ve Kahraman Maraş gibi illerde bulunan Kamu Araştırma Enstitülerinin geliştirilen standart çeşitler yaygın olarak üretilmektedir (Özalp, 2010). Ülkemizde yaklaşık 4 milyar sebze fidesi üretilmiş olup, aşılı fide üretimi ise 135 milyon civarındadır (fidebirlik.org.tr).

Tohumda nem ve sıcaklık kontrolü, ticari anlamda önem taşıyan tohum depolamada ya da gen bankalarında tohum örneklerinin gen kaynağı olarak depolanmadaki tohum kalitesinin devamlılığı için temel arz eder (Ellis and Roberts, 1981). Yapılan birçok deneme sonuçlarına göre 'başparmak kuralı' olarak adlandırılan; depo sıcaklığındaki her 5°C'lik, tohum nemindeki her %1'lik azalmanın tohum ömrünü iki katı uzattığının belirlendiği kural ortaya atılmıştır (Harrington, 1972). Bu kural özellikle yağlı tohumlarda % 3-18, nişastalı türlerde ise % 3-25 nem kapsamları arasında tohum kalitesinin neme göre değişimini belirlemek için kullanılmaktadır. Küçük tohumlular için ideal nem içeriğinin % 5-6 dolayında, iri tohumlularda ise % 9-10 olmalı ve depolanan tohumlarda zararlanmanın ve kimyasal değişimlerin tohumlarda su içerikleriyle ilgili olduğu belirlenmiştir (Roberts and Ellis, 1989). Ayrıca yüksek nemde depolamanın hücresel bozulma yoluyla yaşlanmayı da teşvik edilir (Rao et al.,1987). Depolama sıcaklıkları ve süre kombinasyonları ile küçük tohumlularda orta uzun depolamada (12-36 ay) 15 °C, uzun süreli (36-60 ay) depolamalarda 5 °C çok uzun süreli (5 yıl ve fazlası) depolamalarda -20 °C'nin kullanılabileceği belirtilmiştir (Walters et al., 2005).

Bitkisel üretimdeki en önemli hedef, birim alandan maksimum verim ve kalitede ürün elde etmek olup yolda, üretimi yapılacak ürün isteklerine uygun bir toprak ortamı oluşturulmalıdır. Günümüzde toprağın fiziksel ve kimyasal yapısının bozukluğu, organik madde ve mikroorganizma yetersizliği, toprak yorgunluğu, tuzluluk, uygun olmayan pH, toksik maddeler, dengesiz gübreleme ve sulama gibi durumlar toprak verimliliğini azaltmaktadır (Karataş ve Demiraslan, 2000). Yetiştirme ortamında özellikle bitki köklerinin gelişminin optimum sağlandığı zirai yapılar tercih edilmektedir (Carneiro, 1995). Bu yapılar bitkinin kök sistemine destek ve koruma sağlayacak katı yapıda; kökler arasında ve ortam ile karbondioksit ve oksijen geçişi için geçirgen olmalıdır (Lemaire, 1995). Fitotoksik maddelerden, bitki patojenleri ve zararlılardan ayrıca istenmeyen otlardan ari olmalıdır. Deniz yosunu ekstraktı, protein hidrolisatları ve aminoasitler, hümik asit, fulvik asit, kompleks organik materyaller, mikrobiyal inokulantlar ve bitki ekstraktları gibi doğal kaynaklar tarımda kullanılmaktadır (du Jardin, 2015; Głodowska et al. 2016). Farklı bitkilerin su ekstraktları büyümeyi teşvik için kullanılıp, özellikle abiyotik

strese karşı faydalı olmaktadırlar (Farooq et al., 2013). *Moringa oleifera* yaprak ekstratları, sorgum ve dut suyu ekstraktları priming ajanı gibi bitki büyüme düzenleyici olarak kullanılır. Çevre dostu ortam olarak tercih edilen, solucan gübresi ve Hindistan cevizi kabuğu ortamın porozitesini arttırarak iyi havalanma sağlar (Edwards and Neuhauser, 1988). Bu ortamlar özellikle nitrat, fosfat, kalsiyum ve çözünebilir potasyum gibi besin maddeleri içerir (Orozco et al., 1996).

Çalışmamızda büyüme ortamlarına alternatif olarak domates, roka ve marul gibi sebzelerin yaprak ekstraktları, iki yıl -18 ve 25 $^0$C de, %3 ve 5 nemde depolanmış biber tohumlarından elde edilen fidelerin gelişim süresince uygulanarak bitki boyu (cm), gövde genişliği (mm), gerçek yaprak sayısı (adet), yaprak aya genişliği (mm) ve kök-gövde yaş ve kuru ağırlığı (gr) değerlendirilmiştir.

## MATERYAL VE METOT

Biber tohumlarının nem seviyeleri (%3-5) LiCl doygun tuz çözletisinde oda sıcaklığında bekletilerek ayarlanmıştır. İki yıl boyunca -18 and 25$^0$C de depolanmıştır. Depolanmış biber tohumlarının fideleri torf ortamında yetiştirilmiştir. Domates, roka ve marul bitki yaprakları toplanıp, parçalandıktan sonra çeşme suyunda (1 birim bitki ağırlığı: 1 birim su) bir gün boyunca oda sıcaklığında bekletilmiştir. Bitki yaprak suları biber fidelerine haftada bir kez verilmiştir ve deneme 45 gün devam etmiştir. Denemeler tesadüf parselleri deneme desenine göre düzenlenmiş, yüzde değerler açı transformasyonundan sonra SPSS programı kullanılarak analiz edilmiştir. **Bitki boyu (cm); t**oprak üstünde kök boğazı seviyesinden bitkinin en uç noktasına kadar olan kısmın uzunluğudur. **Gövde genişliği (mm):** Dijital kumpas ile ölçüm belirlenmiştir. **Yaprak ayası genişliği (mm):** Gerçek yaprakların en geniş kısmındaki iki noktanın arasından ölçüm alınmıştır. **Gerçek yaprak sayısı (adet):** Bitkideki gerçek yaprak adet olarak belirlenmiştir. **Kök ve gövde yaş-kuru ağırlığı (gr):** bitki kök ve toprak üstü kısmının ayrı ayrı tartımı yapılarak yaş ağırlık, 1 gün 80 $^0$C'de etüvde tutularak ise kuru ağırlık belirlenmiştir.

## BULGULAR ve TARTIŞMA

**Çalışmamızda** genel olarak sonuçlara bakıldığında; %5 nem %3 e göre **özellikle** 25° C'de canlılığı (%15 oranında) daha **çabuk** kaybetmiştir (Tablo 2). Yapılan diğer bir çalışmada; biber tohumları için %8-10 nem ve sıcaklığın 5 °C olduğu en uygun orta-uzun süreli depolama ile belirtmektedir (Sundstrom, 1990). Passam et al. (1997) biber tohumlarının %9.8 nemde 20 °C'de 12 aydan daha uzun süre depolanmamalarının canlılık ve güç kayıplarının önlenmesi yönünden önemli olduğunu belirtmişlerdir. Aynı araştırıcılar yüksek nem koşullarının tohumun depolama ömrünü önemli düzeyde kısalttığını saptamışlardır. Tohumlarda ekstrem kurutmanın depolamada canlılığı korunmasında etkili olabileceği ortaya konmuştur (Nakamura, 1975). Bu sonucu desteklercesine, düşük nemde depolamanın etkileri; soğan, kabak, marul ve biber tohumlarında ultra kuru olarak % 3-4 nem kapsamlarında 20 °C'de hermetik ortamda 5 yıl depolanma sonucunda canlılıklarının % 50 ve üzerinde olduğu belirlenmiştir (Demir and Ozcoban, 2007). Ayrıca soğan tohumlarının özellikle tropik bölgelerdeki depolanma sürecinde tohum neminin canlılığın korunmasında çok önemli olması ve % 6 dolayında kurutulması gerektiği ifade edilmiştir (Rao et al., 2006).

Tablo 1. -18 °C %5 ve 3 nemde depolanmış tohumların fide çıkış oranlarına ve gelişimine bitki ekstraktlarının etkisi

| D.K. | D.Ö. F.Ç.O. (%) | D.S. F.Ç.O. (%) | Uyg. | B.B. (cm) | G.G. (mm) | G.Y.S. (adet) | Y.A.G. (mm) | K.Y.A. (gr) | G.Y.A. (gr) | K.K.A. (gr) | G.K.A. (gr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -18 ° C %3 nem | | 67 | **DYE** | 12.5a | 3.9b | 12.9a | 51.7ab | 8.87ab | 7.53ab | 1.23a | 1.28a |
| | | | **RYE** | 10.5b | 3.5b | 12.5ab | 53.8a | 6.58b | 7.79ab | 0.71b | 1.24a |
| | | | **MYE** | 12.9a | 4.2a | 13.3a | 52.4a | 10.7a | 9.17a | 1.09a | 1.39a |
| | | | **K** | 11b | 4.1a | 13.2a | 51.4ab | 11.3a | 6.48b | 1.02a | 1.24a |
| | | | **Ort.** | **11.8** | **3.9** | ***12.9*** | ***52.3*** | **9.4** | **7.77ab** | **1.01a** | **1.29a** |
| | | | **LSD (p≤0.05)** | öd | öd | öd | öd | öd | öd | öd | öd |
| -18 ° C %5 nem | 70 | 58 | **DYE** | 12.8a | 4.1a | 9.7b | 47.5b | 18.2a | 7.02b | 1.79b | 1.02b |
| | | | **RYE** | 12a | 4.2a | 12.4a | 52.5a | 12.3c | 8.99a | 1.34c | 2.24a |
| | | | **MYE** | 12a | 4.1a | 11.2ab | 50.5ab | 18.6a | 8.81a | 2.23a | 2.08a |
| | | | **K** | 11b | 3.7ab | 10.4b | 47.3b | 15.9b | 5.89c | 1.46c | 1.05b |
| | | | **Ort.** | **11.9** | **4** | **10.9** | **49.5** | ***16.3*** | **7.68** | **1.71** | **1.59** |
| | | | **LSD (p≤0.05)** | öd | öd | öd | öd | * | * | * | * |

***D.K.:** Deneme koşulları, **D.Ö.F.Ç.O:**Depolama öncesi fide çıkış oranı, **UYG.:** Uygulama, **B.B.:**Bitki boyu, **G.G.:**Gövde genişliği, **G.Y.S.:** Gerçek yaprak sayısı, **Y.A.G.:** Yaprak aya genişliği, **K.Y.A.:** Kök yaş ağırlığı, **G.Y.A.:**Gövde yaş ağırlığı, **K.K.A.:** Kök kuru ağırlığı, **G.K.A:** Gövde kuru ağırlığı ***DYE:** Domates yaprak ekstraktı, **RYE:** Roka yaprak ekstraktı, **MYE:** Marul yaprak ekstraktı, **K:** Kontrol

-18 °C %3 nem grubunda, domates yaprak ekstraktı; bitki boyu, gövde yaş ağırlığı ve kök kuru ağırlığı kontrole göre en iyi artışı sağlamıştır. Fidelerin tüm ölçümlerinde uygulama ile kontrol grubu arasındaki farkı istatistiksel olarak anlamlı bulunmamıştır (P›0.05). -18° C %5 nem grubunda, kök kuru ve yaş ağırlığı ile bitki boyu **ölçümleri** hariç tüm kriterlerde roka yaprak ekstraktı en iyi sonucu vermiştir. Fidelerin kök ve gövde yaş-kuru ağırlığı ölçümlerinde uygulama ile kontrol grubu arasındaki fark istatistiksel olarak anlamlı bulunmuştur (P≤0.05). **Özellikle** KYA ve GYA **ölçümlerinde** bu depo koşulundaki tohumların fideleri daha iyi sonuç vermiştir (Tablo 1). 25 °C 3% nem grubunda, bitki boyu, gövde yaş ve kök kuru ağırlığı **ölçümleri** hariç tüm kriterlerde marul yaprak ekstraktı en iyi sonucu vermiştir. Fidelerin yaprak alanı ve kök- gövde yaş ağırlığı ölçümlerinde uygulama ile kontrol grubu arasındaki farkı istatistiksel olarak anlamlı bulunmuştur (P≤0.05).25 °C %5 nem grubunda ise kök ve gövde yaş-kuru ağırlığı dışında uygulamaların kontrole göre farkı net belirlenememiştir (Tablo 2). Ayrıca fidelerin kök-gövde yaş ağırlığı ile kök kuru ağırlığı ölçümlerinde uygulama ile kontrol grubu arasındaki farkı istatistiksel olarak anlamlı bulunmuştur (P≤0.05). Genel ortalama değerlerinde ise en yüksek veriler GYS (12.9 gr), YAG (52.3mm) ve KYA (16.3 gr) **ölçümlerinden** alınmıştır (Tablo 1,2).

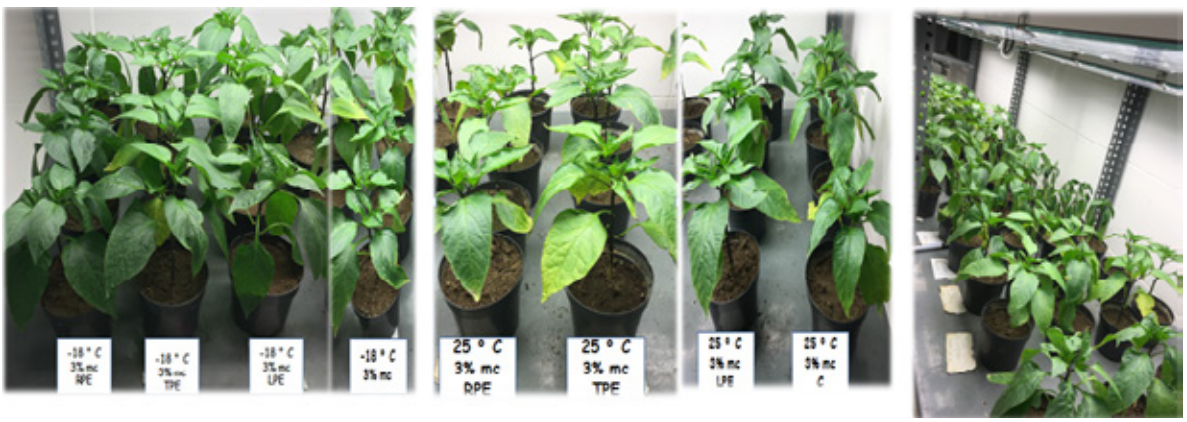
Tablo 2. 25 °C %5 ve 3 nemde depolanmış tohumların fide çıkış oranlarına ve gelişimine bitki ekstraktlarının etkisi

| D.K. | D.Ö. F.Ç.O. (%) | D.S. F.Ç.O. (%) | Uyg. | B.B. (cm) | G.G. (mm) | G.Y.S. (adet) | Y.A.G. (mm) | K.Y.A. (gr) | G.Y.A. (gr) | K.K.A. (gr) | G.K.A. (gr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 ° C %3 nem | | 68 | **DYE** | 11.2a | 3.9a | 9.3b | 45.6ab | 11.8a | 5.58b | 1.07a | 0.98ab |
| | | | **RYE** | 10.3b | 3.7ab | 9.4b | 39.6b | 10.7ab | 4.78c | 1a | 0.83b |
| | | | **MYE** | 11.7a | 4a | 9.7b | 47.7a | 11.9a | 8.39a | 1.04a | 1.22a |
| | | | **K** | 11.3a | 3.6ab | 11.4a | 46.2ab | 8.6b | 4.82c | 0.77b | 0.78b |
| | | | **Ort.** | **11.1** | **3.8** | **9.9** | **44.8** | **10.8** | **5.89** | **0.97** | **0.95** |
| | | | **LSD (p≤0.05)** | ö**d** | öd | öd | * | * | * | öd | öd |
| 25 ° C %5 nem | 70 | 55 | **DYE** | 12.1a | 4.1a | 10.7a | 49.8b | 15.5a | 7.37a | 1.52b | 1.10b |
| | | | **RYE** | 11.7a | 4.3a | 10.3a | 49.9b | 15.6a | 6.26a | 1.87a | 1.28a |
| | | | **MYE** | 11.5ab | 4.3a | 9.3b | 50.7b | 12.9b | 6.55a | 1.95a | 1.59a |
| | | | **K** | 11.7a | 4.2a | 11.3a | 52.7a | 11.3b | 5.79ab | 1.33b | 1.27a |
| | | | **Ort.** | **11.8** | **4.2** | **10.4** | **50.8** | **13.8** | **6.49** | **1.67** | **1.31** |
| | | | **LSD (p≤0.05)** | ö**d** | öd | öd | öd | * | * | * | öd |

***D.K.:** Deneme koşulları**, D.Ö.F.Ç.O:**Depolama öncesi fide çıkış oranı**, UYG.:** Uygulama**, B.B.:**Bitki boyu**, G.G.:**Gövde genişliği**, G.Y.S.:** Gerçek yaprak sayısı**, Y.A.G.:** Yaprak aya genişliği**, K.Y.A.:** Kök yaş ağırlığı**, G.Y.A.:**Gövde yaş ağırlığı**, K.K.A.:** Kök kuru ağırlığı**, G.K.A:** Gövde kuru ağırlığı ***DYE:** Domates yaprak ekstraktı**, RYE:** Roka yaprak ekstraktı**, MYE:** Marul yaprak ekstraktı**, K:** Kontrol

Civanperçemi bitki ekstraktının kanola ve sarı keten tohumu çimlenmesi üzerine yapılan bir araştırmada, civanperçeminin sürgün ve kök kısmından hazırlanan farklı dozlarda solüsyonların etkileri belirlenmiş ve artan dozlarda çimlenme yüzdesi, kök ve sürgün uzunluğu artmış ve her iki türün tohumunda saf su uygulamasından daha yüksek çimlenme oranı belirlenmiştir (Hesabi, 2014). Mavi ve Matthews (2013), Patula bitki çayı uygulaması ile patlıcan tohumlarında ozmotik koşullandırma ile tuz stresinde çimlenme oranı, fide çıkışı, ortalama çıkış zamanı ve yaş-kuru ağırlık açısından olumlu etki belirlenmiştir.

Resim 1. Denemeden farklı uygulama gruplarındaki fide görüntüleri




Çalışmamızda kullanılan fide ortamlarının analiz sonuçlarına göre; organik madde kapsamı en yüksek kontrol (%4.01) ortamı olurken, fosfor ve potasyum kapsamı (ppm) ise en düşük bulunmuştur. Ca oranı (ppm) ise sadece roka

yaprak ekstraktı uygulanan ortamda orta düzeyde bulunmuştur (Resim 2).

Resim 2. Fide ortamlarının deneme sonundaki toprak analiz sonuçları

| TOPRAK ELEMENTLERİ | METODLAR | BİRİMLER | R.Y.E. | |
|---|---|---|---|---|
| %Organik Madde | WALKEY BLACK | % | 2,81 | ORTA |
| P (Fosfor) | OLSEN | ppm | 4,84 | ZENGİN |
| K (Potasyum) | AMONYUM ASETAT | ppm | 300,2 | ZENGİN |
| Ca (kalsiyum) | AMONYUM ASETAT | ppm | 1543 | ORTA |

| TOPRAK ELEMENTLERİ | METODLAR | BİRİMLER | M.Y.E. | |
|---|---|---|---|---|
| %Organik Madde | WALKEY BLACK | % | 3,10 | İYİ |
| P (Fosfor) | OLSEN | ppm | 4,91 | ZENGİN |
| K (Potasyum) | AMONYUM ASETAT | ppm | 505,2 | ÇOK ZENGİN |
| Ca (kalsiyum) | AMONYUM ASETAT | ppm | 1323 | FAKİR |

| TOPRAK ELEMENTLERİ | METODLAR | BİRİMLER | Kontrol | |
|---|---|---|---|---|
| %Organik Madde | WALKEY BLACK | % | 4,01 | YÜKSEK |
| P (Fosfor) | OLSEN | ppm | 3,56 | İYİ |
| K (Potasyum) | AMONYUM ASETAT | ppm | 195,7 | FAKİR |
| Ca (kalsiyum) | AMONYUM ASETAT | ppm | 1275 | FAKİR |

| TOPRAK ELEMENTLERİ | METODLAR | BİRİMLER | D.Y.E. | |
|---|---|---|---|---|
| %Organik Madde | WALKEY BLACK | % | 2,91 | ORTA |
| P (Fosfor) | OLSEN | ppm | 5,45 | ZENGİN |
| K (Potasyum) | AMONYUM ASETAT | ppm | 370,2 | ÇOK ZENGİN |
| Ca (kalsiyum) | AMONYUM ASETAT | ppm | 997,2 | FAKİR |

***DYE:** Domates yaprak ekstraktı**, RYE:** Roka yaprak ekstraktı**, MYE:** Marul yaprak ekstraktı**, K:** Kontrol

## SONUÇ

Biber tohumlarında tohum kalitesinin toplam yağ içeriği ve yağların kompozisyonu ile de bağlantılı olabileceğini ortaya konmuştur (Kaya et al., 2010). Tohum depolamadaki bozulma sürecinde, toplam yağ kapsamları kadar yağların, doymuş doymamış olma durumları da dikkate almalıdır. Bu etkilerin yanında; tohumun üretim kalitesi ve bu dönemde ekolojik değişimlerin etkisi ile testanın nem alım oranından, tanen ve lignin içeriğinden, hücre zarı ve kabuk sağlamlığının da depolama süresini ve kalitesinin korunmasını etkilediği belirlenmiştir.

Günümüzde, tarımsal üretimdeki kimyasal kullanımın ortalamanın çok üstünde olması ekoloji için tehlike arz etmektedir. Sonuç olarak tohum ya da fidenin verimi ve kalitesini yükselten, ekolojik dengeyi koruyan, çevre dostu üretim teknikleri önem kazanmıştır. Bitki besin maddeleri, antioksidantlar, organik ve inorganik kimyasallar, bitki büyüme düzenleyicilerin kullanımı hem ekonomik hem de kullanım açısından üretici için avantajlı olmaktan çıkmış olup bitkisel katkı maddeleri alternatif olmaktadır.

Çalışmamızda genel olarak kullanılan tüm bitki ekstraktlarının kontrole göre çok avantajı belirlenmese de, kök-gövde kuru ve yaş ağırlığında fark elde edilmiştir. Depolama sürecinde tohum canlılığını en iyi koruyan -18$^0$C ve % 3 nem grubunda, bitki boyunda 12.9 mm, gövde genişliğinde 4.2 mm ve gerçek yaprak sayısında 13 adet ile MYE en yüksek değeri vermiştir (Tablo 1). Yaprak aya genişliği (53.8 mm) bakımından ise aynı grupta RYE ile elde edilmiştir. Sonuç olarak tohumun depodaki canlılığı üzerine depo koşullarının ve tohum neminin önemi ortaya bir kez daha konarak özellikle yaprak genişliği ve fotosentez aktivitesi sonucu kök-gövde yaş ağırlığındaki artışda desteklenmiştir. Kullanılan bitkisel ortamların kontrole kıyasla avantajı ise değişkenlik göstermiştir.

## KAYNAKLAR


Carneiro, J.G.A. (1995). Produção e controle de qualidade de mudas florestais. Curitiba, UFPR/FUPEF, 451 pp

Demir, I., Ozcoban, M. (2007). Dry and Ultra-Dry Storage of Pepper, Aubergine, Winter Squash, Summer Squash, Bean, Cowpea, Okra, Onion, Leek, Cabbage, Radish, Lettuce and Melon Seeds at -20˚C and 20˚C over Five Years. Seed Science and Technology, 35, 165-175.

Ellis, R.H., Roberts, E.H. (1981). The Quantification of Ageing and Survival in Orthodox Seeds, Seed Science and Technology, 9, 373-409.

Edwards, C.A., Neuhauser, E.F. (1988). Earthworms in waste and environmental management. SPB Academic Publ.

Farooq, M., Bajwa, A.A., Cheema, S.A., Cheema, Z.A. (2013) Application of allelopathy in crop production. Inter J Agric Biol 15:1367–1378

Głodowska, M., Husk, B., Schwinghamer, T., Smith, D. (2016) Biochar is a growth-promoting alternative to peat moss for the inoculation of corn with a pseudomonad. Agron Sustain Dev 36:1–10.

Harington, J.F. (1972). 145-240. Seed Biology, Editör: Kozlowski, K., U. K. : Longman

Hesabi, S., Vazan, S., Golzardi, F., 2014. The effect of yellow yarrow (Achillea santolina) aqueous extracts as a factor in seed priming of canola and flax. International Journal of Biosciences. Vol. 5, No. 5, p. 195-202, 2014

Jardin, P. (2015) Plant biostimulants: definition, concept, main categories and regulation. Sci Hortic (Amsterdam) 196:3–14.

Karataş, A., Demiraslan, R., 2000. Toprak Düzenleyicisi Terralyt Plus Elektrolitinin Marulda Bitki Gelişimi ve Bazı Toprak Özelliklerine Etkileri. III. Sebze Tarımı Sempozyumu 2000, 11-13 Eylül, Isparta.

Kaya, G., Demir, I., Tekin, A., Yaşar, F., Demir, K. (2010). Priming Uygulamasının Biber Tohumlarının Stres Sıcaklıklarında Çimlenme, Yağ Asitleri, Şeker Kapsamı ve Enzim Aktivitesi Üzerine Etkisi. Tarım Bilimleri dergisi, 16, 9-16.

Lemaire, F. (1995). Physical, chemical and biological properties of growing medium. Acta Hort 396: 273-284.

Mavi, K., Matthews, S., 2013. An alternative method of organic priming technique in naturally aged .30 ISTA$^{th}$ seed congress abstract book, Antalya

Nakamura, S. (1975). 'The Most Appropriate Moisture Content of Seeds for Their Long Life Span, Seed Science and Technology, 3, 747-759

Orozco, F.H., Cegarra, J., Trujillo, L.M., Roig, A. (1996). Vermicomposting of coffee pulp using the earthworm Eisenia fetida: Effects on C and N contents and the availability of nutrients. Biol Fert Soils 22 (1-2): 162-166.

Özalp, R. (2010). Ülkemizde Biber Üretimi ve Örtüaltı Biber Yetiştiriciliği. Tarım Türk Dergisi, Temmuz-Ağustos 2010, Sayı:24, Yıl:5, 29-32.

Passam, H.C., Lompropulos, E., Khah, E.M. (1997). Pepper Seed Longevity Production Under Ambient Temperature, Seed Science and Technology, 25, 177-185.

Rao, R.G.S., Singh, P.M., Rao, M. (2006). Storability of onion seeds and effects of packaging and storage conditions on viability and vigor, Scientia Horticulturae, 110, 1-6.

Rao, N.K., Roberts, E.H., Ellis R.H. (1987). Loss of Viability in Lettuce, Seeds and Accumulation of Chromosome Damage Under Different Storage Conditions, Seed Science and Technology, 15, 499-514.

Roberts, E.H., Ellis, R.H. (1989). Water and Seed Survival, Annals of Botany, 63, 39-52.

Sundstrom, F.J. (1990). Seed Moisture Influences in Tabasco Pepper Seed Viability Vigor and Dormancy During Storage, Seed Science and Technology, 18, 179-185

Walters, C., Wheeler, L.M., Grotenhuis, J.M. (2005). Longevity of Seeds Stored in a Genebank : species characteristics Seed Science Research, 15, 1-20.

# P-2 MINERAL NUTRIENT STATUS OF ALMOND (PRUNUS AMYGDALUS L.) ORCHARDS GROWING IN THE UŞAK (TURKEY) PROVINCE

E. Yıldız[1], V. Uygur[2]

[1]Department of Horticulture, Faculty of Agriculture and Natural Sciences, Uşak University, Uşak, Turkey; [2]Department of Soil Science and Plant Nutrition, Faculty of Agriculture, Süleyman Demirel University, Isparta, Turkey; corrospondin outhor email: ercan.yildiz®usak.edu.tr

## Abstract

This experiment was carried out almond orchards which grown in Uşak province. For this experiment, 49 almond orchards were selected from all districts. In experiment orchards, soil samples were taken only in 2014, almond leaves were sampled both 2014 and 2015. By comparing the results of soil and leaf samples with boundary values, it is attempted to determine feeding problems and conditions of nutrient elements of investigated orchards. According to the results, it has been found that the soils of experimental area were loamy (37%) and clayey loamy (63%) in texture. The soils do not have salinity problem. It was determined that the problem of lime in the orchard of about 64%, and pH is mainly slightly alkaline. Organic matter contents of soils are medium levels. It has also been found that 80% magnesium, 88% phosphorus, 96% zinc and 100% potassium of almond orchard soils had insufficient levels. According to the results of leaf analysis, 69% for phosphorus, 55% for magnesium, 71% for iron, 80% for zinc and 63% for copper concentration of almond leaves had no sufficient levels.

**Keywords:** Almond orchard, Mineral nutrition, Soil and leaf analysis

## INTRODUCTION

Almond is one of the oldest fruit species of Anatolia. On the other hand, almonds are not as important as other fruit species in Turkey, and usually grown through the border of the fruit orchards. The almond flowers are damaged by the spring frosts due to the early flowering, and so the crop can not obtained regularly from the almond trees. For all these reasons commercial almond cultivation has not been developed (Kaska, 2001). However, almond production areas in Turkey are rapidly increasing in recent years. Turkey's almond trees have reached to approximately 9.5 million number in 2014; with an increase of 2.4 times in the last decade (Anonymous, 2014).

The fruit species, such as almond, are different from other fruit varieties in terms of climate requirements, cultivation methods, and rootstock requirements depending on the fields they grown. Therefore, suitable techniques should be applied to the almond cultivation. Some European countries and the United State of America have improved new almond genotypes through breeding research that they have been carried out for many years. Therefore, these countries have eliminated major problems of their almond cultivation. And so, these countries increased the total amount of products that they receive from the unit area by appliying new and modern cultivation techniques. In terms of almond cultivation, Turkey has advantages in terms of soil, climate and irrigation facilities. For this reason, there is a necessity to apply modern methods in the cultivation of almond in Turkey (Kaska et al., 1999).

Yield and quality in fruit trees are most affected by problems related to nutrition. Nutritional deficiencies in fruit trees retard the plant development, reduce the fruit yield and quality. Even in some cases, nutrient deficiency paused completely the plant development, and can cause the plant to die. For this reason, precautions must be taken in order to prevent nutritional deficiencies in plants. If any nutritional deficiencies occur for any reason, it is vital to eliminate it in the fastest way for fruit yield. Nutritional defects not only decrease fruit yield and quality, but also reduce the tolerance of the plant to stress conditions such as disease, extreme cold and hot, drought (Lucena, 1996).

In order to obtain abundant and high quality crops in vegetative production, it is necessary to regulate the agriculture inputs as well as the selection of suitable varieties. Agricultural activities have been carried out in Turkey for many years,

so fertilization is extremely important for sustainability of productivity. For a successful fertilization, the content of the nutrient element of the soil, the nutrient element requirement of the plant and the environmental conditions must be taken into the consideration. Otherwise, the excess or ineffectiveness of one of the plant nutrients adversely affects the plant growth and crop yield. The situation stated above occurs due to balance of the nutrients in the plant is affected and the sensitivity of the plants to environmental conditions is changed (Kacar and Katkat, 2010).

A correct and balanced fertilization program can be fulfilled by knowing both the nutritional status of the plant and the available amounts of the nutrients in the soil. It is important for the necessary interventions to know the nutrients that can not obtainable by the plant despite the existence of sufficient level in the soil. Therefore, the researches have been carried out in different parts of the world in order to identify the orchards with nutrient deficiency and make a correct fertilization planning (Adiman, 2013).

In this study, it was aimed to determine the fertility status of the soil and the nutrient element levels of the almond orchards in the province of Uşak/ Turkey. Preliminary information has been obtained from the plant nutrition and soil fertility studies that have been carried out in this field. The results of the research may contribute to the quality and efficiency of the agricultural area, and guide to the possible future works in similar topics.

## MATERIALS AND METHODS

The experiment was carried out in Uşak between 2014 and 2015. In the study, samples of soil and leaves were collected from 49 almond orchards of at least 10 decare sizes between the middle of June and the beginning of July. The location information of the orchards is given in Table 1.

**Table 1.** Sampling locations

| No | Village / District | No | Village / District |
|---|---|---|---|
| 1 | Kuyucak / Center | 26-27 | Takmak / Eşme |
| 2 | Yapağılar / Center | 28 | Bozlar / Eşme |
| 3-4-43 | Demirören / Center | 29-30 | Ağabey / Eşme |
| 5-6 | Kaşbelen / Center | 31 | Kazaklar / Eşme |
| 7 | Karahasan / Center | 32 | Kolankaya / Eşme |
| 8 | İlyaslı / Center | 33 | Ağaçbeyli / Sivaslı |
| 9 | Çukurağıl / Center | 34 | Aktaş / Center |
| 10 | Beylerhan / Center | 35 | Cinoğlu / Sivaslı |
| 11-12 | Karaağaç / Center | 36-37 | Hacım / Sivaslı |
| 13 | Gökçetepe / Center | 38 | Omurca / Ulubey |
| 14-15 | Ulucak / Center | 39 | Külçen / Ulubey |
| 16-17 | Boyalı / Center | 40 | Çalışkanlar / Ulubey |
| 18 | Dışkaya / Center | 41-44-45 | Avgan / Ulubey |
| 19 | Hocalar / Center | 42 | Dutluca / Ulubey |
| 20-22-23 | Delihıdırlı / Karahallı | 46 | Kızılcasöğüt / Banaz |
| 21 | Çokaklı / Karahallı | 47 | Gedikler / Banaz |
| 24 | Buğdaylı / Karahallı | 48 | Büyükoturak / Banaz |
| 25 | Dereköy / Eşme | 49 | Kuşdemir / Banaz |

The data of the 2014 and 2015 growing seasons were used in this study. The leaves were sampled from nonfruiting shoots on 10-15 trees for each almond orchards (Beede et al., 2011). For a sampling, 40-50 leaves were collected from healthy leaves from each side of the tree for each almond orchard. Soil samples were also done in 2014 from each almond orchard where leaf were sampled. Soil samples were taken to describe the characteristics of soils from 20–40 cm depth from 3-4 different points in almond orchards. The soil samples were mixed in a plastic container and turned into a single representative sample.

Sampled leaves were quickly placed in an ice-box and immediately transferred to the laboratory to remove the con-

taminants by washing with 0.1% surface reactive detergent and rinsed with de-ionized water. Then, samples were dried at 65-70 °C till constant weight and homogenized by particle size reduction to <0.5 mm. Nitrogen (N) contents of samples was determined by Kjeldahl digestion and steam distillation (Lees, 1971). For determination of other nutrient elements samples were digested in nitric acid ($HNO_3$) and perchloric acid ($HClO_4$) (V/V:4/1) mixture (Kacar, 1972). The concentrations of phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), iron (Fe), copper (Cu), manganese (Mn), zinc (Zn), and boron (B) in digest were determined by means of Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-AES, Varian, Liberty Series II; Varian Inc., Palo Alto, CA, USA) (Kacar and Inal, 2008).

Air dried soil samples were gently crushed and passed through a 2 mm sieve. Particle size distribution was determined by the hydrometer method (Bouyoucus, 1952). Soil chemical properties were determined following Standard procedures, pH and soluble salts in 1:2.5 soil: water suspension, organic matter by potassium dichromate ($K_2Cr_2O_7$) oxidation (Jackson, 1959), calcium carbonate ($CaCO_3$) equivalent by a manometric method (Caglar, 1949), available P by extraction with 0.5M sodium bicarbonate ($NaHCO_3$) at pH 8.5 (1 g soil: 20 mL solution) (Olsen et al., 1954), exchangeable K, Ca and Mg by replacing with 1M ammonium acetate ($NH_4CH_3COO$) at pH 7.0 (Carson, 1980). In the extracts Fe, Mn, Cu, Zn, and B were determined by extraction with DTPA by Inductively coupled plasma atomic emission spectrometer (ICP-AES, Varian Liberty Series II; Varian Inc., Palo Alto, CA, USA).

## RESULTS AND DISCUSSION

The results of some physical and chemical analyzes of the soil in the almond orchards are given in Table 2. The soils are generally loamy (37%) and clayey loamy (63%) and they have a moderate structure according to the textures class (Bouyoucus, 1952). It has been determined that there is no salinity problem in the majority of soils, and vegetable production is not limited to the orchards in the low salinity class (Waters et al., 1972). The pH of the soil ranged from 6.3 to 8.0, and the soil reaction was predominantly in the slightly alkaline class (71%) (Jackson, 1959). Lime content was found in the high rates (at about 64% of the orchards). This condition constitutes a potential risk, especially in terms of the availability of phosphorus and micro (iron, zinc, copper, manganese, etc.) elements (Kacar et al., 2006). Organic matter contents of the soils ranged from 1.51% to 3.11%, while about 76% of the orchards were in the middle class. Similarly, above 79% of the Aegean region soils were reported to have organic matter deficiency problems (Eyupoglu, 1999). The positive situation in this study with regard to the content of organic matter is due to the farmers' use of intensive farmyard manure. Organic materials are important to improve the physical, chemical and microbiological properties of soil, and increase cation exchange capacity of soil, organic carbon, microbial biomass and biological activity (Giusquiani et al., 1995; Jorgensen et al., 1996).

The lowest, highest and average values of nutrient content and the ratio of orchards showing nutrition deficiencies according to soil analysis results of almond orchards cultivated in Uşak province are presented in Table 3. The variable nutrient content of the orchard soil is classified according to Lindsay and Norwell (1978). In the majority of soils, the P, K, Mg and Zn elements were low; the Ca element was high. The P (88%), K (100%), Mg (80%) and Zn (96%) contents of orchard soils were deficient, while the Ca content was found to be in a high level, at about 47% of the orchards. Similar to the findings of this study, there were deficiencies in P contents of Aegean region soils and in K contents of Western Anatolia, and especially Aegean and Mediterranaen region soils (Eyupoglu, 1999). It is difficult for plants to utilize P in lime and high pH soils. If there are high amounts ions such as K and Ca in the soil solution, Mg uptake by plants could reduce. The high Ca amount in the arid soils may create antagonistic effects in the intake of some nutrients, especially micro elements.

**Table 2.** Some physical and chemical properties of almond orchard soils

| Level | Texture class | Soluble salt (mmhos/cm) | pH | Lime (%) | Organic matter (%) |
|---|---|---|---|---|---|
| Minimum | - | 0.03 | 6.1 | 2.48 | 1.51 |
| Maximum | - | 0.70 | 8.0 | 63.70 | 3.11 |
| Mean | - | 0.15 | 7.5 | 29.01 | 2.21 |
| Percentage of orchards by limit values and proficiency classes (%) | | | | | |
| Texture class | Clayey | Clayey loamy | | Loamy | |
| | 0.0 | 63.3 | | 36.7 | |
| Soluble salt | Not salinity | Low salinity | Medium salinity | High salinity | |
| | 95.9 | 4.1 | 0.0 | 0.0 | |
| pH | Medium acidic | Slightly acidic | Neutral | Slightly alkaline | Strong alkaline |
| | 0.0 | 14.3 | 14.3 | 71.4 | 0.0 |
| Lime | Very low | Low | Medium | High | Very high |
| | 0.0 | 16.3 | 19.3 | 42.2 | 22.2 |
| Organic matter | Very low | Low | Medium | High | Very high |
| | 0.0 | 24.4 | 75.6 | 0.0 | 0.0 |

**Table 3.** Some nutrient contents of almond orchard soils

| Level | $P_2O_5$ | $K_2O$ | Mg | Ca | Fe | Zn | Mn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|
| | (%) | | | | (ppm) | | | | |
| Minimum | 0.02 | 14.2 | 37.9 | 319 | 0.88 | 0.007 | 4.5 | 0.06 | 0.09 |
| Maximum | 21.50 | 189.0 | 304.0 | 5600 | 38.90 | 1.540 | 97.6 | 1.74 | 1.24 |
| Mean | 4.23 | 71.9 | 94.3 | 2740 | 11.25 | 0.270 | 27.1 | 0.58 | 0.43 |
| Orchard rate with deficient (%) | 87.8 | 100.0 | 79.6 | 46.9 (high) | 42.8 | 96.0 | 0.0 | 4.0 | 2.0 |

According to the reference values suggested by Lindsay and Norvell (1978), the microelements such as Fe, Mn, Cu and B levels of orchard soils used in this study were above the deficiency threshold, while Zn deficiency was 96% of the orchard soils. The soils used in this study have slightly alkaline soil pH and also high lime content. This generally affects the micro-element intake of plants in a negative way (Karacal, 2008; Kacar and Katkat, 2010). Therefore, micro-element nutrition from the soil in the orchards may cause a problem. Similar to our results, Eyupoglu (1999) reported critical Zn levels, which is lower than 0.5 mg $kg^{-1}$, were above 88% of the Uşak province soils. Although Zn element, which has positive effects in plants, is generally found in low levels in Turkey's agricultural soils, almond farmers have not taken into account the enough attention to Zn fertilization.

The Table 4 also presents the results of leaf nutrient content in almond orchards cultivated in Uşak province. These results were evaluated through the optimum range suggested by Beede et al. (2011). N contents of almond leaves were found between 2.56% and 3.98%. When the results were compared to standard values, N deficiency was not detected in any of the orchards. In the study, it was determined that P, K and Mg contents of the leaves were 0.06 and 0.15%; 0.67 and 1.50%; 0.13 and 0.44%, repectively. The deficiencies of P, K and Mg contents were found at about 69%, 33% and 55% of the orchards, repectively. These results show that local almond farmers consider to use solely N nutrients in fertilization. There were distinct results in the previous studies suggested from almond orchards in different areas of Turkey. It has been reported that the contents of N, P, K in the leaves of different almond cultivars in the province of Sanliurfa is deficient, and that Mg and Ca contents are in the optimum range (Parlakci, 2008). On the other hand, Yalcin (2014) reported that the N, P and K contents were deficienct at about 65%, 5% and 20% of almond orchards in another provience named Muğla, repectively.

The Fe, Zn, Mn, Cu and B contents of leaves from almond orchards ranged between 19.8-85.3 mg $kg^{-1}$, 7.8-27.0 mg

kg$^{-1}$, 15.4-78.8 mg kg$^{-1}$, 1.7-21.6 mg kg$^{-1}$ and 16.7-129.0 mg kg$^{-1}$, repectively (Table 4). The Fe (71%), Zn (80%), Cu (63%) and B (45%) contents of orchard leaves were deficient according to the optimum ranges (Beede et al., 2011). It has been determined that the there is no problem related to manganese nutrition of orchards in this study. In previous studies regarding micro elements in Turkey, only the Cu deficiency was found in the almond orchards (Parlakci, 2008; Yalcin, 2014).

**Table 4.** Some plant nutrient contents of almond leaves

| Level | N | P | K | Mg | Ca | Fe | Zn | Mn | Cu | B |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | (%) | | | (mg kg$^{-1}$) | | | | |
| Minimum | 2.56 | 0.06 | 0.67 | 0.13 | 0.90 | 19.8 | 7.8 | 15.4 | 1.7 | 16.7 |
| Maximum | 3.98 | 0.15 | 1.50 | 0.44 | 3.27 | 85.3 | 27.0 | 78.8 | 21.6 | 129.0 |
| Mean | 3.20 | 0.09 | 1.10 | 0.25 | 1.82 | 40.1 | 15.0 | 43.8 | 4.0 | 43.1 |
| Orchard rate with deficient (%) | 0.0 | 69.4 | 32.6 | 55.1 | 71.4 | 71.4 | 79.6 | 4.1 | 63.3 | 44.9 |

N element, which most needed by plants, was found to be insufficient in any of the almond orchards taken in this study. Also, the N element which significantly influences vegetative and generative growth in the plant may be easily washed from the soil. Therefore, it should be applied in the form of acid fertilizer for this study area. Approximately half of the study area soils have the high Ca content. It is known that Ca, which is found in the soil at high levels, prevents the uptake of P and K in plants (Kacar and Katkat, 2010). Chemical fertilizers with acid character or physiological acid character should be preferred with primary elements in fertilization. In an unsuitable situation, such as the soils of the study area, application of nutrients to the fruit trees is an alternative and effective solution. In addition, Mg, Fe, Zn and Cu elements may be applied to the leaves of the plants to solve nutritional problems (Bright, 2005).

## CONCLUSION

The soil of Uşak province has high lime content, and is not rich in organic matter content. This situation must be taken into consideration particularly in almond orchard fertilization. In order to reduce the high soil reaction detected in the almond orchards in the region, various applications, such as powdered sulfur (S) should be used, and the fertilizers with acid character should be preferred. In addition, green fertilization practices should be applied to soil in order to improve the soil structure and increase the amount of organic matter. In the long term, it is necessary that legumes such as vetch and soybean must be added to the soil or the application of farmyard manure should be increased. In this way nutritional problems of micro elements such as iron, zinc, copper and boron in the soils may be removed.

## ACKNOWLEDGEMENTS

This study was funded by Usak University, Scientific Research Project # 2013-MF-015

## LITERATURE CITED

Adiman, M. 2013. Determination of Mineral Nutrient Status of Walnut Orchards in Niksar District of Tokat Province. Gaziosmanpaşa University, Institute of Science, Mater Thesis, p. 67.

Anonymous, 1980. Soil and Plant Testing and Analysis as a Basis of Fertilizer Recommendations. http://www.fao.org/3/a-ar118e.pdf (erişim tarihi: 14.04.2016)

Anonymous, 2014. FAO Statistical database. http://apps.fao.org/page/collestionssubset: agriculture (erişim tarihi: 02.05.2016)

Beede, R.H., Brown, P.H. and Kallsen, C. 2011. Understanding and Correcting Nutrients in Nut Crops. California Plant and Soil Conference, 1-2 February, 2011, California, 21-29.

Bouyoucus, G.J. 1952. A Recalibration of the Hydrometer for Making Mechanical Analysis of Soils. Agronomy Journal, 1952, 43: 434-438.

Bright, J. 2005. Apple and Pear Nutrition. http://www.dpi.nsw.gov.au/_data/assets/pdf_.file/ 0004/41485/Apple and pear nutrition Primefact 85.pdf (erişim tarihi: 26.05.2016)

Carson, P.L. 1980. Recommended Potassium Test In: Recommended Chemical Soil Test Procedures for the North Central Region. (Ed. Dahnke, W.C.), Regional Publicaton, USA, pp. 20-21.

Caglar, K.O. 1949. Soil Information. Ankara University Faculty of Agriculture Publications, Ankara.

Eyupoglu, F., Kurucu, N. and Talaz, S. 1998. The General Situation of Turkish Soils in Terms of Some Micro Elements (Fe, Cu, Zn, Mn). Publications of Directorate of Soil and Fertilizer Research Institute, Ankara.

Giusquiani, P.L., Pagliai, M., Gigliotti, G., Businelli, D. and Benetti, A. 1995. Urban Waste Compost: Effects on Physical, Chemical and Biochemical Soil Properties. Journal of Environmental Quality, 1995, 24: 175–182.

Jackson, M.L. 1959. Soil Chemical Analysis. Englewood Cliffs, New Jersey.

Jorgensen, R.G., Meyer, B., Roden, A. and Wittke, B. 1996. Microbial Activity and Biomass in Mixture Treatments of Soil and Biogenic Municipal Re-fuse Compost. Biology and Fertility of Soils, 1996, 23: 43–49.

Kacar, B., Katkat, A.V. and Ozturk, S. 2006. Bitki Fizyolojisi, (2. baskı). Nobel Yayınları, Ankara.

Kacar, B. ve İnal, A. 2008. Bitki Analizleri. Nobel Yayınları, Ankara.

Kacar, B. ve Katkat, A.V. 2010. Plant Nutrition, (5. press). Nobel Publications, Ankara.

Karacal, I. 2008. Soil Productivity. Nobel Publications, Ankara.

Kaska, N., Ak, B.E. and Acar, I., 1999. Almond Production, Breeding and the Future in the World and in the GAP Region. 1st GAP Agriculture Congress, 26-28 May 1999; 9-18.

Kaşka, N., 2001. Evaluation of Walnut Research in Turkey and Future Outlook. I. National Walnut Congress in Turkey, 5-8 September 2001; 1-11.

Less, R. 1971. Laboratory Handbook of Methods of Food Analiysis. Leonard Hill Boks, London.

Lindsay, W.L. and Norvell, W.A. 1978. Development of a DTPA Soil Test for Zinc, Iron, Manganese and Copper. Soil Science Society American Journal, 1978, 42: 421-428.

Lucena, J.J. 1996. Methods of Diagnosis of Mineral Nutrition of Plants a Critical Review. III. International Symposium on Mineral Nutrition of Deciduous Fruit Trees. 27-30 Mayıs, 1996, Zaragoza-İspanya, 179-192.

Olsen, S.N., Cole, C.V., Watanabe, F.S. and Dean, L.A. 1954. Estimation of Avilable Phosphorus in Soils by Extraction with Sodiumbicarbonate. United States Department of Agriculture, Washington.

Parlakci, H. 2008. Determination of some pomological and chemical traits with nutrient elements contents for some foreign originated different almond cultivars. Harran University, Institute of Science, Mater Thesis, p. 73.

Waters, W.E., NeSmith, J., Geraldson, C.M. and Woltz, S.S. 1972. The Interpretation of Soluble Salt Tests and Soil Analysis by Different Produces. Florida Flower Grower, 1972, 9 (4): 1-10.

Yalcin, H.I., 2014. Nutritional status of Datça district in Muğla province where almond is cultivated as organic. Ege University, Institute of Science, Mater Thesis, p. 68.

# P-5 Effects of bacterial fertilizer on yield and yield parameters of cucumber in greenhouse conditions

**Ertan YILDIRIM[1], Atilla DURSUN[1], Metin TURAN[2], Melek EKİNCİ[1], Fazilet P. KARAGÖZ [1], Raziye KUL[1]**

[1] Atatürk University, Agriculture Faculty, Department of Horticulture, Erzurum, Turkey

[2] Yeditepe University, Engineering Faculty, Genetic and Bioengineering, Istanbul, Turkey

Corresponding author: ertanyil@atauni.edu.tr

## Abstract

In recent years, there has been an increase in the use of organic fertilizer, increasing in the yield and quality and environment friendly in vegetable growing. For this reason, the effect of bacterial applications on yield and some quality parameters were investigated in cucumber (*Cucumis sativus* L., cv. A.21) under greenhouse conditions. Two applications ( *Azotobacter* spp., and mixed of *Bacillus subtilis* and *Bacillus megatarium*) having three dosses (1, 3 and 5 $gL^{-1}$ and control (no application)) were applied in a completely randomized design with 3 replications. The applications were treated after a week of planting of the seedlings. The solutions were given to the root zone of the plant and repeated 3 times at intervals of 10 days. Average fruit weight, fruit number per plant, fruit weight per plant, plant height, fruit width and length, total soluble solid and dry matter yield and mineral content were evaluated on cucumber plants and fruits. The effects of applications were significant on plant growth of cucumber. The bacterial applications increased in yields and plant growth parameters of cucumber. The applications were also having significant effect on the mineral content of cucumber fruits.

**Keywords:** *Cucumis sativus*, Plant Development, Yield, Macro and Micro Elements, Nutrition

## 1. Introduction

Use of microbial preparations for enhancement of plant production and quality is becoming a more widely accepted practice in many countries (Higa, 1994; Rodriguez and Fraga, 1999). Bacterial fertilizers are products containing different types of microorganisms, having an ability to convert nutritionally important elements from unavailable to available form (Vance, 1997; Hegde et al., 1999; Kincses et al., 2008). Bacterial fertlizers may increase in the soil microbial sources, improve crop nutrition conditions, accelerate the decomposition of organic wastes, increase in the availability of mineral nutrients, dissolve soil phosphorus, potassium, increase in the nitrogen content of soil and enhance the activities of beneficial microorganisms (Kovács et al., 2012). Therefore, they are effect on improving of the quality and productivity of soil and increasing in the vegetable production (Higa, 1991; Higa and Wididana, 1991). In general, the vegetable crops require much nutrients for short period of cultivation. It seems that bacterial fertilizers is a good supply source of nutrients in vegetable crops because bacterial fertilizer can make a favourable condition for the growth of crops, promoting the mobilization of non-soluble and activating the beneficial microorganisms in soil (Higa. 1991). In addition bacterial fertilizers are seen as an alternative product able to use in sustainable soil fertility, conservation of natural balance and environmental friendly plant production.

This study was undertaken to evaluate the effect of two different certifiable organic bacterial fertilizers on yileld and yield parameters of cucumber.

## 2. Material and Methods

### 2.1. Growth conditions and plant materials

The experiment was carried out on ‘A.21’ cucumber cultivar in the Department of Horticulture at Atatürk University under unheated greenhouse condition in Erzurum, Turkey, in 2016. Cucumber seedlings were planted as 50x50x100 on 20 May in 2016. Drip irrigation method was used during the experiment. The experiment was ended on 3 September in the same year.

## 2.2. Bacterial Fertilizers

Three different concentrations (1,3 and 5 $gL^{-1}$ and control (no fertilizing)) of two different (*Azotobacter spp.* ($1x10^9$):A, mixed of *Bacillus subtilis* and *Bacillus megatatium* ($1x10^9$) two different certifiable organic bacterial fertilizer were used in this study and bacterial fertilizers were obtained from Professor Dr. Metin TURAN (Yeditepe University, Department of Genetics and Bioengineering, İstanbul, Turkey). This bacterial fertilizers contain also 15% organic matter, 6% organic carbon, 13% humic +fulvic acid and enzyme, acid phosphatese, urease, denitrogenase, protease, (30 $Uml^{-1}$ from each) besides the PGPR.

## 2.3. The application procedure to plants

The study was made based on a completely randomized design with three replication per treatment and each treatment has 10 plants. The aplications were treated after a week of planting of the seedlings. The solutions were given to the root zone of the plant and repeated 3 times at interveals of 10 days.

## 2.4. Data Collection and statistşcal analysis

Fruits were harvested three time a week. Fruit number per plant (adet), fruit weight per plant (g), avarege fruit weight (g), fruit width (mm), fruit length (cm), total soluble solid matter (% Birix), fruit dry matter yield (%) plant height (cm) were determined. In addition, the effect of bacterial fertilizer on the macro and micro plant nutrient elements (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, Pb, B and Cd) of fruit in cucumber was also evaluated. Plant saples were oven dried at 68 0C for 48 h and were then ground. The Kjeldahl method and a Vapodest Rapid Kjeldahl Distillation Unit (Gerhardt, Konigswinter, Germany) were used for determining total N (Bremner,1996). Macro (P, K, carbon (C), magnesium (Mg) and sodium (Na)) and microelements (Fe, Mn, Cu, Zn and B) were determined after the wet digestion of dried and ground samples using a nitric acid–hydrogen peroxide (HNO3–H2O2) acid mixture (2:3 v/v) in three stages [first stage; 145 °C, 75% radio-frequency power (RF), 5 min; second stage; 180 °C, 90% RF, 10 min; and third stage; 100 °C, 40% RF, 10 min] under microwave digestion (Bergof Speed wave Microwave Digestion Equipment MWS-2; Berghof Products and Instruments, Eningen, Germany) (Mertens, 2005a). P, K, Ca, Mg, Na, Fe, Mn, Cu, Zn and B were determined using an inductively coupled plasma spectrophotometer (Optima 2100 DV, ICP/OES; Perkin-Elmer, Shelton, CT) (Mertens, 2005b). All data were subjected to analysis of variance using SPSS statistical program and means were separated by Duncan's multiple range tests.

## 3. Results and Discussion

**Plant growth:** Effects of bacterial fertilizer on fruit number per plant, fruit weight per plant, plant length, fruit length and fruit dry matter yield were significant and there were no significant differences in avarege fruit weight, fruit width, total soluble solid matter and plant height (Table 1). The highest fruit number per plant (12.59), fruit number per plant (1499,53 g) and fruit length (16,88 cm) were obtained from A-5 bacterial fertilizer aplication as comparing to that of the other applications. According to the study carried out by Kim et al. (2012), treatments of bacterial fertilzer affect on increasing in yields of Chinese cabbage and radish in field. In addition, similar results on that subject were reported by Seymen et al., 2010.

Table 1. Effect of different bacterial fertilizers on yield, yield compenent and quality in cucumber

| Parameters | A-1 | B-1 | A-3 | B-3 | A-5 | B-5 | C |
|---|---|---|---|---|---|---|---|
| **Fruit number per plant** | 11,16 ab* | 11,29 ab | 10,47 bc | 9,40 c | 12,59 a | 11,59 ab | 11,44 ab |
| **Fruit weight per plant (g)** | 1413,70 ab*** | 1298,97 bc | 1244,70 cd | 1130,49 d | 1499,53 a | 1417,83 ab | 1326,56 bc |
| **Avarege fruit weight (g)** | 126,95ns | 114,93 | 119,22 | 120,47 | 119,24 | 122,34 | 116,77 |
| **Fruit width (mm)** | 33,58 ns | 32,31 | 31,71 | 33,59 | 33,62 | 31,69 | 32,52 |
| **Fruit length (cm)** | 16,21 ab* | 16,16 ab | 15,51 b | 16,78 a | 16,88 a | 15,17 b | 15,80 ab |
| **Total soluble solid matter (°Birix)** | 4,10 ns | 4,53 | 4,30 | 3,93 | 4,07 | 4,30 | 4,03 |
| **Fruit dry matter yield (%)** | 2,86 a** | 2,63 a | 2,99 a | 2,19 b | 3,01 a | 2,71 a | 2,96 a |
| **Plant height (cm)** | 411,44ns | 363,56 | 379,22 | 368,11 | 366,00 | 366,78 | 332,11 |

A: Bacterial fertilizer of *Azotobacter spp.* ($1x10^9$); B: Bacterial fertilizer mixed of *Bacillus subtilis* and *Bacillus megatarium* ($1x10^9$); C: Control (no fertilizing). A/B-1: 1 $gL^{-1}$; A/B-3: 3 $gL^{-1}$; A/B-5: 5 $gL^{-1}$. *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001 (values in the same column with different letters are significantly different).

**Fruit nutrient contents:** Bacterial fertilizers consists of mixed cultures of beneficial and naturally-occurring microorganisms that can be applied as inoculants to increase in the microbial diversity of soils and plants. Beneficial microorganisms are those that can fix atmospheric nitrogen, decompose organic wastes and residues, detoxify pesticides, suppress plant diseases and soil-borne pathogens, enhance nutrient cycling, and produce bioactive compounds such as vitamins, hormones and enzymes stimulating plant growth.These microorganisms maintain the growth environment of plants, and may have primary effects on both soil quality and crop quality (Higa and Parr, 1994).

The results showed that the bacterial fertilizer enhanced the nutrient intake significantly. maksimum N, P, K and Ca uptake was observed in the fruit cucumber treated with bacterial fertilizer when compared to control. The content of Mg and Fe was higher in the fruits belonging to the control group when compared to the other applications. The highest Cd content was determinated in A-1 application while the highest B content was found in A-3 application. Yıldırım et al., (2015) detected that P-solubilising and N2-fixing PGPR strain improved growth characteristics and seedling nutrient content of cabbage seedlings.

Table 2. Effect of different two bacterial fertilizers on fruit chemical contents of cucumber

| Element | A-1 | B-1 | A-3 | B-3 | A-5 | B-5 | C |
|---|---|---|---|---|---|---|---|
| N (%) | 2,27 c*** | 2,41 b | 2,41 b | 2,39 bc | 2,56 a | 2,36 bc | 2,14 c |
| P (mg $kg^{-1}$) | 3526,00 a*** | 3502,00 a | 3767,33a | 3762,00 a | 3774,33 a | 3788,00 a | 2838,33 b |
| K (mg $kg^{-1}$) | 22689,33 a*** | 22463,33 a | 24464,33 a | 23741,33 a | 23681,67 a | 23986,33 a | 18493,67 b |
| Ca (mg $kg^{-1}$) | 9614,67 a**** | 9258,33 a | 9948,00 a | 9519,00 a | 9438,67 a | 9603,33 a | 7320,00 b |
| Mg (mg $kg^{-1}$) | 3974,33 d*** | 4447,00 b | 4233,33 bcd | 4243,33 bcd | 4101,00 cd | 4286,67bc | 5141,67 a |
| Fe (mg $kg^{-1}$) | 150,67 c** | 157,67 bc | 162,00 bc | 172,00 b | 151,00 c | 167,00 bc | 196,33 a |
| Mn (mg $kg^{-1}$) | 26,53ns | 27,31 | 25,69 | 29,11 | 30,12 | 27,34 | 26,02 |
| Zn (mg $kg^{-1}$) | 40,69ns | 38,59 | 37,84 | 40,07 | 38,67 | 40,89 | 42,16 |
| Cu (mg $kg^{-1}$) | 8,03ns | 8,08 | 7,91 | 8,06 | 8,23 | 7,85 | 8,20 |
| Pb (mg $kg^{-1}$) | 0,35ns | 0,29 | 0,28 | 0,21 | 0,24 | 0,25 | 0,30 |
| B (mg $kg^{-1}$) | 26,35 abc** | 23,94 bc | 28,50 a | 26,50 ab | 27,91 a | 23,76 c | 23,83 bc |
| Cd (mg $kg^{-1}$) | 2,05 a*** | 1,00 d | 1,33 c | 0,99 d | 1,65 b | 1,11 d | 1,10 d |

A: Bacterial fertilizer of *Azotobacter spp.* ($1x10^9$); B: Bacterial fertilizer mixed of *Bacillus subtilis* and *Bacillus megatarium* ($1x10^9$); C: Control (no fertilizing). A/B-1: 1 $gL^{-1}$; A/B-3: 3 $gL^{-1}$; A/B-5: 5 $gL^{-1}$. **$P \leq 0.01$, ***$P \leq 0.001$ (values in the same column with different letters are significantly different).

## 4. Conclusions

According to study, using bacterial fertilizers has significantly increased in yield compenent of cucumber. Chemical fertilizers have unpleasant environmental impacts such as soil and water pollution, health problems on human and other organisms, the tearing down of soil, disturbing chemical balance of soil, reduction of production potential during long-term and environmental pollution. Therefore, in order to achive stable agriculture increasing use of bacterial fertilizers could be a good solution. As a result, bacterial fertilizers can be recommended for the sake of achieving the higher quality production.

## References


Bremner, J. M. (1996). Nitrogen-total. In Methods of soil analysis part III, eds. J. M. Bartels and J. M. Bigham, 1085–121. Madison WI, USA: ASA SSSA Publisher Agron No: 5.

Hegde, D.M., Dwived, B.S., Sudhakara, S.N., (1999). Biofertilizersfor cereal production in India—a review. Indian Journal of Agricultural Sciences 69: 73– 83.

Higa, T. (1994): Effective Microorganisms; A biotechnology for mankind, P 8-14. In J.F. Parr, S.B. Hornick and C.E. Whitman(ed.) Proceedings of the First International Conference on Kyusei Nature Farming .U.S Department of Agriculture, Washington, D.C., USA.

Higa, T., & Parr, J. F. (1994). Beneficial and effective microorganisms for a sustainable agriculture and environment (Vol. 1). Atami,, Japan: International Nature Farming Research Center.

Higa, T., Wididana G.N.. (1991). Changes in the soil micro flora induced by Effective Microorganisms. P.153-162. In J.F. Parr, S.B. Hornick and C.E. Whitman(ed.) Proceedings of the First International Conference on Kyusei nature farming U.S. Department of Agriculture, Washington, D.C., USA.

Kim, S. G., Lim, Y. D., & Ryang, H. G. (2012). Yield And Quality of Vegetable as Affected by Effective Microorganisms.

Kincses, S. - Nagy, P. T. - Kremper R. (2008): A mű és baktériumtrágya hatása a növény-talaj rendszer makrotápelemforgalmára tenyészedénykísérletben. 50. Jubileumi Georgikon Napok Keszthely 09.25-25, 202-206.

Kovács, A. B., Kremper, R., Jakab, A., & Szabó, A. (2012). Effects of farmyard manure and a bacterial fertilizer on the phosphorus and potassium content of grape leaves. Analele Universităţii din Oradea, Fascicula: Protecţia Mediului, 18, 105-110.

Mertens, D. (2005a). AOAC official method 922,02, plants preparation of laboratuary sample. In Official methods of analysis, eds. W. Horwitz and G. W. Latimer, Chapter 3, 18th ed., 1–2. Gaitherburg, Maryland: AOAC-International Suite.

Mertens, D. (2005b). AOAC official method 975,03, metal in plants and pet foods. In Official methods of analysis, eds. W. Horwitz and G. W. Latimer, Chapter 3, 18th ed., 3–4. Gaitherburg, Maryland: AOAC-International.

Rodriguez, H. & Fraga, R. (1999): Phosphate solubilizing bacteria and their role in plant growth promotion, Biotechnology Advences. 17 pp. 319–339.

Seymen, M., Turkmen, O., Dursun, A., Donmez, M. F., & Paksoy, M. (2010). Effects of bacterium inoculation on yield and yield components of cucumber (Cucumis sativus). Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, 67(1), 274-277.

Vance, C.P., (1997). Enhanced agricultural sustainability through biological nitrogen fixation. In: Bio Fix of Nitrogen for Eco and Sustain Agric. Proc. NATO Adv Res. Work, Ponzan, Poland, 10–14 September 1996, Springer-Verlag, Berlin, Germany, pp. 179–185.

Yildirim E, Turan M, Ekinci M, Dursun A, Gunes A, Donmez M (2015) Growth and mineral content of cabbage seedlings in response to nitrogen fixing rhizobacteria treatment. Rom Biotechnol Lett 20(6):10929–10935

# P-13 Molecular Studies In Almond

Başak ÖZDEMİR[1], Yeşim OKAY[1]

[1] Ankara University, Faculty of Agriculture, Horticulture Department, Ankara, Turkey
e-mail: f.yesim.okay@agri.ankara.edu.tr

**Abstract**

The almond (*Prunus dulcis*) in Rosaceae family is a major tree nut grown in areas of Mediterranean climate. In terms of almond production, United States is the first almond producer with 1.545.500 tonnes in the world, followed by Spain (195.704 tonnes), Australia (160.000 tonnes), Iran (111.936 tonnes) and Morocco (101.026 tonnes). In recent years, molecular markers have been used to study genetic diversity and cultivar identification of almond. Methods based on knowledge provided by advances in molecular genetics, notably molecular markers, promise faster and more efficient approaches to cultivar improvement. In fact, important tools such as molecular markers, maps, DNA sequences and quantitative trait loci (QTLs) have been developed and applications at the breeding program level have already started. Studies carried out for this purpose are genetic mapping, identification of genotypes and determination of genetic relations, investigation of disease resistance and tolerance conditions, determination of blooming date especially late blooming candidate genes and identification of genes that play an important role in fruit composition. There has been an increase in marker assisted selection studies which have been conducted for many features. This situation has brought a different dimension to almond breeding trials. In this study, the general situation of molecular studies carried out on almond in the world was evaluated.

**Keywords**: Almond, Molecular genetic, *Prunus dulcis*

## INTRODUCTION

Almond (*Prunus dulcis*) is an economically valuable nut species which has been cultivated on about 1.637.245 ha land with a total production amount of 2.917.894 tonnes worldwide. The first studies supporting almond breeding were started with marker studies and have received considerable interest due to practical use of isoenzymes and especially DNA markers for studying quantitative traits (Ruana and Sonnio, 2003). Molecular studies in almond showed parallelism with such studies in other nut species. Some of these studies are listed below based on their topics.

### Molecular Studies on Genetic Mapping of Almond

Viruel et al. (1995) constructed the first almond linkage map using restriction fragment length polymorphism (RFLP) from the cross Ferragnes x Tuono and the map spanned a distance of 400 cM. Similarly, Foolad et al. (1995) constructed a genetic linkage map of *Prunus* from a cross between a dwarf peach selection (54P455) and an almond cultivar 'Padre'. The map included 107 markers and spanned a distance of 800 cM. Joobeur et al. (1998) developed a saturated linkage map using a F2 cross 'Texas' (almond) x 'Earlygold' (peach). This map has been adopted as *Prunus* reference map. After this map, two more low density maps were constructed that covered the whole genome at distances of 10–25 cM using the markers in Tuono x Earlygold mapping. The first of these maps allowed a study of the map position of genes involved in self-incompatibility (Ballester et al., 1998), shell hardness (Arús et al., 1998) and blooming time (Ballester et al., 2001). The second map was based on an F2 progeny between almond and peach using the markers selected from 8 linkage groups from formerly developed *Prunus* maps. The study of pollen fertility and chromosome behavior during meiosis in the F1 generation confirmed the hypothesis that a reciprocal translocation exists between 'Garfi' almond and 'Nemared' peach. This map located genes involved in nematode resistance, and flower color (Jauregui et al., 2001).

Joobeur et al. (2000) constructed a linkage map with 7 isozyme genes and 120 RFLPs in the F1 progeny of a cross between almond cultivars 'Ferragnes' and 'Tuono'. The map included 54 RAPD markers and 6 SSRs. Polymorphism was detected in 6 of the 8 *Prunus* SSRs. The sizes of the maps of 'Ferragnès' (415 cM) and 'Tuono' (416 cM) were similar. The estimated total size of the almond map was of 457 cM. Dirlewanger et al. (2004) developed a high density version of Tuono x Earlygold map with 562 markers (361 RFLPs, 185 SSRs, 11 isoenzymes and 5 STSs) which defined 519 cM in total with the average density of 0.92 cM/marker and largest gap of 7 cM**.** Using an almond intraspecific cross between 'Nonpareil' and 'Lauranne' (N×L), Tavassolian et al. (2010) constructed a moderately saturated map with SSRs, SNPs, ISSRs and RAPDs. The N×L map covered 591.4 cM of the genome with 157 loci. The average marker distance of the map was 4.0 cM. The map displayed high synteny and colinearity with the *Prunus* T×E (Texas x Earlygold) reference map in all 8 linkage groups (G1-G8). Integrated maps produced by two different mapping methods using JoinMap® 3 were compared, and their high degree of similarity was evident.

### Molecular Studies on Identification of Almond Genotypes and Determination of Genetic Relations

There are many molecular studies on determination of genetic relationships between almond cultivars and genotypes

from in different geographical locations and related almond species. These studies aimed to analyze the origins of examined genotypes and species as well as to understand evolutionary history of the species. In a study, the genetic relatedness among 17 almond genotypes and 1 peach genotype was estimated using 37 RAPD markers. The level of similarity between almond and the peach was 0.424 supporting the value of peach germplasm to future almond genetic improvement (Bartolozzi et al. 1998). Similarly, analysis of genetic variability and differentiation within and among some *Prunus* species using AFLP revealed 4 well-supported groups corresponding to the four sections *Amygdalus, Armeniaca, Cerasus* and *Prunophora* described within the genus. The section *Armeniaca* showed significant differentiation from its sister section *Prunophora* within the subgenus (Aradhya et al. 2004). In their study on identification of *Prunus* spp. rootstocks, Bianchi et al. (2004) used microsatellite markers (SSR) in the molecular characterization of 29 *Prunus* spp. rootstocks. In the dendrogram, the 5 markers allowed the 29 rootstocks to be grouped into subgroups corresponding to the subgenus they belong to, either *Prunophora* or *Amygdalus*. SSR markers (UDP96-005, UDP96-008, UDP96-013, UDP96-18 and UDP98-414) proved to be efficient and reliable for the molecular characterization of *Prunus* spp. rootstocks. Sorkheh et al. (2007) aimed to estimate genetic similarities, marker indices, and polymorphic information contents for AFLP markers in almond cultivars. The genetic diversity of 45 almond cultivars from Iran, Europe, and America, were studied assaying 19 primer combinations. The correlation between genetic similarity clustering as based on AFLP and clustering for agronomic traits was low. Cluster analysis based on AFLP data clearly differentiated the genotypes and wild species according to their origin and pedigree, whereas, cluster analysis based on agronomic data differentiated according the pomological characterization. 12 highly polymorphic loci were selected for their ability to uniquely identify a set of 18 almond cultivars commonly grown in California, many of which are closely related. These markers were used for an accurate assessment of parent/progeny relationships among cultivars. It was suggested that this system can reliably identify at an early stage of development all major California almond cultivars in current production (Dangl et al. 2009). Amplification of genomic DNA from 13 almond genotypes was carried out by using 15 random decamer primers (Sharma and Sharma, 2010). Most of the genotypes were not defined by a single marker but a set of several markers; however GP-10 and GP-14 were distinctly identifiable from rest of the genotypes with unique bands obtained with OPP-10, OPP-14, OPP-15 and OPP-19. Zeinalabedini et al. (2010) evaluated 16 nuclear and 10 chloroplast SSR markers for 40 almond genotypes including cultivated almond, 18 related species and 5 interspecific-hybrid populations. Results established the value of SSR (nuclear and chloroplast) markers for distinguishing different genetic lineages and characterized an extensive gene pool available to almond genetic improvement. Hierarchical analysis using integrated nuclear and chloroplast DNA markers supported *Prunus fenzliana*, a species native to the northeast Iran, as a probable ancestor of the cultivated almond. Results also established the importance of interspecific hybridization and subsequent genetic introgression in the development of cultivated almond and demonstrate continuing value of an interspecific gene pool for modern cultivar improvement. Molecular results implicated a dissemination of the cultivated almond from Asia to the Eastern Mediterranean and subsequently the Western Mediterranean and the New World were supported by the molecular analysis of regional germplasm. Kadkhodaei et al. (2011) used a total of 39 morphological traits and 9 SSR loci to study the morphological and genetic diversity among 53 selected almond cultivars/landraces with different geographical origins; to assess the level of correlation between phenotypic and nuclear genetic distance matrices, and to classify the accessions into groups based on molecular profiles and morphological traits. The UDA-002 and UDA-005 markers were the most informative revealing 17 and 15 polymorphic alleles distributed among all genotypes, respectively, but considering polymorphism information content (PIC), UDA-023 was the most informative one. The mean morphological similarity (0.59) was calculated using SSR markers (0.23).

It is remarkable that the studies on the determination of genetic relationships in almond are mainly performed in the countries and regions where naturally grown almond species/varieties exist and almond cultivation is predominant.

In a study on phylogenetic analysis of almond trees from China and the Mediterranean region, expressed sequence tag (EST) derived simple sequence repeats (SSRs, microsatellites) were screened and identified from 3863 almond and 10185 peach EST sequences, and the spectra of SSRs in the non-redundant EST sequences were investigated after sequence assembly (Xu et al., 2004). 21 EST-SSRs were thereafter, developed and used together with 7 genomic SSRs. It was suggested that Chinese almond cultivars have a distinct evolutionary history from the Mediterranean almond. The preliminary results indicated that common almond was more closely related to peach than to the four wild species of almond (*P. mongolica Maxim., P. ledebouriana Schleche, P. tangutica Batal.,* and *P. triloba Lindl*.). The implications of these SSR markers for evolutionary analysis and molecular mapping of *Prunus* species were discussed. Chinese almond is represented by 6 species and over 100 cultivars/genotypes of common almond. To analyse this diverse germplasm, Ma et al. (2005) used SSRs derived from both genomic and cDNA clones, and the self-incompatibility alleles. They obtained over 1000 ESTs from almond pistil, and 723 unique sequences were assembled. These ESTs were used in EST-SSR analysis. The SSR markers obtained showed high cross-species transferability and allowed to construct the phylogenetic tree of common almond, wild almond and their relative species. In this work, 54 SSR pairs were newly developed and 27 were used for the phylogenetic analysis and fingerprinting. The results showed that almond cultivars from China and the Mediterranean region countries were classified in two independent groups. Phylogenetic analysis indicated that the S-RNase sequences formed a relatively independent subgroup from those of almond cultivars originated from the Mediterranean region, suggesting that the S-genes have different evolutionary history after almond was introduced from the Central and Western Asia to the Mediterranean

region, which might have been related to their geographic origin. Researchers suggested that the almond pistil EST analysis provides a first picture of the numerous almond genes potentially involved in the pistil development, and it not only contributes to the understanding of gene expression patterns in pistils but also provides an extensive reservoir for the gene cloning and genetic mapping in almond and other related fruit trees. Xie et al. (2006) used 16 SSR markers including 8 EST-SSR and 8 genomic SSRs for genetic diversity analysis of 23 Chinese and 15 international almond cultivars. EST- and genomic SSR markers previously reported in species of *Prunus*, mainly peach, proved to be useful for almond genetic analysis. Furthermore, it was shown that some potential point mutations in the flanking regions are linked with new SSR repeat motif variation in almond and peach.

Genetic diversity of the Spanish national almond collection was characterized with 19 SSR markers selected because of their polymorphism in almond and other *Prunus* species (Fernandez-Marti et al., 2009). A total of 93 almond genotypes, including 63 Spanish cultivars from different growing regions, as well as some international cultivars and breeding releases were analyzed in the study. All primers produced a successful amplification, giving a total of 323 fragments in the genotypes studied, with an average of 17 alleles per SSR, ranging from 4 (EPDCU5100) to 33 (BPPCT038). Allele size ranged from 88 bp at locus PMS40 to 260 bp at locus CPPCT022. The heterozygosity observed (0.72) was much higher not only than in other *Prunus* species, but also than in other almond pools already studied. The dendrogram generated using the variability observed classified most of the genotypes according to their geographical origin, confirming the particular evolution of different almond ecotypes. The SSR markers have consequently shown their usefulness for cultivar identification in almond, for establishing the genetic closeness among its cultivars, and for establishing genealogical relationships. In another study, 9 SSR markers were used to analyze 113 almond cultivars and accessions coming from ex-situ conservation, including most of almond genotypes spread in Sicily and Apulia and foreign cultivars from Mediterranean, American and Australian areas in order to determine the level of genetic diversity within Italian genotypes and elucidate phylogenetic and possible parentage relationships between Italian accessions and foreign germplasm (Distefano et al., 2013). Distance and model-based analyses revealed a high level of variability both among and within geographical areas. These data represent the first overview of genetic diversity among Italian almond cultivars using molecular markers. Gouta et al. (2010) studied genetic diversity of 50 Tunisian almond genotypes and their relationships to European and American cultivars. In total 82 genotypes were analyzed using 10 genomic SSRs. The results demonstrated that the genetic diversity within local almond cultivars was important, with clear geographic divergence between the northern and the southern Tunisian cultivars. Assessment of genetic diversity of Moroccan cultivated almond grown from seed and cultivated at 4 eco-geographical regions was performed using 16 nuclear SSRs (Elhamzaoui et al., 2012). A high genetic diversity of the local almonds was apparent and structured into 3 major clusters (Oasis cluster, High and Anti Atlas cluster, and Middle Atlas cluster). It was concluded that compared to the Mediterranean genetic pools, from the East to West, the genetic diversity tends to be limited in Morocco which is the area of its extreme diffusion. RAPDs and SSRs were used to study the genetic diversity of Iranian almond cultivars and their relationship to important foreign cultivars and three related species (Shiran et al., 2007). 8 unidentified almond Shahrodi cultivars and 3 wild almonds (*Prunus communis, Prunus orientalis* and *Prunus scoparia*) were also included. Results demonstrated an extensive genetic variability within the tested cultivars as well as the value of SSR markers developed in peach for characterization of almond and related species of *Prunus*. Dice similarity coefficient was calculated for all pair wise comparisons and was used to construct a UPGMA dendrogram. For both markers a high similarity in dendrogram topologies was obtained. All dendrograms, including that obtained by the combined use of both the marker data, depicted the phenetic relationships among the cultivars and species, depending upon their geographic region and/or pedigree information. Almond cultivars clustered with accession of *P. communis* showing their close relationship. *P. orientalis* and *P. scoparia* were clustered out of the rest of *P. dulcis*. In another study (Zeinalabedini et al., 2007) , the genetic diversity of different accessions of several wild almond species including *P. eleagnifolia, P. hausknechtii, P. scoparia* and *P. lycioides*, endemic to Irano-Afghan plate, was investigated using nuclear and chloroplast DNA markers. In addition, 5 cultivated almond cultivars (Marta, Nonpareil, Mission, Ferrangnes and Tuono) were included in the study. Hierarchical analysis using integrated nuclear and chloroplastic microsatellite data yielded best clustering with 6 logical clusters or groupings corresponding to the different subgenus and sections. Fathi et al. (2008) analysed the genetic diversity among 56 almond genotypes using 35 microsatellite markers and 14 morphological traits. Regression analyses revealed a positive correlation between the CPPCT03 locus and kernel yield, kernel percentage, grain weight, leaf length and tree altitude. The results of the study showed that microsatellite markers could be successfully used to assay genetic diversity among Iranian almond landraces/cultivars and to identify informative markers for improving traits in breeding programs. Otaghvari and Ghaffarian (2011) assessed the genetic diversity of 19 late flowering almond genotypes using ISSR markers. The results of molecular analysis showed that almond cultivars and genotypes that are collected from close geographical regions are of large genetic homogeneity and the overall polymorphism content in studied genomes is rather low. Considering the self-incompatible nature of the almond plants, it may be concluded that the domesticated genotypes and those cultivated in studied regions, have had little mixture with alien almond germplasm.

In a study, genetic relationships were explored between wild almond genotypes from different ecotypes of Turkey using RAPD and SSR markers (Küden et al., 2005). The highest similarity between species was 0.957 and the lowest similarity was 0.250. Similarly, Bayazit (2007) were performed molecular identifications of wild almond genotypes in

Turkey's natural flora using RAPD markers. Nonpareil, Cristomorto, Hacı Alibey (48-5), Gülcan-1 (101- 23) cultivars and 101-13 almond genotype were used to compare these wild almond genotypes. In dendogram of the results of RAPD analysis, cultured almond cultivars (*Prunus dulcis* L.) were placed in the same group with Middle Anatolia wild almonds. Genetic relationships were explored between selected almond genotypes from different ecotypes of East Anatolia Region of Turkey using AFLP and SSR molecular markers and polymorphism content and genetic relationships between cultivars/ genotypes were identified succesfully (Karakurt, 2013). In a study on the identification of late flowering and superior almond genotypes among the naturally grown almond population in İspir district of Erzurum province (Turkey) by using RAPD method, the lowest genetic distance was 0.46, and the highest was 0.79 (Köse, 2013).

**Molecular Studies on Resistance to Disease Causative Agents and Diseases in Almond**

In recent years, almond anthracnose has developed into a major problem in some countries. The identification of the causal pathogen as *Colletotrichum acutatum* was confirmed using species-specific primers and RFLPs of ribosomal DNA in comparative studies with isolates of *C. acutatum* from strawberry and *C. gloeosporioides* from citrus (Förster and Adaskaveg, 1999). 2 distinct clonal subpopulations among the almond isolates of *C. acutatum* were identified. These 2 subpopulations differed molecular fingerprints using RAPD and SSR primers in polymerase chain reactions. A new and devastating disease of almond trees in Lebanon was recently reported, characterized by the development of severe witches'-brooms on which no flowers or fruits developed, and leading to tree death within a few years (Verdin et al., 2003). A phytoplasma was detected in diseased trees by PCR amplification of rRNA operon sequences, and RFLP patterns of amplified DNA indicated that the phytoplasma belonged to the pigeon pea witches'-broom (PPWB) group.

**Molecular Studies on Flowering Time in Almond**

Almond is the earliest temperate fruit species to bloom. This restricts the economic growing of almond to frost free regions. Most almond-breeding programmes aim to develop lateflowering cultivars in order to avoid frost damage and take advantage of higher temperatures which are favourable for pollination and fertilization. Flowering time is generally considered to be inherited quantitatively but a single gene conferring very late flowering in a qualitative way has been identified in several progenies tracing back to a single mutant, 'Tardy Nonpareil'. The effect of this allele was studied in 3 progenies, showing that the effect of this major gene is modified by minor genes, quantitatively inherited, and probably influenced by inbreeding (Socias i Company et al., 1999). In their study, Ballester et al. (2001) aimed to determine the genetic basis of late blooming in almond. Molecular markers were used to study the Late bloom gene (Lb), responsible for a delay of blooming time. The Lb gene was located on linkage group 4 of the almond map, flanked by markers AG6 and FG3. 3 RAPD markers associated with the Lb gene were identified by bulked segregant analysis. One was placed at 5.4 cM from Lb and could be used as a diagnostic marker for flowering time. The identification of genes involved in flower development and blooming time is important to assist breeders in creating new late flowering cultivars as well as to understand the complex process of flower induction in a fruit species like almond. A major gene and some quantitative trait loci (QTLs) for blooming time were previously detected and localized on the *Prunus* genome. Silva et al. (2005) aimed to associate these QTLs to known genes using a candidate gene approach. 2 cDNAs putatively encoding protein homologs to Arabidopsis flower genes were isolated from almond flower buds. A Prunus EST database was screened and 10 ESTs were selected by their matches with genes known to be involved in flower development in other plant species. Molecular markers were developed from these candidate genes for mapping on the almond 'Texas' x peach 'Earlygold' F2 population. 12 candidate genes were assigned to 7 linkage groups in the *Prunus*.

Biochemical and molecular events underlying flowering regulation must be understood before methods to stimulate late flowering can be developed. Attempts to elucidate the genetic control of this process have led to the identification of a major gene (Lb) and QTLs linked to observed phenotypic differences, but although this gene and these QTLs have been placed on the *Prunus* reference genetic map, their sequences and specific functions remain unknown. Silva et al. (2005) aimed to associate these loci with known genes using a candidate gene approach. 10 candidate genes were assigned to 6 linkage groups in the *Prunus* genome. The positions of 2 of these were compatible with the regions where two QTLs for blooming time were detect. To gain insight into the still unclear molecular processes underlying blooming in temperate fruit trees, expression of genes putatively involved in the cold response was studied in almond (Barros et al., 2012). After bud break, with temperatures still within the chilling range, both PdCBF genes and PdDHN1 were found to sharply reduce transcription in flower buds and internodes. Flower bud break was also followed by a decrease in the expression of PdGA20OX, a candidate gene involved in gibberellin biosynthesis, and an increase in the expression of 2 homeotic genes related to floral organ development, PdMADS1 and -3. These genes may also be relevant players in the regulation of anthesis in this model Rosaceae species. Sánchez-Pérez and Dicenta (2012) studied the chilling and heat requirements and flowering time were studied, for 2 years, in an almond progeny from the cross between the late-flowering French selection "R1000" and the early-flowering Spanish "Desmayo Largueta". The results indicated that flowering time is mainly a consequence of the chilling requirements; heat requirements having a smaller effect. In agreement with the genetic findings, a significant QTL for chilling requirements was found in G4 together with other minor QTLs in G1, G3, and G7. For heat requirements, two QTLs in G2 and G7 were identified. The results also show the high influence of temperature in the expression of the

three traits and their QTL analyses. In addition, QTL analysis for flowering time allowed the identification of one significant QTL in linkage group 4 (G4) that explained most of the phenotypic variation together with other minor QTLs located in G1, G6, and G7. Sánchez-Pérez et al. (2014) reported that flowering time is the result of the interaction between chilling and heat requirements. Flowering time is a polygenic trait with high heritability, although a major gene Late blooming (Lb) was described in "Tardy Nonpareil."Molecular studies at DNA level confirmed this polygenic nature identifying several genome regions (QTL) involved. Studies about regulation of gene expression are scarcer although several transcription factors have been described as responsible for flowering time. From the metabolomic point of view, the integrated analysis of the mechanisms of accumulation of cyanogenic glucosides and flowering regulation through transcription factors opened new possibilities in the analysis of this complex trait in almond and in other *Prunus* species (apricot, cherry, peach, plum).

**Molecular Studies on Fruit Composition in Almond**

Upon crushing, amygdalin present in bitter almonds is hydrolysed to benzaldehyde, which gives a bitter flavour, and to cyanide, which is toxic. Bitterness is attributable to the recessive allele of the Sweet kernel (Sk/sk) gene and is selected against in breeding programmes (Sánchez-Pérez et al., 2010). It has been important to develop molecular markers to distinguish between sweet and bitter genotypes. The Sk gene is known to map to linkage group 5 (G5) of the almond genome, but its function is still undefined. Candidate genes involved in the amygdalin pathway have been mapped, but none of them were located to G5. In the study, G5 was saturated with additional SSRs using the progeny from the cross "R1000" × "Desmayo Largueta" and 6 SSRs (UDA-045, EPDCU2584, CPDCT028, BPPCT037, PceGA025, and CPDCT016) closely linked to the Sk locus were found. A map with 56 simple sequence repeat or microsatellite (SSR) markers was constructed for an almond population showing a wide range of variability for the chemical components of the almond kernel (Font i Forcada et al., 2012). A total of 12 putative QTL controlling these chemical traits were detected in this analysis, corresponding to 7 genomic regions of the 8 almond linkage groups.

**Molecular Studies on Almond Breeding For Resistance**

Campalans et al. (2001) analyzed several genes that were strongly expressed in response to dehydration of almond as a means of identifying and determining the genetic basis of mechanisms involved in drought tolerance. They also compared the levels of expression of the identified genes in leaves of young trees of 8 almond cultivars differing in drought tolerance. Almond is commonly considered as tolerant to diverse biotic or abiotic factors, but little is known
concerning the molecular mechanisms involved in the response to stress. In their study, Barros et al. (2010) focused on the search for candidate disease resistance genes (R), and on the isolation of almond homologues to the CBF/DREB1 family of transcription factors, known to play an important role in abiotic stress response. A set of resistance-gene candidate sequences (RGCs) were isolated from one almond cultivar and 2 wild almond ecotypes (*P. webbii*). Preliminary RT-PCR analysis showed that the isolated almond CBF/DREBs are expressed in cold- and drought-induced tissues. Alimohammadi et al. (2013) used cDNA-AFLP to identify genes responsible for water stress tolerance in the resistant wild almond *Prunus scoparia*. It is suggested that the results will be useful for exploring the functions of these multiple signal-inducible genes in order to unveil the relationship between different signalling pathways involved in *Prunus* resistance to water-deficit.

**CONCLUSION**

It is seen that most of the molecular studies on almond mainly focused on genetic mapping, identification of genotypes, identification of cultivars and investigation of genetic relations between species-cultivars-genotypes and other *Prunus* species. In the molecular studies on some of the disease causative agents, disease resistance and tolerance conditions in almond species were investigated. Further, almond has been used as study material in some research conducted on isolates of certain disease causative agents some studies. There has been increasing number of studies also on late flowering, flowering time, incompatibility, self efficiency, fruit composition and identification of genes which improve resistance to drought, water stress and some diseases.

**LITERATURE CITED**

Alimohammadi, A., Shiran, B., & Martinez-Gomez, P. (2013). Identification of water-deficit resistance genes in wild almond Prunus scoparia using cDNA-AFLP. *Scientia Horticulturae 159,* 19-28.

Aradhya, M. K., Weeks, C., & Simon, C. J. (2004). Molecular characterization of variability and relationships among seven cultivated and selected wild species of *Prunus* L. using amplified fragment length polymorphism. *Scientia Horticulturae 103,* 131-144.

Arus, P., Ballester, J., Jauregui, B., Joobeur, T., Truco, M., & Vicente, M. C. (1998). The European *Prunus* mapping project: update on marker development in almond. *Acta Hort 484*, 331–338.

Ballester, J., Boskovic, R., Batlle, I., Arus, P., Vargas, F., & Vicente, M. C. (1998). Location of the selfincompatibility gene on the almond linkage map. *Plant Breed 117*, 69–72

Ballester, J., Socias i Company, R., Arus, P., & Vicente, M. C. (2001). Genetic mapping of a major gene delaying blooming time in almond. *Plant Breed 120*, 268–270.

Barros, P., Saibo, N., Martins, M., Ma, R. C., & Olievira, M. M. (2010). Identification of candidate genes involved in the response to biotic and abiotic stres in almond. *XIV Grempa Meeting on Pistachios and Almond. 94*, 87-94.

Barros, P. M., Gonçalves, N., Nelson, J. M., Saibo, N. J. M., & Oliveira, M. M. (2012). Cold acclimation and floral development in almond bud break: insights into the regulatory pathways. *Journal of Experimental Botany 63(12),* 4585-4596.

Bartolozzi, F., Warburton, M. L., Arulsekar, S., & Gradziel, T. M. (1998). Genetic Characterization and Relatedness among California Almond Cultivars and Breeding Lines Detected by Randomly Amplified Polymorphic DNA Analiysis. *J.Amer. Soc. Hort. Sci. 123(3),* 381-387.

Bayazit, S. (2007). Phenological, morphological, pomological and molecular characteristics of the wild almond genotypes collected from different ecotypes of Turkey. Çukurova University Graduated School Of Natural And Applied Sciences. Horticulture Department, Ph.D. Thesis, Adana, 336 pp.

Bianchi, V. J., Sansavini, S., & Fachinello, J. C. (2004). Microsatellite Markers For Identification of *Prunus* spp. Rootstocks. *Sci. Agric. 61(3),* 303-306.

Campalans, A., Pages, M., & Messeguer, R. (2001). Identification of differantially expressed genes by the cDNA-AFLP technique during dehydration of almond. *Tree Physiology 21,* 633-643.

Dangl, G. S., Yang, J., Golino, D. A., & Gradziel, T. (2009). A pactical method for almond cultivar identification and parental analysis using simple sequence repeat markers. *Euphytica 168*, 41-48.

Dirlewanger, E., Graziano, E., Joobeur, T., Garriga-Caldera, F., Cosson, P., Howad, W., & Arus, P. (2004). Comparative mapping and marker-assisted selection in Rosaceae fruit crops. *PNAS 101(26),* 9891-9896.

Distefano, G., Caruso, M., Malfa, S., Ferrrante, T., Signore, B., Gentile, A., & Sottile, F. (2013). Genetic diversity and relationships among Italian and foreign almond germplasm as revealed by microsatellite markers. *Scientia Horticulturae 162*, 305-312.

Elhamzaoui, A., Oukabli, A., Charafi, J., & Moumni, M. M. (2012). Assessment of genetic diversity of Moroccan Cultivated Almond In Its Area of Extreme Diffusion, Using Nuclear Microsatellites. *American Journal of Plant Sciences 3,* 1294-1303.

Fathi, A., Ghareyazi, B., Haghnazari, A., Ghaffari, M. R., Pirseyedi, S. M., Kadkhodaei, S., Naghouri, M. R., & Mardi, M. (2008). Assessment of the genetic diversity of almond (*P.dulcis*) using microsatellite markers and morphological traits. *Iranian Journal of Biotechnology 6(2),* 98-106.

Fernandez i Marti, A., Alonso, J. M., Espiau, M. T., Rubio-Cabetas, M. J., & Socias i Company, R. (2009). Genetic Diversity in Spanish and Foreign Almond Germplasm Assessed by Molecular Characterization with Simple Sequence Repeats. *J. Amer. Soc. Hort. Sci. 134(5),* 535-542

Foolad, M. R., Arulsekar, S., & Becerra, V. (1995). A genetic map of Prunus based on an interspecific cross between peach and almond. *Theor. Appl. Genet. 91,* 262-269.

Font i Forcada, C., Marti, A. F., & Socias i Company, R. (2012). Mapping quantitative trait loci for kernel composition in almond. *BMC Genetics 13*,47.

Förster, H., & Adaskaveg, J. E. (1999). Identification of Subpopulations of *Colletotrichum acutatum* and Epidemiology of Almond Anthracnose in California. *Phytopathology 89(11),*1056-1065.

Gouta, H., Ksia, E., Buhner, T., Moreno, M. A., Zarrouk, M., Mliki, A., & Gogorcena, Y. (2010). Assessment of genetic diversity and relatedness among Tunisian almond germplasm using SSR markers, *Hereditas 147,* 283-292.

Jauregui, B., Vicente, M. C., Messeguer, R., Felipe, A., Bonnet, A., Salesses, G., & Arus, P. (2001). A reciprocal translocation between 'Garfi' almond and 'Nemared' peach. *Theor. Appl. Genet. 102*, 1169-1176.

Joobeur, T., Viruel, M. A., Vicente, M. C., Jauregui, B., Ballester, J., Dettori, M. T., Verde, I., Truco, M. J., Messeguer, R., Battle, I., Quarta, R., Dirlewanger, E., & Arffls, P. (1998). Construction of a saturated linkage map for Prunus using an almond peach F2 progeny. *Theor Appl Genet 97*, 1034–1041

Joobeur, T., Periam, N., Vicente, M. C., King, G. J., & Arus, P. (2000). Development of a second generation linkage map for almond using RAPD and SSR markers. *Genome 43*, 649-655

Kadkhodaei, S., Shahnazori, M., Nekouei, M. K., Ghasemi, M., Etminani, H., Imani, A., & Ariff, A. B. (2011). A comparative study of morphological and molecular diversity analysis among cultivated almonds (*Prunus dulcis*). *Australian Journal of Crop Science 5(1),* 82-91.

Karakurt, H. (2013). Determination of Genetical Diversities of Summer Apple, Almond and Raspberries Genotypes Selected From The East Anatolian Region of Turkey with AFLP and SSR Molecular Primers. Atatürk Üniversity, Graduated School Of Natural And Applied Sciences. Horticulture Department, Ph.D. Thesis, Erzurum.

Köse, M. (2013). Breeding of naturally grown almond genotypes in İspir of Erzurum by selection and determination of their genetic diversty by using RAPD method. Atatürk Üniversity, Graduated School Of Natural And Applied Sciences. Horticulture Department, Ph.D. Thesis, Erzurum

Küden, A., Küden, A., Mendi, Y. Y., Kaçar, Y. A., Bayazit, S., Çömlekçioğlu, S., & İmrak, B. (2005). Farklı Ekolojilerdeki Badem Genotiplerinde Bitkisel ve Moleküler Özelliklerin Tanımlanması. Tübitak Proje No: TOGTAG-3063.

Ma, R., Xie, H., Xu, Y., Ma, Y., Jiang, Y. Q., & Cao, M. Q. (2005). Molecular analysis of almond germplasm in China. XIII Grempa Meeting on Almonds and Pistachios*, 63,* 281-290.

Otaghvari, A. M., & Ghaffarian, M. R. (2011). Assessment of genetic diversity in late flowering almond varieties using ISSR molecular markers aimed to select genotypes tolerant to early spring frost in Yazd province. *Curr. Bot. 2(1),* 01-04.

Ruana, J., & Sonnio, A. (2003). Marker-assisted selection – Current status and future perspectives in crops, livestock, forestry and fish. Chapter 1: 4-13.

Sanchez-Perez, R., Howad, W., Garcia-Mas, J., Arus, P., Martinez-Gomez, P., & Dicenta, F. (2010). Molecular markers for kernel bitterness in almond. *Tree Genetics and Genomes 6,* 237-245.

Sanchez-Perez, R., Dicenta, F., & Martinez-Gomez, P. (2012). Inheritance of chilling and heat requirements for flowering in almond and QTL analysis. *Tree Genetics and Genomes 8*, 379-389.

Sanchez-Perez, R., Cueto, J. D., Dicenta, F., & Martinez-Gomez, P. (2014). Recent advancements to study flowering time in almond and other Prunus

species. *Frontiers in PLant Science 5(334),*1-7.

Sharma, G., & Sharma, N. (2010). Molecular characterization of diversity and relationship among almond cultivars and indigenous selections. *Indian Journal of Biotechnology 9,* 378-383.

Shiran, B., Amirbakhtiar, N., Kiani, S., Mohammadi, S., Sayed-Tabatabaei, B. E., & Moradi, H. (2007). Molecular characterization and genetic relationship among cultivars assessed by RAPD and SSR markers. *Scientia Horticulturae 111,* 280-292.

Silva, C., Sanchez, A. M., Garcia-Mas, J., Arus, P., & Oliveira, M. M. (2005). Candidate gene analysis of quantitative trait variation in flowering time in almond (Prunus dulcis Mill D.A. Webb), *XIII Grempa Meeting on Almonds and Pistachios 63*,141-145.

Socias i Company, R., Felipe, A. J., & Gomez Aparisi, J. (1999). A major gene for flowering time in almond. *Plant Breeding 118*, 443-448.

Sorkheh, K., Shiran, B., Gradziel, T. M., Epperson, B. K., Martinez-Gomez, P., & Asadi, E. (2007). Amplified fragment lenght polymorphism as a tool for molecular characterization of almond germplasm: genetic diversity among cultivated genotypes and related wild species of almond and its relationships with agronomic traits. *Euphytica 156,* 327-344

Tavassolian, I., Rabiei, G., Gregory, D., Mnajja, M., Wirthensohn, M. G., Hunt, P. W., Gibson, J. P., Ford, C. M., Sedgley, M., & Wu, S. (2010). Construction of an almond linkage map in on Australian population Nonpareil x Laurenne. *BMC Genomics 11*, 551.

Verdin, E., Salar, P., Danet, J., Choveiri, E., Jreijiri, F., Zammar, S., Gelie, B., Bove, J. M., & Garnier, M. (2003). Candidates Phytoplasma phoenicium sp. nov., a novel phytoplasma associated with an emergiry lethal disease of almond trees in Lebanon and Iran.*Int. J. Syst. Evol. Microbiology 53*, 833-838.

Viruel, M. A., Messeguer, R., Vicente, M. C., Garcia-Mas, J., Puigdomenech, P., Vargas, F. J., Arus, P. (1995). A linkage map with RFLP and isozyme markers for almond. *Theor Appl Genet 1,* 964–971.

Xie, H., Sui, Y., Chang, F.Q., Xu, Y., & Ma, R. C. (2006). SSR allelic variation in almond (*Prunus dulcis* Mill.). *Theor. Appl. Genet. 112,* 366–372.

Xu, Y., Ma, R., Xie, H., Liu, J., & Cao, M. (2004). Development of SSR markers fort he phylogenetic analysis of almond trees from China and the Mediterranean region. *Genome 47*, 1091-1104.

Zeinalabedini, M., Majourhat, K., Khayam-Nekoui, M., Grigorian, V., Toochi, M., Dicenta, F., & Martinez-Gomez, P. (2007). Molecular characterization of almond and related wild species using nuclear and chloroplast DNA markers. *Journal of Food Agriculture and Environment 5(3-4),* 242-247.

# P-14 A SOCIAL RESPONSIBILITY PROJECT: CHILDREN AND ENVIRONMENTAL AWARENESS

Yeşim Okay[1], Şebnem Ellialtıoğlu[1]
[1] Ankara University, Faculty of Agriculture, Department of Horticulture, Ankara, Turkey
e-mail: okay@agri.ankara.edu.tr

**Abstract**

One of the disadvantages caused by intense urbanization is the isolation from nature and growing up our children disconnected from nature and the natural plant production systems. Nowadays most children live in big cities and can only get to know agricultural products on the store shelves. As a result of this disconnection, physical and emotional development of children are adversely affected, responsibility to protect natural resources is not developed, the adoption of the environmental awareness and environmental sensitivity concepts are increasingly difficult. However, the recognition and protection of natural resources with environmental awareness, manners and knowledge are gained characters at early ages. In order to create awareness of natural resources and environmental protection, the recognition of these concepts should be known primarily. One of the most appropriate solutions to the problem will be created using the urban sample models based on nature education for children. The aim of this project is to introduce agriculture and agricultural production processes to the 10-11 age group children in primary education by direct involvement, enabling them to follow up the natural cycles in nature and to increase children's natural curiosity by encouraging the love of nature but also strengthening physical and social skills as a game format.

**Key Words:** Social responsibility project, Children, Environmental awareness

## INRODUCTION

In the last century which could be called the century of technology, knowledge, development, industrialization and urbanization, important inventions in science and technology were made and many important global changes occured in human history. One of the most striking aspects of this century is that the relationship between human and nature is transformed into a power struggle between ecology and economy. As a result, man has come to the stage of destroying his own kind and environmental problems have left their mark in this century. The environment, which can be defined as the biological, physical, social, economic and cultural ambient in which the living beings maintain their relations and interact with each other throughout their lives, is a system of interdisciplinary interactions between living and inanimate entities (Anonymous, 1983; Ertürk, 1998; Keleş et al., 2009; Karataş and Aslan, 2012). Therefore, it is not possible to talk about healthy living balance within a deteriorated environment medium. Environment and life quality are inextricably linked with each other (Çepel, 2008; Kışlalıoğlu and Berkes, 2009). Contrary to other living beings, the people who control the environment with the technologies they develop affect the natural life negatively and consume the natural resources fast and unconsciously in order to meet the increasing needs. Rapid population growth also accelerates this disappearance. In places where environmental degradation occurs, the extinction process accelerates in plant, soil, water resources and other living species and economic and social problems such as diseases, hunger, poverty and human rights violations are seen more. The people who consume the resources of the world unlimitedly in order to dominate the nature forget that they themselves are also members of the environment, and increasingly become estranged to nature and continue to destroy the environment that they actually need for their own lives. Environmental issues that arise at the global level threaten the future of our planet. For this reason, people must be more aware of environmental issues (Alpagut, 1997; Erten, 2004; Arvanitis, 2007; Erentay and Erdoğan, 2009).

Today, there is an intense urbanization all over the world. One of the disadvantages of intense urbanization is that the living spaces are separated from the nature and people are disconnected from the production systems that depend on nature. This situation brings many problems in every age group. When evaluated in terms of generations who will live the future of the world, children are the group that is greatly affected from the negativities brought about by the disconnected life from the nature (Louv, 2008; Yardımcı and Bağcı Kılıç, 2010).

Human-plant-nature interactions were evaluated and the positive effects of plants on humans were determined (Elings, 2006). One of the most important studies about the necessity of human's existence in natural environments due to the evolutionary process and the need for this physical and psychological health is the 'Biophillia Hypothesis' developed by Edward O. Wilson. According to this hypothesis, the preference of the human to be in natural environmentals is a genetic phenomenon as a consequence of human evolutionary process (Neill, 2004). Different studies show that nature in general can relieve stress and mental fatigue (Ulrich, 1983; Kaplan and Kaplan, 1989). It has been reported that green environment has directed people to physical activities which are extremely beneficial to human health, reduced the effects of mental illnesses such as schizophrenia and alzheimer and prevented chronic heart diseases, depression, anxiety and other mental illnesses (Kaiser, 1976; Kaplan, 1993; Owen, 1994; Lewis, 1996; Ulrich et al., 1991; Sempik et al., 2003). In addition to this, it is stated that people living and working in the environments where plants are located have more calm, resolute, confident and respectful behaviors and work more efficiently (Rice and Remy, 1998; McGuinn and Relf, 2001; Fjeld et al., 2002).

Today, especially the children in big cities are living isolated from the nature. Due to the lack of adequate and reliable open spaces (parks, playgrounds, urban forests, etc.) as a result of crooked and unplanned construction in cities, many

children spend most of their time in enclosed spaces and can not establish adequate relationship with society and nature. In such cities, most of the natural habitats and playgrounds have disappeared, traditional group games have ceased to exist, children's games have been isolated from nature and people. These reasons have led children to watch more television, play computer games and spend more time with various technological tools. Most of these activities cause children to be mentally inactive and prevent them from creative play activities. It also causes children to move away from more social and personality-enhancing activities such as playing with friends, physically exercising, reading. Whereas, it is known that games are one of the most effective ways for the child to prepare for adult life. As children play, their skills increase and their abilities improve. In this sense, natural environments are very valuable playgrounds for children (Vessey et al., 1998; Strasburger and Donnerstein, 1999; Başal, 2003; Çelik, 2012).

It has been reported that children who play games outside and spend more time in nature have higher self-discipline as a result of being incontact with nature. Thus children with high self-discipline are better at overcome various problems more easily (Taylor et al., 2002). Similarly, it is noted that green spaces have provided children an important life experience and increased their physical activity, learning capacities, success rates, imagination, creativity and self-confidence. It is clearly stated that the childen who spend time in nature and play games are more succesful in expressing their feelings, being careful and using their body features efficiently. Also knowledge on the environment expand their perspective and improve their behaviours positively (Bradley et.al., 1999; Blair, 2009; Chen et al., 2012; Chawla et al., 2014). Also similar results were obtained in studies on nature compatible constructions in school gardens (Martensson et al., 2014; Jansson et al., 2014; Bondo Andersen et al., 2015).

Living away from nature are the source of many environmental problems. For this reason, educational activities that provide nature-human harmony are an important step. It is well known that education is essential to prevent environment problems. For this purpose, many organizations such as UNESCO, UNEP, Ministries of Environment, Universities, Municipalities and some Civil Society Organizations are carrying out studies based on environmental education. These trainings are aimed at protecting the nature and natural resources. In addition to giving information, it is aimed to gain positive and permanent behavioral changes to the identification and protection of nature (Geray, 1997; Doğan, 1997; Ayvaz, 1998). Environmental education is necessary for all people who are in contact with the environment. The studies show that environmental awareness and environmentalist behavior are also increasing with the increase of environmental information (Barraza and Walford, 2002; DiEnno and Hilton, 2005). It is stated that environmental education must reach the whole society and that these experiences must be acquired at a very young age (Atasoy and Ertürk, 2008; Gülay, 2011). Children's education is significant in terms of sustainability of the desired changes about nature and environment in the society. For these reasons, educational programs aiming at the development of nature and environmental awareness in children starting from pre-school period are very important in many respects.

Heffernan (1994) reports that gardens are important places for children to have knowledge of nature and natural processes. The programs in which children actively participate and work are determined as the most successful horticultural programs (Lucas, 1995). It has been determined that primary and secondary school students participating in a school garden program have developed more positive attitudes towards environmental issues (Waliczek and Zajicek, 1999). It was observed that children who joined a gardening programme consumed more fruit and vegetables. Additionaly, they made new friends and their awarnesses about plant ecology, nutrition and aquaculture raised (Pothukuchi, 2004). It was determined that 3rd, 4th and 5th grade students who participated in the horticultural program were significantly better than the students who did not participate in the scientific achievement tests (Klemmer et al., 2005). Also it was stated that group work and self-understanding skills improved in the positive direction in the students who participated in the horticultural program carried out in their schools (Robinson and Zajicek, 2005).

With this programme, planned within the Ankara University, Faculty of Agriculture, Department of Horticulture, it is aimed to introduce plant production and the cycle of production to the children aged 10-11 years in primary education by observation, participation and awareness in fruits, vegetables, ornamental plants and forestation. With this education programme will increase their love of nature, by encouraging nature curiosity, to help better understand nature and natural cycles. Little Gardeners' School will be held at three different consequtive periods for each participating group. In the programme, as vegetables, species that have a short vegetative period will be used. For the selection of this material, vegetable species that can be shortly harvested in cool autumn period in Ankara and vegetables which may be preferred by kids will be utilized. As ornamental plants, bulb plants will be preffered again by considering the vegatation period. For afforastation studies, different fruit species such as apples, cherries and rose plants will be used.

**First Period (Beginning of Autumn)**

***Vegetable Growing:*** Vegetable seeds will be sown to plots with students. At this stage, the field will first be ploughed by plow, fine adjusted by cultivator and together with kids will be made ready for the preparation of plots. Between the assigned dates, one group will make the preparation of the plots, seed sowing and bulb plantations everyday. Half day of the schedulded whole day will be spent for the field work and in the rest of the day, theoretical information supported with visual presentations will be provided on the subjects such as definition of seed, seed sowing, plant growth, cold and warm season vegetables, ecological requirements. In addition, bean, lentil and chickpea seeds will be sown in petri dishes or glass jars students will be able to take with them while leaving and will be asked to grow the plants.

***Ornamentals:*** Hyacintus, daffodil, and tulip bulbs will be planted to the prepared plots and these plants will be maintained under the soil during winter season (to break dormancy) and differences in terms of sprouting and flowering in spring will

be explained.

***Afforestation:*** In autumn, required explanations will be made for plantations followed by planting fruits and ornamentals in prepared plots. Explanation regarding the resting period requirement in winter and fruiting age will be given followed by the initiation of observation on plant natural cycle. Therefore, kids will be able to answer basic questions such as why plants shed leaves in winter, how they tolerate cold.

**Second Period ( End of autumn-beginning of winter)**

***Vegetable Growing:*** Each student will detect developmental changes when s/he comes to the same plots 30 days later. Developed plants will be harvested hence students will experience obtaining produce and processing period.

***Ornamentals and Afforestation:*** Following plots, explanations will be made on how plants remain kind of asleep until the next spring period and grow in spring. Cultural practices such as irrigation, weeding and fertilizing will be performed.

**Third Period (Beginning of spring)**

***Ornamentals:*** Development and flowering of bulbs planted in autumn will be observed and upon harvest flowers will be given to the students.

***Afforestation:*** Leafing of the autumn plantations will be observed and it will be emphasized that they wake up and they are living organism.

***Education:*** Flower structures will be investigated in species growing at fruit orchards of the Department of Horticulture, mechanism of flowering and fertilization will be explained according to the students' level. At the same time, almond, apricot, cherry and sour cherries as small fruitlets at the period will be investigated and kids will be able to touch and see at the same time.

During the little gardeners school that will be held as three periods, primary school students will be given visual and practical demonstrations, dramas and play supported programs on fruit-vegetable and ornamental plants, warm and cold season plants, ecological requirements, importance of fruits and vegetables in diet, seed-seed sowing, seedling-generation of seedlings, planting seedlings, plantlet–derivation of plantlets–planting the plantlets, how plants grow, how they survive winter, mechanism of pollination and fertilization, when and how fruits and vegetables are harvested, how fruit-vegetable gardens are established and cultural practices in orchards.

## LITERATURE CITED


Alpagut, B. (1997). Doğal çevre ve insanın evrimi. In *İnsan Çevre Toplum* (Editör: Ruşen Keleş). İmge Kitabevi. Ankara:

Anonymous (1983). T.C. Çevre Kanunu. Kanun Numarası:2872. Kabul Tarihi: 09.08.1983. Resmi Gazetede Yayımlanma Tarihi: 11.08.1983. Sayı:18132. Yayımlandığı Düstur Tertip: 5,Cilt:22, Sayfa:499.

Arvanitis, A.V. (2007). Bio-politika: Bir vizyon ve umut toplumu kurmak.Çeviren: Bülent Duru). In *Çevre ve Politika Başka Bir Dünya Özlemi*. (Editör:Ayşegül Mengi). Ankara: İmge Kitabevi.

Atasoy, E. & Ertürk, H. (2008). İlköğretim öğrencilerinin çevresel tutum ve çevre bilgisi üzerine bir alan araştırması. *Erzincan Eğitim Fakültesi Dergisi. 10*(1), 105-122.

Ayvaz, Z. (1998). *Çevre eğitiminde temel kavramlar el kitabı*. Çevre Koruma ve Araştırma Vakfı, Çevre Eğitim Merkezi Yayınları. İzmir

Barraza,L & Walford, R.A. (2002). Environmental education: A comparison between english and mexican school children. *Environmental Education Research. 8,*171-186.

Başal, H.A. (2003). Okul öncesi eğitiminde uygulamalı çevre eğitimi (Ed. M. Sevinç). In *Erken çocuklukta gelişim ve eğitimde yeni yaklaşımlar* (pp. 366-380). İstanbul: Morpa Kültür yayınları.

Blair, D. (2009). The child in the garden. *Winter. 40*(2),15-38.

BondoAndersen, H. DemantKlinker, C., MetteToftager, M., SkauPawlowski, C. & Schipperijn, J. (2015). Objectively measured differences in physical activity in five types of schoolyard area. *Landscape and Urban Planning. 134*,83-92.

Bradley, J.C., Waliczek, T.M. & Zajicek, J.M. (1999). Relationship between environmental knowledge and environmental attitude of high school students. *Journal of Environmental Education. 30*(3),17-21.

Chawla, L., Keena, K., Pevec, I. & Stanley, E. (2014). Green schoolyards as havens from stress and resources for resilience in childhood and adolescence. *Health & Place. 28*, 1-13.

Chen, J., Cheng, H. & Monroe, M.C. (2012). Connection to nature: children's affective attitude toward nature. *Environment and Behavior. 44*(1),31-49.

Çelik, A. (2012). Okul öncesi eğitim kurumlarında açık alan kullanımı: Kocaeli örneği. *Journal of Agricultural Faculty of Atatürk Univ. 43*(1),79-88.

Çepel, N. (2008). *Ekolojik sorunlar ve çözümleri (3. Basım)*. TÜBİTAK Ankara:

DiEnno, C.M. & Hilton, S.C. (2005). High school students' knowledge, attitudes and levels of enjoyment of an environmental education unit on non-native plants. *Journal of Environmental Education. 37,*13-25.

Doğan, M. (1997). *Türkiye ulusal çevre stratejisi ve eylem planı eğitim ve katılım raporu.* DPT Müsteşarlığı ve Türkiye Çevre Vakfı. Ankara

Elings, M. (2006). People-plant interaction: The physiological, psychological and sociological effects of plants on people. In *Farming for Health. Green-Care Farming Across Europe and the United States of America.* (pp. 43-56). Springer.

Erentay, N. & Erdoğan, M. (2009). *22 Adımda Doğa Eğitimi.* Ankara. ODTÜ Yayıncılık.

Erten, S. (2004). Çevre eğitimi ve çevre bilinci nedir, çevre eğitimi nasıl olmalıdır? *Çevre ve İnsan Dergisi*. *Sayı 65/66,* 1-13.

Ertürk, H.. (1998). *Çevre bilimlerine giriş (3. Baskı)*. Bursa: Ceylan Matbaacılık

Fjeld, T., Veiersted, B., Sandvik, L., et al., 2002. The effect of indoor foliage plants on health and discomfort symptoms among office workers. *Indoor and Built Environment. 7*(4), 204-206.

Geray, C. (1997). Çevre için eğitim. In *İnsan çevre toplum* (Editör: Ruşen Keleş). İmge Kitabevi. Ankara:

Gülay, H. (2011). Ağaç yaş iken eğilir: Yaşamın ilk yıllarında çevre eğitiminin önemi. *TÜBAV Bilim Dergisi. Cilt:4*(3),240-245.

Heffernan, M. (1994). The children's garden project at river farm. *Children's Environments*. 11(3), 221-231

Jansson, M., Gunnarsson, A., Martensson, F. & Anderson, S. (2014). Children's perspectives on vegetation establishment: Implications for school ground greening. *Urban Forestry & Urban Greening. 13*(1),166-174.

Kaiser, M., 1976. Alternative to therapy: garden program. *Journal of Clinical Child Psychology.* 21-24.

Kaplan, R., 1993. The role of nature in the context of the workplace. *Landscape and Urban Planning. 26* (1/4), 193-201.
Kaplan, R. and Kaplan, S., 1989. *The experience of nature: a psychological perspective*. Cambridge University Press, Cambridge.
Karataş, A. & Aslan, G. (2012). İlköğretim öğrencilerine çevre bilincinin kazandırılmasında çevre eğitiminin rolü: Ekoloji temelli yaz kampı projesi örneği. *Zeitschrift für die Welt der Türken. 4*(2), 259-276.
Keleş, R., Hamamcı, C. & Çoban, A. (2009). *Çevre politikası.(6. Basım)*. İmge Kitabevi. Ankara
Kışlalıoğlu, M. & Berkes, F. (2009). *Çevre ve ekoloji (11. Basım)*. Remzi Kitabevi. İstanbul.
Klemmer, C.D., Waliczek, T.M. & Zajicek, J.M. (2005). Growing minds: The effect of a school gardening program on the science achievement of elementary students. *Hort Technology*. *15*(3), 448-452.
Lewis, C.A. (1996). *Green nature/human nature: the meaning of plants in our lives*. University of Illinois Press, Urbana.
Louv, R. (2008). *Doğadaki Son Çocuk*. Ankara:TÜBİTAK.
Lucas, B. (1995). Learning through landscapes: An organization's attempt to move school grounds to the top of the educational agenda. *Children's Environments*. *12*(2), 233-244.
Martensson, F., Jansson, M., Johansson M., Raustrop, A., Kylin, M. & Boldemann, C. (2014). The role of greenery for physical activity play at school grounds. *Urban Forestry & Urban Greening. 13*(1),103-113.
McGuinn, C. & Relf, P.D., 2001. A profile of juvenile offenders in a vocational horticulture curriculum. *HortTechnology. 11*(3), 427-433.
Neill, J. (2004). Nature Theory: On the connection between natural environments and human well-being. Outdoor education research and evaluation center. http://www.wilderdom.com.)
Owen, P.J. (1994). *Influence of botanic garden experience on human health*. Master Thesis Kansas State University, Department of Horticulture, Forestry and Recreation Resources, Manhattan.
Pothukuchi, K. (2004). Hortilizia: A youth 'nutrition garden' in southwest Detroit. *Children, Youth and Environments*. *14*(2), 124-155
Rice, J.S. & Remy, L.L. (1998). Impact of horticultural therapy on psychosocial functioning among urban jail inmates. *Journal of Offender Rehabililtation. 26*(3/4), 169-191.
Robinson, C.W. & Zajicek, J.M. (2005). *Hort Technology*. 15(3), 453-457
Sempik, J., Aldridge, J. & Becker, S., (2003). *Social and therapeutic horticulture: evidence and messages from research*. Thrive with the Centre for Child and Family Research, Loughborough University, Reading.
Strasburger, V.C. & Donnerstein, E. (1999). Children, adolescents, and the media: issues and solutions. *Pediatrics*. *103*(1):129-39
Taylor, A.F., Kuo, F.E. & Sullıvan, W.C. (2002). Wiews of nature and self-discipline: evidence from inner city children. *Journal of Environmental Physiology. 22*(1-2), 49-63.
Ulrich, R.S. (1983). Aesthetic and affective response to natural environment. In *Behavior and the natural environment*. (Altman, I. and Wohlwill, J.F. eds.). (pp.85-125). Plenum, New York,.
Ulrich, R.S., Simons, R.F., Losito, B.D., Fiorito, E., Miles, M. A. & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*(3), 201-230.
Vessey, J.A., Yim-Chiplis, P.K. & MacKenzie, N.R. (1998). Effects of television viewing on children's development. *Pediatr Nurs. 24*(5), 483-486.
Waliczek, T.M. & Zajicek, J.M. (1999). School gardening: Improving environmental attitudes of children through hands-on learning. *Journal of Environ. Hort. 17*(4), 180-184.
Yardımcı, E. & Bağcı Kılıç, G. (2010). Çocukların gözünden çevre ve çevre sorunları. *İlköğretim Online 9*(3),1122-1136.

# P-16 EFFECT OF DIFFERENT NOZZLE TYPE ON DICAMBA + TRIASULFURON PERFORMANCE

Derya ÖĞÜT YAVUZ[1], Özhan BOZ[2], M. Nedim DOĞAN[2]

[1]:Uşak University, Faculty of Agric. & Natural Sciences, Dept. of Plant Protection, Uşak, Turkey

[2]:Adnan Menderes University, Faculty of Agriculture, Dept. of Plant Protection, Aydın, Turkey corrosponding author e-mail: derya.ogutyavuz@usak.edu.tr

## Abstract

The objective of the research was to determine the effect of nozzle type on the performance of Dicamba plus triasulfuron on four broad leaved weed species (*Matricaria chamomilla* L., *Melilotus officinalis* (L.) Desr., *Sinapis arvensis* L. and *Galium tricornutum* Dandy). The project was carried out under semi-controlled conditions in 2010-11 at Adnan Menderes University, Faculty of Agriculture, Research and Application Center. Herbicide performance was evaluated with 20 l/da spraying volume and tap water by using cone nozzle and flat fan nozzle and based upon ED50 (15 g/ha), ED90 (40 g/ha) and recommended (125 g/ha). The herbicide was applied separately under 4 atm pressure by using 11002 flat fan and 6.1.2 cone nozzles. The study had five replications and was repeated twice. As a result, it was determined that the performance of dicamba + triasulfuron was not important for MATCH and MELOF depending on the type of nozzle. Both types of nozzles achieved the effect level of 90% and above. A higher effect was achieved with cone nozzles in SINAR and GALTR control.

**Keywords**: Cone nozzle, Dicamba+Triasulfuron, Flat fan nozzle, Herbicide optimization, Weed

## GİRİŞ

Buğday, tek yıllık bir bitki olup, her türlü iklim ve toprak koşullarında yetişebilecek çok sayıda çeşitlere sahip olması nedeniyle, dünyanın hemen her tarafında yetiştirilmektedir. Tarım yapılabilir 23,9 milyon hektarlık alan içerisinde %49 ile en büyük payı tahıllar almaktadır. Toplam tahıl alanları içerisinde ise %67'lik pay ile ilk sırada buğday yer almaktadır. (TÜİK 2016). Son 10 yılın buğday ekim alanları 7,5-8,5 milyon hektar arasında, üretim miktarı ise 17,2-22,6 milyon ton arasında değişmektedir. 2016 yılı buğday üretimimiz ise 20,6 milyon ton ve 7.671.945 ha olarak gerçekleşmiştir. Buğday yetiştiriciliğinde yüksek verimli ve kaliteli çeşitlerin yetiştirilmesinin yanında uygun yetiştirme tekniklerinin kullanılmasıyla üretimde verim ve kaliteyi artırmak mümkündür. Bu kadar öneme sahip buğdayın üretimini sınırlandıran birçok biotik ve abiotik faktör bulunmakta olup hububat üretimine ve kalitesine olumsuz etki eden faktörlerden birisi de yabancı otlardır. Ülkemiz hububat ekim alanlarında sorun oluşturan başlıca dar ve geniş yapraklı yabancı ot türü çeşitli çalışmalarla değişiklik göstermekle birlikte yaklaşık 64 adet tür tespit edilmiştir (Güncan 2006). Boz, (2000) Aydın ili buğday ekim alanlarında yabancı otlar ile bunların yaygınlık ve yoğunluklarını belirlemek amacıyla yaptığı surveylerde 1997 yılında 106 buğday tarlasında toplam 90 yabancı ot türü, 1998 yılında yaptığı surveylerde de 80 yabancı ot türü saptamıştır. Yabancı otların neden olduğu ürün kayıpları coğrafi bölgelere bağlı olarak değişiklik göstermektedir. Dünyada buğday alanlarında bitki koruma tedbirlerinin kısmen alınması durumunda yabancı otlardan kaynaklanan ürün kaybının %7 olduğu, bitki koruma tedbirlerinin alınmaması durumunda ise yabancı otlardan ileri gelen ürün kaybının %23,3 belirlenmiştir (Oerke, 2006'e atfen Güncan, 2014). Ülkemizde yapılan çalışmalarda buğday alanlarında yabancı ot mücadele tedbirleri alınmasına rağmen yabancı otlardan meydana gelen ürün kaybı ortalama % 24 olarak belirtilmiştir (Güncan, 2014). Buğday ekim alanlarında, çıkış sonrasında yabancı ot mücadelesinin yalnızca kültürel yöntemlerle sürdürülmesi yabancı ot kontrolünü sağlamakta yetersiz kalmakta, bu nedenle kültürel uygulamalara ek olarak kimyasal mücadele şeklinde yürütülmektedir. Kimyasal mücadele, uygulanabilirliğinin kolay olması, kısa sürede etki göstermesi ve diğer yöntemlere göre maliyetinin düşük olması nedeniyle en çok tercih edilen yöntem olarak değerlendirilmektedir (Sönmez, 1991; Zoschke, 1994; Doğan ve ark., 2004; Serim ve Özdemir, 2012). Ülkemizde herbisit uygulamalarında yelpaze ve içi boş konik hüzmeli memeler kullanılmaktadır.

Herbisit uygulamalarında kullanılan yelpaze hüzmeli memeler 2-5 bar uygulama basınçlarında kullanılabilen genellikle 1-4 mm orifis büyüklüğünde, içi boş konik hüzmeli memeler ise 4-8 bar uygulama basınçlarında kullanılan 1.0, 1.2 ve 1.5 mm çaplarında hidrolik püskürtme memelerdir (Serim ve Özdemir, 2012). İlaç uygulamasının gerektirdiği pülverizasyon karakteristiklerini sağlayabilecek sözü edilen meme tiplerinden birisi seçilmezse, ilaç uygulamasından beklenen biyolojik etkinlik sağlanamaz (Çilingir ve Dursun, 2002). İlaçlama tekniğinin büyük ölçüde memeler tarafından oluşturulan pülverizasyonun kalitesine bağlı olması memelerinin hastalık, zararlı ve yabancı ot mücadelesinde oldukça önemli bir yere sahip olmasına neden olmaktadır (Özkan ve ark., 1992) Uygulama normunun ve hava emişli memenin, buğday ekim alanlarında kullanılan Sulfosulfuron, Mesosulfiıron-methyl+iodosulfuron methyl sodium ve Thifensulfuron methyl + Tribenuron methyl aktif maddeli herbisitlerin tavsiye edilen dozlarda biyolojik performanslarına etkileri değerlendirilmiş, sonuçta standart yelpaze huzmeli memeler hava emişli memelere göre yabancı ot kontrolünde daha fazla etki sağladığı belirlenmiştir (Serim ve ark., 2008). Ülkemizde en yaygın olarak kullanılan meme tipleri; yelpaze hüzmeli ve konik hüzmeli memelerdir. Her iki meme tipinde oluşan ilaç dağılımı birbirinden farklıdır. Bunun sonucunda verdikleri ilaç damla dağılımı ve ilacın ortaya çıkan etkisi de farklı olmaktadır. Yelpaze huzmeli memeler içinde en çok kullanılanı geleneksel yelpaze huzmeli memedir. Bu tip memeler geniş bir basınç aralığında çalışmaya imkan sağladıklarından dolayı yaygın olarak kullanılmaktadır. Ancak bu memelerin ürettiği damla çapları ince ile orta sınıf arasında değiştiğinden sürüklenme açısından riskli damla oranları yüksektir (Güler vd., 2010). Çukurova Bölgesi'nde ikinci ürün mısır yetiştiriciliğinde herbisitlerin içi boş konik hüzmeli memelerle uygulanması oldukça yaygındır. Mısır üretiminde yaygın olarak kullanılan acetochlor ve nicosulfuron sırasıyla çıkış öncesi ve çıkış sonrası uygulanmıştır. Düşük püskürtme hacmiyle döner diskli memeler kullanılarak yapılan uygulamalarda azaltılmış herbisit dozları yetersiz yabancı ot kontrolü sağlamıştır. Buna karşın herbisitin yelpaze hüzmeli memeyle 15, 20, 25, 30 ve 35 cm olan farklı şerit aralıkları ile uygulanması yabancı ot kontrolünde etkili bulunmuş, herbisitin bu şekliyle uygulanması hem herbisit hem de su kullanımını % 78'e kadar düşürmüştür (Üremiş vd., 2004).

Her ne kadar yabancı ot ilaçlamalarında yelpaze hüzmeli memeler tavsiye edilmiş olsa da üreticilerimiz çoğu zaman hastalık, zararlı ve yabancı otlar için yalnızca tek tip meme kullanmakta ve kullandığı pestisite göre memeyi değiştirmeyi tercih etmemektedir. Genellikle ülkemizde yelpaze hüzmeli memeler, daha çok yabancı ot ilaçlamalarında, konik hüzmeli memeler ise zararlı ve hastalık etmenlerinin ilaçlamalarında kullanılmaktadır. Bu durum göz önüne alınarak çalışmada buğday üretim alanlarında geniş yapraklı yabancı otların mücadelesinde kullanılan Dicamba+Triasulfuron etkili maddeli herbisitin etkili minimum dozları belirlenerek bu dozların konik hüzmeli ve yelpaze hüzmeli meme ile performansı değerlendirilmiştir.

## MATERYAL VE METOT

Meme tipi seçiminin Dicamba + Triasulfuron etkili maddeli herbisitin performansına olan etkisinin belirlenmesi konulu çalışma 2010-11 üretim sezonunda Adnan Menderes Üniversitesi, Ziraat Fakültesi, Araştırma ve Uygulama Çiftliği'nde yarı kontrollü koşullarda yürütülmüştür. Çalışmada buğday üretim alanlarında sorun olan geniş yapraklı dört yabancı ot türü (*Matricaria chamomilla* L., *Melilotus officinalis* (L.) Desr., *Sinapis arvensis* L. ve *Galium tricornutum* Dandy) yer almıştır. Öncelikle çalışmada kullanılacak olan herbisitin etkili minimum dozları belirlenmiştir. Etkili minimum herbisit dozlarının belirlenebilmesi için öncelikle hedef yabancı ot ile herbisit arasındaki doz-etki ilişkilerinin belirlenmesi gerekliliğinden hareketle herbisitin farklı sayıda doz serisi kullanılmıştır. Bu sebeple herbisitin önerilen dozunun % 0, 2.5, 5, 10, 20, 40, 60, 80 ve 100'ünü içeren dozlarda uygulaması yapılmıştır. Denemeler 5 tekrarlı olacak şekilde kurulmuş ve iki kez tekrarlanmıştır. İlaçlamalardan 4 hafta sonra yabancı otlar toprak yüzeyinden kesilerek yaş ağırlıkları belirlenmiştir. Daha sonra kuru ağırlıkları 48 saat 65˚C'de etüvde bekletilerek elde edilmiştir. Elde edilen tüm kuru ağırlık değerleri kontrol bitkilerinin ortalama kuru ağırlıklarına göre oransal olarak % ağırlık değerine dönüştürülmüş ve % ağırlık değerleri regresyon analizinde Hannson ve Ascard (2002), tarafından kullanılan aşağıdaki eşitlikten yararlanılmıştır. $Y=100/[1+9*(x/ED_{90})^b]$ Formülde yer alan **X** değeri uygulanan herbisit dozunu, **Y** değeri X dozu uygulandığında elde edilen parametre seviyesini (ortalama bitki yaş ağırlığı), $\mathbf{ED_{90}}$ değeri uygulandığında % 90 ağırlık azalmasına neden olan herbisit dozunu (etkili minimum doz ) ve **b** değeri ise eğrinin dikliğini vermektedir. Regresyon analizleri sonucunda her bir yabancı ot türü için $ED_{50}$ ve $ED_{90}$ değerleri Sigma Plot paket programında belirlenmiştir.

Çalışmada herbisitin, $ED_{50}$-$ED_{90}$ ve tavsiye dozu temel alınarak konik hüzmeli meme ve yelpaze hüzmeli meme koşullarında 20 l/da püskürtme hacmi ve çeşme suyu ile performansı değerlendirilmiştir. Denemede herbisit 11002 yelpaze hüzmeli meme ve 6.1.2 konik meme kullanılarak 4 atm basınç altında ilaçlama kabininde ayrı ayrı uygulanmıştır. Çalışma 5 tekerrürlü olarak yürütülmüş ve iki kez tekrarlanmıştır. Herbisit uygulamasından 4 hafta sonra yabancı otlar toprak yüzeyinden kesilerek yaş ağırlıkları belirlenmiştir. Daha sonra kuru ağırlıkları için 48 saat 65˚C'de etüvde bekletilmiştir. Herbisit etkinliğinin belirlenmesinde bitki kuru ağırlıkları baz alınmıştır. İstatistiksel değerlendirmelerde, kontrol

bitkilerinin ortalama ağırlıkları % 100 olarak kabul edilmiş ve buna bağlı olarak herbisit uygulanan bitkilerin ağırlıkları da yüzdeye çevrilmiştir. Elde edilen % kuru ağırlık değerleri aracılığıyla herbisit etkinliği hesaplanmıştır. % kuru ağırlık değerleri, varyans analizine tabi tutulmuş (General Linear Model) ve ortalamalar Tukey testi ile 0.05 önem seviyesinde karşılaştırılmıştır. Tüm faktörler ve bu faktörlerin interaksiyonları test edilmiş ve SPSS 18 paket program kullanılmıştır.

## BULGULAR VE TARTIŞMA

Herbisitin analiz sonucunda elde edilen $ED_{50}$ ve $ED_{90}$ değerleri ortalamaları Tablo 1'de belirtilmiştir. Elde edilen bu doz serisi meme tipi seçiminin herbisit performansına etkisi konulu çalışmada kullanılacak olan dozu oluşturmuştur.

Tablo 1. Herbisitin $ED_{50}$- $ED_{90}$- Tavsiye Doz Serisi

| Herbisit | $ED_{50}$ ortalama | $ED_{90}$ ortalama | Önerilen Doz (%100) |
|---|---|---|---|
| **Dicamba+ Triasulfuron** | 1.5 g/da<br>% 12 oranı | 4.0 g/da<br>% 32 oranı | 12.5 g/da |

Etkili minimum doz çalışmaları sonucunda elde edilen herbisitin $ED_{50}$ ve $ED_{90}$ ve tavsiye dozu yelpaze hüzmeli meme ve konik hüzmeli meme tipi ile uygulanmış, meme tipi seçiminin MATCH, MELOF, SINAR ve GALTR'a olan etkisi ile ilgili ANOVA değerleri Tablo 2'de sunulmuştur. Analizde deneme faktörü istatistiki olarak önemli bulunmuş ve bu nedenle denemeler birbirinden bağımsız olarak değerlendirilmiştir. Meme tipi seçimine bağlı olarak Dicamba+Triasulfuron'un performansı birinci deneme sonuçlarında, MATCH ve MELOF için yalnızca doz faktörü önemli bulunurken, SINAR ve GALTR'da ise meme tipi ve doz faktörleri önemli bulunmuştur. Ancak ikinci deneme koşullarında GALTR haricindeki diğer yabancı ot türleri için tüm faktörler önemlidir (Tablo 2).

Tablo 2. Dicamba+Triasulfuron'nun performansı üzerine meme tipi kullanımının etkinliği ile ilgili varyans analiz sonuçları (F olasılıkları % 0.05) (Deneme 1-2)

| ANOVA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Faktör** | **MATCH** | | **MELOF** | | **SINAR** | | **GALTR** | |
| Deneme | **1** | **2** | **1** | **2** | **1** | **2** | **1** | **2** |
| Meme tipi | 0.29 | **0.00** | 0.15 | **0.00** | **0.01** | **0.00** | **0.00** | **0.01** |
| Doz | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |
| Meme tipi * Doz | 0.60 | **0.00** | 0.23 | **0.00** | 0.24 | **0.00** | 0.09 | 0.34 |

Birinci deneme sonuçları ele alındığında, MATCH % kuru ağırlığı üzerine en yüksek etki herbisitin tavsiye dozu uygulandığında elde edilmiş olmasına karşın $ED_{90}$ dozundan farksızdır. Her iki doz ile elde edilen etki seviyesi MATCH için % 93 ve üzeri olarak belirlenmiştir. Doz faktörü MELOF kontrolünde önemli olup tavsiye dozu ile elde edilen etki diğer dozlardan yüksek bulunmuş ve istatistiki olarak önemlidir. SINAR ve GALTR için tavsiye dozu diğer dozlardan önemlidir. Her iki yabancı ot türü için meme tipi önemli olup, konik hüzmeli meme ile elde edilen etki yelpaze hüzmeli memeden yüksektir (Tablo 2). Serim ve Özdemir (2012) yapmış oldukları çalışmada herbisit uygulamalarında içi boş konik hüzmeli memeler yerine yelpaze hüzmeli memelerin tercih edilmesinin, sürüklenme potansiyeli yüksek damla (<100 μm) miktarının azaltılmasına yardımcı olabileceği belirtilmiştir.

Tablo 2. Dicamba+Triasulfuron'un performansı üzerine meme tipi ve dozun etkisi (Deneme 1)

| | % Kuru Ağırlık ve Etki | | | |
|---|---|---|---|---|
| **Doz (g/da)** | **MATCH** | **MELOF** | **SINAR** | **GALTR** |
| **1.5** | 55.7 a<br>(% 44)* | 71.3 a<br>(% 29) | 24.0 a<br>(% 76) | 44.0 a<br>(% 66) |
| **4.0** | 7.4 b<br>**(% 93)** | 28.7 b<br>(% 71) | 14.5 ab<br>(% 85) | 39.1 a<br>(% 61) |
| **12.5** | **1.7 b**<br>**(% 98)** | **8.5 c**<br>**(% 91)** | 3.5 b<br>(% 96) | 15.6 b<br>(% 84) |
| **Std. Hata** | 3.2 | 4.7 | 3.6 | 4.9 |
| **Meme tipi** | ns | ns | | |
| **Yelpaze hüzmeli meme** | | | 19.7 a<br>(% 80) | 43.9 a<br>(% 66) |
| **Konik hüzmeli meme** | | | 8.3 b<br>**(% 92)** | 21.9 b<br>(% 78) |
| **Std. Hata** | | | 2.97 | 4.06 |

*Parantez içindeki değerler söz konusu yabancı otlar için % etkileri belirtmektedir.

ns: Önemsiz

**İkinci deneme sonuçları ele alındığında,** Dicamba+Triasulfuron'un $ED_{50}$ dozu (1.5 g/da) kullanıldığında en yüksek etki tüm yabancı ot türleri için yelpaze hüzmeli meme ile sağlanmış ve konik hüzmeli memeden farklı bulunmuştur. $ED_{90}$ dozu (4 g/da) kullanıldığında, MATCH % kuru ağırlığında etki bakımından her ne kadar konik hüzmeli meme tipi ile elde edilen etkiden daha yüksek sonuç elde edilmiş olsa da iki meme tipinin birbirinden farksız olduğu belirlenmiştir. MELOF üzerinde yelpaze hüzmeli meme tipi ile yüksek etki sağlanırken, SINAR için bu durumun tersi sonuç elde edilmiştir. Tavsiye dozlarının (12.5 g/da) meme tipi ile olan ilişkisi incelendiğinde, MATCH için meme tipinin önemli olmadığı ve her iki meme tipi kullanılmasıyla % 97 ve üzeri etki elde edildiği belirlenmiştir. Brown ve ark., (2007) herbisit dozu, meme tipi, püskürtme hacmi ve püskürtme basıncının herbisit performansına etkisini belirlemek amacıyla yürütülen Bromoxynil'in önerilen dozunun yelpaze hüzmeli memeler ile uygulanmasıyla *A. theophrasti*, *A. artemisiifolia* ve *C. album*'un, Dicamba uygulanmasıyla *A. artemisifolia* ile *C. album*'un ve Nicosulfuron uygulanmasıyla *E. crus-galli*'nin hava emmeli (AI) memelere nazaran daha iyi kontrol edildiği belirlenmiştir. Serim ve ark., (2008) yapmış oldukları çalışmada, buğday ekim alanlarında kullanılan sulfosulfuron, mesosulfuron-methyl+iodosulfuron methyl sodium ve thifensulfuron-methyl+tribenuron-methyl etkili maddeli herbisitlerin etkinliğinde standart yelpaze hüzmeli memelerin, hava emişli memelere göre yabancı ot kontrolünde ve buğday veriminde daha etkili olduğu sonucuna varılmıştır. Ancak MELOF ve SINAR için meme tipi seçiminin doza bağlı olarak değiştiği ve tavsiye dozun yelpaze hüzmeli meme ile uygulanması durumunda daha yüksek etki sağlandığı ve bunun da istatistiki olarak önemli olduğu belirlenmiştir. GALTR için doz meme interaksiyonu önemli olmayıp en yüksek etki yelpaze hüzmeli meme ile (% 80) elde edilirken, doz bakımından yapılan değerlendirmede ise $ED_{50}$ dozu en düşük etki seviyesi ile diğer dozlardan farklı bulunmuştur (Tablo 3).

Tablo 3. Dicamba+Triasulfuron'un performansı üzerine meme tipi doz interaksiyonunun etkisi (Deneme 2)

| % Kuru Ağırlık ve Etki | | | | | |
|---|---|---|---|---|---|
| **Meme tipi** | **Doz (g/da)** | **MATCH** | **MELOF** | **SINAR** | **GALTR** |
| **Yelpaze hüzmeli meme** | **1.5** | 11.9 (% 88)* | 13.6 (% 86) | 33.9 (% 66) | 25.6 (% 74) |
| | **4.0** | 6.6 (% 93) | 9.4 (% 91) | 14.5 (% 85) | 16.7 (% 83) |
| | **12.5** | 2.9 (% 97) | 4.9 (% 95) | 3.7 (% 96) | 17.4 (% 83) |
| **Konik hüzmeli meme** | **1.5** | 88.6 (% 11) | 45.3 (% 55) | 50.5 (% 49) | 34.8 (% 65) |
| | **4.0** | 2.7 (% 97) | 13.9 (% 86) | 9.1 (% 89) | 25.3 (% 75) |
| | **12.5** | 1.7 (% 98) | 7.3 (% 93) | 9.4 (% 91) | 19.2 (% 81) |
| **Std. Hata** | | **2.2** | **1.4** | **2.1** | **2.7** |

*Parantez içindeki değerler söz konusu yabancı otlar için % etkileri belirtmektedir.

## SONUÇ

Buğday ekim alanlarında sorun olan yabancı otlardan (*M. chamomilla* L., *M.officinalis* (L.) Desr., *S.arvensis* L. ve *G. tricornutum* Dandy) nin kontrolünde Dicamba+Triasulfuron etkili maddeli herbisitin etkili minimum dozlarının konik hüzmeli ve yelpaze hüzmeli meme ile performansının değerlendirildiği çalışma sonucunda meme tipi seçimine bağlı olarak Dicamba+Triasulfuron performansı'nın MATCH ve MELOF için önemli olmadığı belirlenmiş, her iki meme tipi seçimiyle de % 90 ve üzeri etki seviyesine ulaşılmış, SINAR ve GALTR mücadelesinde konik hüzmeli meme ile daha yüksek etki sağlanmıştır. Çalışmalar sonucunda meme tipi etkinliği; herbisite, yabancı ot türlerine ve denemeden denemeye farklılık göstermiştir. Kullanılan her iki meme tipininde herbisit etkinliğinde bir farklılık söz konusu olmamıştır. Konik hüzmeli memenin etkili bulunmasında, herbisitlerin sistemik etkili olması ve ilaçlamaların ilaçlama kabininde uygulanmış olmasından kaynaklanmış olabileceği, bu şekilde sürüklenme koşullarından izole edilmiş olabileceği düşünülmektedir. Üremiş ve ark., (2004) yapmış oldukları çalışma sonucunda, küçük damlaların rüzgar ve sıcaklık gibi çevre koşullarından etkilenerek hedef yüzeye ulaşmadan sürüklenebileceğini belirtmişlerdir.

## TEŞEKKÜRLER

Bu çalışma ADÜ Bilimsel Araştırma Projeleri (ZRF-11027) tarafından desteklenmiştir.

## KAYNAKLAR

Boz, Ö. 2000. Aydın ili buğday ekim alanlarında bulunan yabancı otlar ile rastlama sıklıkları ve yoğunluklarının saptanması. Türkiye Herboloji dergisi, 3 (2): 1-11.

Brown, L., Soltani, N., Shropshire, C., Spieser, H., Sikkema, P.H. 2007. Efficacy of four corn (Zea mays L.) herbicides when applied with flat fan and air induction nozzles. Weed Biology and Management, 7: 55-61.

Çilingir, İ., ve Dursun, E. 2002. Bitki Koruma Makinaları. Ankara Üniversitesi Ziraat Fakültesi Yayın No:1531, Ders Kitabı: 484, pp. 248, Ankara.

Doğan, M.N., Boz, Ö., Albay, F. 2004. Tarım Alanlarında Sorun Olan Yabancı Otların Kimyasal Mücadelesinde Azaltılmış Herbisit Dozlarının Etkinliğinin Araştırılması. TÜBİTAK, Proje No:2688.

Güler, H., Urkan, E., Tozan, M., Tekin, A. B., Caner, Ö. 2010. Tarımsal Savaşım Mekanizasyonunda Teknolojik Gelişmeler. Ziraat Mühendisliği VII. Teknik Kongresi Bildiriler Kitabı 1- 2. Ankara

Güncan, A. 2006. Yabancı ot mücadelesi, Selçuk Üniversitesi Basimevi, Konya, 5-6.

Hanson, D., Ascard, J. 2002. Influence of developmental stage and time of assessment on hot water weed control. Weed Research, 42, 307-316.

Oerke, E.C.2006. Crop losses to pests. Journal of Agricultural Science, 144,31-43

Özkan, H. E., D. L. Reichard, and K. D. Ackerman, 1992. Effect of wear on spray patterns from fan nozzles. Transactions of the ASAE, 35 (4) 1091-1096.

Serim, A.T., Başaran, M.S., Dursun, E., Koçtürk, B.Ö., Üre, T. 2008. Uygulama normu ve hava emişli memenin bazı buğday herbisitlerinin performansına etkileri. Türkiye Herboloji Dergisi, 11(1), 16-25.

Serim, A.T., Özdemir, Y.G. 2012. Herbisit uygulamalarında kullanılan pülverizatör memelerinin damla büyüklük dağılımlarının belirlenmesi. Tarım Bilimleri Araştırma Dergisi, 5(2), 172-175.

Sönmez, S. 1991. Türkiye herbisit pazarı-Türkiye I. Herboloji Kongresi, (3-5 Şubat), pp. 17-22 Adana, Türkiye.

TUİK, 2016. Türkiye İstatistik Kurumu, Bitkisel Üretim İstatistikleri.

Üremiş İ., Bayat, A., Uludağ, A., Bozdoğan, N., Aksoy, E., Soysal, A., Gönen, O. 2004. Studies on different herbicide application methods in second crop maize fields. Crop Protection, 23: 1137-1144.

Zoschke, A. (1994). Toward reduced herbicide rates and adapted weed management. Weed Technology, 8, 376-386.

# P-24 The effect of colchicine application to obtain chromosome duplication on the germination of some forage crops seeds.

M. Bilgen[1], Z. Delibalta[1], A. Adak[1]

[1]Field Crops Departments, Faculty of Agricultre, Akdeniz University, Antalya, Turkey.

**Abstract**

The effect of different concentrations of colchisine on seed germination on some forage crops. Ten diffrent forage crops (*Medicago sativa* L., *Trifolium alex*and*rinum* L., *Onobrychis viciifolia* Scop., *Lotus corniculatus* L., *Dactylis glomerata* L., *Chloris gayana* Kunth, *Agropyron cristatum* (L.) Gaertn., *Agropyron intermedium* (Host) P.Beauv., *Phleum pratense* L. and *Phacelia tanacetifolia* Benth.) seeds were treated %0.25 and %0.50 colchicine solutions. Each species was incubated for 2, 4 and 6 hours at different concentrations. The seeds filtered from the colchicine concentration were directly planted in trays. For each species and each application, seeds were planted in 50 pot of tray.. The trays are positioned in the open area and irrigation as needed. The seed germinations that have been observed for 1-3 days according to the speed of seed emergence. In some tray, due to environmental conditions (heavy rain, strong winds, etc.), some violations have occurred. These problems have also been identified and these applications have been left out of the observation. In some species (*Chloris gayana* and *Agropyron intermedium*), no germination, including control, was observed due to seed viability. According to the results obtained, colchicine concentrations and incubation times have different effects on germination number, root length and shoot length. These effects have also changed by species. Some species, such as *L. corniculatus*, were more affected, but some species were slightly affected (*T. alexandrinum* and *O. viciifolia*). Species in *Poaceae* has generally declined in all properties with concentration and time increase.

**Introduction**

The most important factor affecting animal production in one region is agriculture of forage crops. This line of agriculture has a special place and priority in animal nutrition and animal health in order to influence the development of animal husbandry and the maximum level of animal production. Forage crops are important for animal husbandry; It is a cheap source of food, contains nutrients required for stomach flora, is a source of minerals and vitamins.

Forage crops are known to have positive effects on the physical and chemical properties of the soil and on the yield and quality of the cultivated plants following it, in addition to providing the bait which constitutes one of the most important inputs of animal production. In particular, leguminous forage crops can cover almost all or a substantial part of the nitrogen requirement of the main plant through green fertilization in the organic farming system (Acikgöz et al. 2005).

Forage production in a country with less, spending more than a certain amount of grass for animal products makes it a more difficult problem to solve (Bakır, 1987). However, in developed countries, rangelands has an important place in animal nutrition due to the fact that rangelands are accepted as abundant and cheap roughage producing areas. In Western Europe, for example, it is stated that 50% of the energy needs of dairy cattle are met by meadow and rangelands, 25% by dry hay and silage, and 25% by concentrates feed. Likewise in the US, forage crops and grass have an important place in the rations of animals outside the cattle. This is also the case for many countries in western Europe (Reid and Jung 1984).

Forage crop cultivation is still insufficient for many countries. Production of forages for higher and high quality animal products is also required. Agricultural areas are decreasing day by day. Therefore it is more important to ensure the increased production by increasing the yield per unit area. The most important method of increasing yield is breeding of forage crops. However forage breeding can be extraordinarily complex in terms of number of species, perenniality, mode of reproduction, mating system, and a variable genetic correlation between spaced plants and sward plots (Resende et al., 2013).

Gains in forage yield from breeding forage crops are low to nonexistent, despite over years of breeding efforts in some forage species (Casler et al., 1996; Casler, 1998; Humphreys, 1999, 2005). Humphreys (1999) and Casler (1998) discussed several reasons for this yield lag in forage crops relative to grain crops: (i) a longer breeding cycle for forage crops, most of which are perennials, (ii) lack of a “harvest index” trait to aid dry-matter partitioning into the economic product, (iii) inability to exploit heterosis in commercial cultivars, and (iv) our focus on a wide array of economically important traits of forage crops, many of which are not specifically correlated or may be negatively correlated with forage yield (Casler, 2001). The main benefits expected from genomic selection in forage grasses and legumes are to increase selection accuracy, reduce cycle time, and potentially reduce evaluation costs per genotype (Resende et al., 2014).

Colchicine has been used since years in chromosome duplication and therefore in plant breeding. None of the other chemicals are as effective as colchicine in obtaining polyploidy (BIakessle, 1937). Plants grown for vegetative parts give better results than plants grown for seeds (Kosstoff, 1938 and Elliot, 1958). The effectiveness of colchicine depends on the concentration of the solution, the duration of application and the physiological activity of the embryo cells during application (Eigisti, 1938).

There are two important mechanisms in the formation of plants. These are polyploids and they are seen as an important mechanism. The second mechanism for the genesis of grasses is reported as chromosomal rearrangements and inversions, translocations and microdeletions are shown as a source of this mechanism, leading to irregular chromosomal matches in meiosis. It is noted that these chromosomal alterations are the source of new chromosomal combinations and hence the formation of new species (Ramana ve Jacobsen, 2003; Sim et al., 2005).

The aim of this research is to obtain the first material for a high growth and high forage yield with chromosome duplication, germination properties and to reveal the differences between them. It is also to provide material for breeding work to be carried out thereafter.

**Materials and methods**

The effect of different concentrations of colchicine on seed germination on some forage crops. Ten diffrent species were examined. These species are *Medicago sativa* L. (Ms), *Trifolium alex*and*rinum* L. (Ta), *Onobrychis viciifolia* Scop. (Ov), *Lotus corniculatus* L. (Lc) in *Fabaceae* family, *Dactylis glomerata* L. (Dg, Dg-C collected from campus flora), *Chloris gayana* Kunth (Cg), *Agropyron cristatum* (L.) Gaertn. (Ac), *Agropyron intermedium* (Host) P.Beauv. (Ai), *Phleum pratense* L. (Pp) *in Poaceae* family and *Phacelia tanacetifolia* Benth. (Pt) in *Boraginaceae* family. Two different colchicine solutions (%0.25 and %0.50) were prepared. Each species was incubated for 2, 4 and 6 hours at these different concentrations. The seeds filtered from the colchicine concentration were directly planted in trays. For each species and each application, seeds were planted in 50 pot of tray. The trays are positioned in the open area and irrigation as needed. The seed germinations that have been observed for 1-3 days according to the speed of seed emergence. In some tray, due to environmental conditions (heavy rain, strong winds, etc.), some violations have occurred. These problems have also been identified and these applications have been left out of the observation. In two species (*Chloris gayana* Kunth and *Agropyron intermedium* (Host) P.Beauv.), no germination, including control, was observed due to seed viability. After germination was completed, about ten plant samples were taken from each species and each treatment. In these samples, plants cleaned from the soil of their roots and then root and shoot lengths were measured. The standard deviation of these measured values is calculated.

**Results and discussion**

The germination numbers obtained from the study are given in table 1. In terms of germination numbers, full germination occurred in almost all the tray of *T. alexandrinum* and *O. viciifolia*. In *L. corniculatus*, the results are quite different. Only 4 seeds germinated at a concentration of 0.50% for 6 hours incubated, while other applications ranged from 18 to 34. *M. sativa* has germination rate of 40-50% in all applications. In general, it is observed that the numbers of germination are high in the *Fabaceae* species. The species of the *Poaceae* family has been found to have a lower number of germination. The highest number of germination was observed in *P. pratense* species, the lowest in *A. cristatum* species. In the species of *P. tanacetifolia*, which is the only species of *Boraginaceae* family, the number of germination varies between 12 and 45.

Table 1. Germination number of species.

| **Species** | **Control** | **%0.25** | | | **%0.50** | | |
|---|---|---|---|---|---|---|---|
| **Poaceae** | | **2 hour** | **4 hour** | **6 hour** | **2 hour** | **4 hour** | **6 hour** |
| *P. pratense* | 18 | 16 | 20 | 6 | 2 | 10 | 0 |
| *D. glomerata* | 24 | 9 | 3 | 4 | 22 | 12 | 12 |
| *D. glomerata* (c) | 42 | 8 | 32 | 28 | 29 | 37 | 3 |
| *A. cristatum* | D | 41 | 23 | 45 | D | 47 | 45 |
| **Fabaceae** | | | | | | | |
| *L.* corniculatus | 34 | 29 | 18 | 32 | D | 25 | 4 |
| *T. alexandrinum* | 52 | 49 | 50 | 48 | 49 | 46 | 50 |
| *O. viciifolia* | 52 | 50 | 50 | 50 | 50 | 50 | 41 |
| *M. sativa* | 48 | 28 | 28 | 20 | 19 | 27 | 33 |
| **Boraginaceae** | | | | | | | |
| *P. tanacetifolia* | 52 | 40 | 41 | 17 | 45 | 12 | 45 |

c mean, collected from campus flora, D mean, damaged tray.

Root length and standard deviation values of species of the *Poaceae* family are given in table 2. When Table 2 is examined, it is seen that root length values are quite variable according to the applications. It has been determined that the value of *D. glomerata* collected from the campus flora is low but less varied. The most diverse result among the applications was obtained from *A. cristatum* species. These values varied between 54.00 and 105.64 cm. It can be said that the long incubation times in this plant increased the root length. Similar result is seen in *P. pratense* species. In this species, the root

length increases as the concentration and the incubation time increase.

Table 2. Root length (cm) and standard deviation of species in *Poaceae* family.

| | | *P. pratense* | *D. glomerata* | *D. glomerata* (c) | *A. cristatum* |
|---|---|---|---|---|---|
| Control | | D | 93.25 ±23.68 | 68.54 ±11.76 | D |
| %0.25 | 2 hour | 35.50 ±20.51 | 124.67 ±60.08 | 64.67 ±35.23 | 75.50 ±15.78 |
| | 4 hour | 42.20 ±7.56 | 105.00 ±52.33 | 81.30 ±36.38 | 54.00 ±12.88 |
| | 6 hour | D | 116.67 ±36.30 | 69.83 ±15.11 | 86.00 ±9.70 |
| %0.50 | 2 hour | D | 98.40 ±22.33 | 79.00 ±8.19 | D |
| | 4 hour | 76.00 ±22.63 | 131.33 ±45.62 | 49.50 ±11.07 | 78.50 ±16.07 |
| | 6 hour | D | D | D | 105.64 ±33.02 |

c mean, collected from campus flora, D mean, damaged tray.

Among the measured root length and standard deviation values, the *Fabaceae* family species are listed in table 3 and the *Boraginaceae* family species table 4. In table 4, *L. corniculatus* species is remarkable. In the *L. corniculatus* species only 41.80 cm root length was measured in the control, while in other applications values between 77.00 and 107.50 were measured. From these values, it can be said that the application of colchicine has increased the root length. In *M. sativa*, the root length is increased at the concentration of 0.25% during the 2 hour incubation period. In *P. tanacetifolia*, on the contrary, roots were shorter than the controls in all applications.

Table 3. Root length (cm) and standart deviation of species in *Fabaceae* family.

| | | *L. corniculatus* | *T. alexandrinum* | *O. viciifolia* | *M. sativa* |
|---|---|---|---|---|---|
| Control | | 41.80 ±13.31 | 95.36 ±26.39 | 122.33 ±31.38 | 49.13 ±6.97 |
| %0.25 | 2 hour | 77.00 ±23.97 | 137.08 ±67.43 | 66.14 ±19.67 | 101.80 ±34.17 |
| | 4 hour | 107.50 ±57.14 | 92.60 ±24.86 | 130.60 ±40.03 | 55.08 ±9.38 |
| | 6 hour | 89.86 ±30.27 | 127.83 ±50.66 | 64.50 ±20.66 | 54.43 ±4.96 |
| %0.50 | 2 hour | D | 126.70 ±37.07 | D | 49.38 ±10.20 |
| | 4 hour | 99.00 ±41.39 | 104.11 ±15.05 | 113.50 ±41.18 | 90.86 ±20.26 |
| | 6 hour | D | 76.08 ±17.23 | 124.25 ±50.42 | 77.60 ±34.75 |

D mean, damaged tray.

Table 4. Root length (cm) and standard deviation of *P. tanacetifolia* in *Boraginaceae* family.

| *P. tanacetifolia* | | | | | |
|---|---|---|---|---|---|
| Control | | 144.71 ±54.43 | | | |
| %0.25 | 2 hour | 130.00 ±33.18 | %0.50 | 2 hour | 76.50 ±27.66 |
| | 4 hour | 139.42 ±27.62 | | 4 hour | 93.33 ±15.28 |
| | 6 hour | 117.75 ±57.20 | | 6 hour | 105.86 ±32.22 |

D mean, damaged tray.

Shoot length and standard deviation values of species of the *Poaceae* family are given in table 5. In shoot length values, *P. pratense* species showed an increase in higher concentration and long incubation time, whereas *D. glomerata* showed a slight decrease. There was no significant change in *A. cristatum*.

Table 5. Shoot length (cm) and standart deviation of species in *Poaceae* family.

| | | *P. pratense* | | *D. glomerata* | | *D. glomerata (c)* | | *A. cristatum* | |
|---|---|---|---|---|---|---|---|---|---|
| Control | | D | | 41.75 | ±0.96 | 37.00 | ±5.35 | D | |
| %0.25 | 2 hour | 22.00 | ±0.12 | 38.67 | ±9.07 | 30.33 | ±7.51 | 43.63 | ±5.97 |
| | 4 hour | 22.20 | ±3.77 | 34.00 | ±1.41 | 37.80 | ±6.34 | 39.25 | ±17.02 |
| | 6 hour | D | | 36.67 | ±1.15 | 45.17 | ±6.55 | 56.00 | ±15.91 |
| %0.50 | 2 hour | D | | 36.80 | ±4.82 | 38.67 | ±7.64 | D | |
| | 4 hour | 38.50 | ±3.54 | 30.00 | ±12.12 | 37.70 | ±9.26 | 51.13 | ±12.60 |
| | 6 hour | D | | D | | D | | 40.09 | ±8.63 |

c mean, collected from campus flora, D mean, damaged tray.

Table 6. Shoot length (cm) and standard deviation of species in *Fabaceae* family.

| | | *L. corniculatus* | | *T. alexandrinum* | | *O. viciifolia* | | *M. sativa* | |
|---|---|---|---|---|---|---|---|---|---|
| Control | | 14.20 | ±6.30 | 41.91 | ±8.23 | 38.67 | ±4.89 | 16.13 | ±3.40 |
| %0.25 | 2 hour | 13.17 | ±5.04 | 43.38 | ±6.78 | 29.00 | ±7.82 | 16.80 | ±5.93 |
| | 4 hour | 19.50 | ±3.94 | 34.80 | ±6.84 | 36.20 | ±4.49 | 18.83 | ±4.34 |
| | 6 hour | 21.57 | ±2.99 | 41.00 | ±8.42 | 24.83 | ±6.34 | 14.57 | ±2.23 |
| %0.50 | 2 hour | D | | 38.20 | ±7.83 | D | | 7.88 | ±2.47 |
| | 4 hour | 22.86 | ±4.60 | 38.67 | ±5.43 | 29.58 | ±3.65 | 22.29 | ±3.40 |
| | 6 hour | D | | 27.46 | ±3.28 | 29.33 | ±6.98 | 14.60 | ±3.51 |

D mean, damaged tray.

Shoot length and standard deviation values for species in *Fabaceae* is given in table 6. As in the root length, colchicine treatments have caused the length of shoots of *L. corniculatus* to increase. In general, at higher concentrations and longer incubation times, shoot length also increased. There was no pronounced change in *T. Alexandrinum* and *O. viciifolia*. However, in *M. sativa*, a very short shoot length was obtained at 0.50% concentration and 2 hours of incubation, while the highest shoot length was determined at 4 hours incubation time of the same concentration.

Table 7. Shoot length (cm) and standard deviation of *P. tanacetifolia* in *Boraginaceae* family.

| *P. tanacetifolia* | | | | | | | |
|---|---|---|---|---|---|---|---|
| Control | | 34.93 | ±4.20 | | | | |
| %0.25 | 2 hour | 36.45 | ±3.96 | %0.50 | 2 hour | 35.14 | ±4.57 |
| | 4 hour | 30.00 | ±1.76 | | 4 hour | 33.67 | ±6.66 |
| | 6 hour | 30.50 | ±3.42 | | 6 hour | 31.57 | ±6.01 |

D mean, damaged tray.

The shoot length values in *P. tanacetifolia* ranged from 30.00 to 36.45 (table 7). In this species, shoot lengths have been observed to decrease with increasing incubation times while not being affected much by different concentration of colchicine. During the shortest incubation period, there was a slight increase compared to the control, but the shoot extension was decreased with the increase of the duration.

**Discussion**

In overall, colchicine concentrations and incubation times have different effects on germination number, root length and shoot length. These effects have also changed by species. Some species, such as *L. corniculatus*, were more affected, but some species were slightly affected (*T. alexandrinum* and *O. viciifolia*). Species in *Poaceae* has generally declined in all properties with concentration and time increase.

As a result, some effects of colchicine applications have not completely prevented germination, root and shoot extension. In some applications, it also has an increasing effect on the properties.

**Literature cited**

Açıkgöz, E., Hatipoğlu, R., Altınok, S., Sancak, C., Tan, A. & Uraz, D. (2005). Yem Bitkileri Üretimi ve Sorunları, Türkiye Ziraat Mühendisliği, VI. Teknik Tarım Kongresi, 3-7 Ocak., 2005, Ankara, S.: 503-518.

Bakır, Ö. 1987. Çayır-Mera Amenajmanı, Ankara Üniv. Zir. Fak. Yayınları, Ankara.

Blakeslee, A.F. & Avery, A.G. (1937). Methods of inducing doubling of chromosomes in plants. Jour Hered. 28: 393-411.

Casler, M.D. (1998). Genetic variation within eight populations of perennial forage grasses. Plant Breed. 117:243–249.

Casler, M.D. (2001). Breeding forage crops for increased nutritional value. Adv. Agron. 71:51–107.

Casler, M.D., Pedersen, J.F., Eizenga, G.C. & Stratton, S.D. (1996). Germplasm and cultivar development. p. 413–469. In L.E. Moser, D. R. Buxton, M. D. Casler, J. M. Bartels, and J. M. Peterson (ed.) Cool-season forage grasses. Agron. Monogr. 34. ASA, CSSA, and SSSA, Madison, WI.

Eigsti, O.J. (1938). A cyto1ogical study of colehicine effeets in the induction of polyploidy in plants. Proc, Nat. Acad. Sci. 24: 56-63.

Elliot, F. C. (1958). Plant Breeding and Cyfogeneitics. Mc Graw Hill Book company lnc. Newyork. s:147-164 Kostoff, D. (1938). Studies on polyploid plants. Current Science 6:549-552.

Humphreys, M.O. (1999). The contribution of conventional plant breeding to forage crop improvement. p. 71–78. In J.G. Buchanan-Smith et al (ed.) Proc. 18th Int. Grassl. Congr., Winnipeg and Saskatoon, Canada. 8–19 June 1997. Assoc Mgmt. Centre, Calgary, AB.

Humphreys, M.O. (2005). Genetic improvement of forage crops: Past, present and future. J. Agric. Sci. 143:441–448.

Ramana, M.S. & Jacobsen, E. (2003), Relevance of sexual polyploidizati on for crop improvement -a review, Euphytica 133:3 - 18.

Reid, R. L., Jung, G. A., Stout W. L. & Ranney, T. S. (1987).Effects of Varying Zinc Concentrations on Quality of Alfalfa for Lambs. Journal of Animal Science. 64:1735-1742

Resende, R. M. S., Casler, M. D. and Vilela de Resende, M. D. (2014). Genomic Selection in Forage Breeding: Accuracy and Methods. Crop Sci. 54:143-156. doi:10.2135/cropsci2013.05.0353

Resende, R. M. S., Casler, M. D. and Vilela de Resende, M. D. (2013). Selection Methods in Forage Breeding: A Quantitative Appraisal. Crop Sci. 53:1925-1936. doi:10.2135/cropsci2013.03.0143

Sim, S., Chang, T., Curley, J., Warnke, S.E., Barker, R.E. & Jung, G. (2005). Chromosomal rearrangements differentiating the ryegrass genome from the Triticeae, oat and rice genomes using common heterologous RFLP probles, Theor Appl Genet 110:1011-1019

# P-26 Frezya (*Freesia sp.*) Kesme Çiçeğinin Yaş Depolama Öncesi ve Sonrası Farklı Konsantrasyonda Sakkaroz İçeren Vazo Solüsyonunda Vazo Ömrünün Araştırılması

**Ö. Dündar*, H. Demircioğlu O. Özkaya**

Çukurova Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü Balcalı, Adana.

*odundar@cu.edu.tr

Özet

Bu çalışmada kesme *Freesia sp.*'nin iki farklı renk (*Freesia alba* ve *Freesia refracta*) çiçeğinde yaş depolama öncesi ve sonrası farklı konsantrasyonda sakkaroz içeren solüsyonlarda vazo ömrü araştırılmıştır. Çiçekler on gün yaş muhafaza için 4±1°C ve %95 oransal nem koşullarında biyosid içeren solüsyon içerisinde ince kağıda sarılarak bekletilmiştir. Yaş depolama öncesi ve sonrası Frezyalar vazo ömrü için 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve kontrol (%0), %1 ve %2 sakkaroz ve biyosid içeren, düşük pH'lı vazo solüsyonu içerisinde bulundurularak iki gün aralıklarla kalite analizleri yapılmıştır. Araştırmada çiçeklerde etilen üretim miktarı, solunum hızı, solüsyon alımı, oransal taze ağırlık, mevcut su içeriği, elektriksel iletkenlik, kandil açılma oranı ve görsel kalite değişimleri incelenmiştir. Deneme sonucunda, belirtilen koşullarda Frezyaların vazo solüsyonu içinde 6 gün boyunca görsel kalite kriterlerini koruduğu, ancak geç derilen çiçeklerin depolama süresinin uzaması ile vazo ömrünün kısaldığı belirlenmiştir.

**Anahtar Kelimeler:** *Freesia refracta*, *Freesia alba,* Depolama, Görsel Kalite, Vazo Ömrü

## Investigation of Wet Storage Before and After the Vase Life in Solutions Containing Different Concentrations of Sucrose in Cut Flower *Freesia sp*

**Abstract**

In this study, wet storage before and after the vase life in solutions containing different concentrations of sucrose in two different colored *Freesia sp* cut flower (*Freesia alba* ve *Freesia refracta*), were investigated. Flowers were kept in contain biocides solution as wrapped inside the thin paper at 4±1°C and 95% relative humidity condition. Freesia flowers were also kept before and after storage for vase life at 20±5°C, 12 hours of natural light, 60% relative humidity and as control (0%), 1% and containing 2% sucrose and biocide low pH treatments in a vase solution and quality analyzes were made at two day intervals. The amount of ethylene production of the flower, respiratory rate, solution uptake, fresh weight proportionate, available water content, electrical conductivity, candle opening rate and visual quality were examined. Trial results of this study showed that visual quality criteria maintained for 6 days in the vase solution of freesias in the circumstances described above, however with the extension of harvest date, the vase life of flowers shortened.

**Keywords:** *Freesia refracta*, *Freesia alba,* Storage, Quality, Vase life

## Giriş

Frezya, son yıllarda Avrupa'da karanfilden sonra en çok üretilen kesme çiçektir Anavatanı Güney Afrika'dır (Zencirkıran 2002). Ülkemizde az tanınmakla beraber son yıllarda üretimi artmış ve 157.289 $m^2$ alanda 17.885.150 adet yetiştirilmektedir (TÜİK 2015). Frezya etilene çok hassastır. 1-metilsiklopropen (1-MCP) veya gümüş tiosülfat (STS) ile ön işlem vazo ömrünü uzatmaktadır (Demircioğlu ve ark. 2013a). Kesme Frezya çiçekleri kısa vazo ömrüne (5 gün) sahiptir. Birçok çiçekte vazo solüsyonuna şeker eklenmesiyle vazo ömrü uzatılabilmektedir. Son araştırmalarda indirgen olmayan disakkarit olan iki glikoz içeren trehaloz ve sakkaroz uygulamasının çiçek ömrünü uzattığı bulunmuştur. Sakkaroz eklenmesi hem yapraklarda hem de petallerde fruktoz, glikoz ve sakkaroz konsantrasyonunu artırmıştır (Ranwala ve Miller 2009). Sakkarozun vazo ömrünü uzatmadaki etkisi su dengesini ve osmotik basıncı düzeltmesiyle gerçekleşmektedir. Devam eden sakkaroz uygulamaları petallerde antosiyanin konsantrasyonunu artırıp kesme çiçeklerin birçoğunda vazo ömrünü uzatmaktadır (Barsen ve ark. 2000). Zencirkıran (2010), Frezya "Cordula" çiçeğinde 1-MCP ve STS çiçekçik ve kandillerinin vazo ömrünü uzatmıştır. En uzun vazo ömrü 1-MCP (4 $nL.L^{-1}$+3 saat) uygulamasında 9.06 gün, kontrol grubunda ise vazo ömrü 6.33 gün olmuştur. Nergis (*Narcissus tazetta subsp. tazetta*) %5 sakkarozlu, düşük pH'lı solüsyon içinde

1°C'de % 95 oransal nem koşullarında 10 gün yaş depolanmıştır. Periyodik olarak yapılan vazo ömrü çalışmaları arasında farlılık gözlenmiştir. Genel olarak nergisler vazoda 6 gün boyunca görsel kalite kriterlerini korumuştur (Demircioğlu ve ark. 2013b). Demircioğlu ve ark. (2013c), nergis (*Narcissus tazetta subsp*.)'in farklı şeker konsantrasyonlarında (%0, 2.5, 5 ve 7.5) düşük pH'lı solüsyon içinde 18±2°C'de, 12 saat doğal ışık, %60 oransal nem koşullarında Nergislerde yapılan analizler sonucunda, vazo solüsyonu içinde 6 gün boyunca görsel kalite kriterlerini koruduğu bulunmuştur. Vazo solüsyonundaki farklı sakkaroz içeriklerinin etkili olduğu gözlenmiştir. First Red güllerinde yapılan araştırmada farklı (Tanık, 100 nL/L, 200 nL/L) 1-MCP doz uygulamalarının ve farklı (kuru-yaş) depolama koşullarının vazo ömrüne etkili olduğu bulunmuştur. Farklı 1-MCP dozları uygulanan güllerin; %1°'lik sakkarozlu, düşük pH'lı vazo solüsyonu içinde, +4°C, %70 oransal nemde 21 gün yaş olarak muhafaza edilebileceği bulunmuştur. (Demircioğlu 2010). Bu çalışmada ticari olarak yetiştirilen iki renk Frezya kesme çiçeğinin yaş depolama öncesi ve sonrası farklı konsantrasyonda sakkaroz içeren vazo solüsyonunda vazo ömrü araştırılmıştır.

## Materyal ve Yöntem

Antalya ilindeki serada yetiştirilen *Freesia alba* ve *Freesia refracta*, derimden hemen sonra, Ç.Ü., Ziraat Fakültesi, Bahçe Bitkileri Bölümü, Derimsonrası Fizyolojisi laboratuvarına getirilmiştir. Laboratuvarda 1 saat su çektirme işlemi yapılmış, sonra çiçekler gruplara ayrılmıştır. Çiçekler vazo ömrü için 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve %0, 1 ve 2 sakkaroz, biyosid içeren düşük pH'lı vazo solüsyonu içerisinde tutulmuştur. Çiçekler 10 gün 4±1°C ve %95 oransal nem koşullarında biyosid içeren solüsyon içinde ve ince kâğıda sarılarak muhafaza edilmiştir. Depolama öncesi ve sonrası vazo ömründe frezyada solüsyon alımı (mL gün$^{-1}$ g$^{-1}$ taze ağırlık) ve oransal taze ağırlık (%) 2 günde bir yapılmıştır. Vazo ömründe mevcut su içeriği, solunum hızı (ml $CO_2$/kg.s, PBI Dansensor CheckPoint $O_2$/$CO_2$ cihazı), çiçekte etilen üretim miktarı (µl.kg$^{-1}$s$^{-1}$, Bioconservacion Ethylene), elektriksel iletkenlik (µS, EC 300 EcoSense®) ölçümleri vazo ömründe 0., 3. ve 6. günlerde yapılmıştır. Görsel kalite değerlendirmesi depolama ve vazo ömrü süresince yapılmıştır. Vazo ömrü depolama öncesi (DÖ), 5 ve 10 gün depolama sonrası (GDS) yapılmıştır. İstatistiksel analizler; denemede 3 tekerrür ve her tekerrürde 5›er çiçekli gruplar kullanılmıştır. Veriler JMP'de analiz edilerek, LSD α=0,05 önem seviyesine göre gruplandırılmıştır.

## Bulgular ve Tartışma

*Freesia alba*'nın DÖ vazo ömründe %1 sakkaroz uygulaması diğerlerine göre yüksek değerde kalmıştır. İstatistiksel olarak uygulama ve süre önemli bulunmuştur. 5 GDS vazo ömründe uygulama, süre ve uygulama*süre istatistiksel olarak önemli bulunmuştur. 10 GDS vazo ömründe Kontrol grubu en yüksek değer almıştır. İstatistiksel olarak süre önemli bulunmuştur. *Freesia refracta*'nın DÖ vazo ömründe etilen üretim miktarında %1 sakkaroz uygulaması diğerlerine göre yüksek değerde kalmıştır. İstatistiksel olarak uygulama ve süre önemli bulunmuştur. 5 GDS vazo ömründe etilen üretim miktarı istatistiksel olarak süre önemli bulunmuştur. 10 GDS vazo ömründe etilen üretim miktarı ise istatistiksel olarak süre önemli bulunmuştur (veriler verilmemiştir).

Solunum hızı *Freesia alba*'nın DÖ vazo ömründe azalmış ve sakkaroz uygulamaları kontrole göre yüksek değerde kalmıştır. İstatistiksel olarak süre önemli bulunmuştur. 10 ve 5 GDS vazo ömründe solunum hızı uygulama ve süre istatistiksel olarak önemli bulunmuştur. *Freesia refracta*'nın DÖ vazo ömründe solunum hızı azalmış ve sakkaroz uygulamaları kontrole göre yüksek değerde kalmıştır. İstatistiksel olarak süre önemli bulunmuştur. 10 ve 5 GDS vazo ömründe uygulama süre ve uygulama*süre istatistiksel olarak önemli bulunmuştur. Demircioğlu'nun (2010) yaptığı çalışmada depolama öncesi ve sonrası vazo ömründe solunum hızındaki değişimler benzerlik göstermektedir (veriler verilmemiştir).

*Freesia alba*'nın DÖ vazo ömründe solüsyon alımı azalmıştır. DÖ ve 5 GDS vazo ömründe süre istatistiksel olarak önemli bulunmuştur. 10 GDS vazo ömründe ise istatistiksel olarak uygulama, süre ve uygulama*süre önemli bulunmuştur. Vazo ömrü çalışmaları karşılaştırıldığında solüsyon alımı en yüksek değer 10 GDS vazo ömründe olmuştur. Solüsyon alımı *Freesia refracta*'nın DÖ vazo ömründe azalmış ve istatistiksel olarak uygulama ve süre önemli bulunmuştur. 5 GDS vazo ömründe süre istatistiksel olarak önemli bulunmuştur. DÖ ve 5 GDS vazo ömründe sakkaroz uygulamaları kontrole göre yüksek değer almıştır. 10 GDS vazo ömründe ise solüsyon alımı azalan değer almış ve istatistiksel olarak süre önemli bulunmuştur. Vazo ömrü çalışmaları karşılaştırıldığında vazo suyu alımı en yüksek değer 10 GDS vazo ömründe olmuştur. Demircioğlu ve ark.'nın (2013 b, c) yaptığı çalışmalarda depolama öncesi ve sonrası vazo ömründe solüsyon alımındaki değişimler benzerlik göstermektedir (Çizelge 1).

Oransal taze ağırlık değeri *Freesia alba*'da DÖ vazo ömründe azalan değer almış ve istatistiksel olarak zaman önemli bulunmuş. 5 GDS vazo ömründe oransal taze ağırlık istatistiksel olarak uygulama, zaman ve uygulama*süre önemli bulunmuştur. 10 GDS vazo ömründe ise 4. ve 6. günde, 2. güne göre artan değer almıştır. Depolama öncesi ve sonrası tüm

vazo ömründe oransal taze ağırlık sakkaroz uygulamaları kontrole göre yüksek değer almıştır. *Freesia refracta*'nın DÖ vazo ömründe oransal taze ağırlık değeri kontrol grubunda azalan değer alırken sakkaroz uygulamaları 4. günde artan ve 6. günde azalan değer almış ve istatistiksel olarak süre ve uygulama*süre önemli bulunmuştur. 5 GDS vazo ömründe oransal taze ağırlık 4. ve 6. gün, 2. güne göre azalan değer almış ve istatistiksel olarak süre önemli bulunmuştur. 10 GDS oransal taze ağırlık 6. günde, 2. güne göre artan değer almıştır ve istatistiksel olarak hepsi önemli bulunmuştur. Oransal taze ağırlık DÖ vazoda kontrol grubu diğer uygulamalara göre yüksek değer alırken, depolama sonrası vazo ömürlerinde sakkaroz uygulamaları kontrole göre yüksek değer almıştır. Demircioğlu ve ark.'nın (2013 b, c) nergisde vazoda oransal taze ağırlık değişim sonuçları arasında benzerlik bulunmuştur (Çizelge 1).

*Freesia alba*'da mevcut su içeriği DÖ ve 5 GDS vazo ömründe kontrol grubunda sakkaroz uygulamalarından yüksek bulunmuştur. DÖ vazoda istatistiksel olarak uygulama, süre ve uygulama*süre önemli bulunmuştur. 5 GDS vazo ömründe istatistiksel olarak uygulama ve süre önemli bulunmuştur. 10 GDS vazo ömrü istatistiksel olarak süre önemli bulunmuştur ve %2 sakkaroz uygulaması diğerlerinden yüksek değer almıştır. *Freesia refracta*'da mevcut su içeriği DÖ Kontrol grubu diğer uygulamalardan yüksek değer almıştır. 5 GDS vazo ömründe %1 sakkaroz uygulaması diğer uygulamalardan yüksek değer almıştır. DÖ ve 5 GDS vazo ömrü istatistiksel olarak uygulama ve zaman önemli bulunmuştur. 10 GDS vazo ömründe istatistiksel olarak süre önemli bulunmuştur. %1 sakkaroz uygulaması diğerlerinden yüksek değer almıştır. Demircioğlu ve ark (2013 b, c) nergiste oransal su içeriğinde elde ettiği sonuçlarla benzerlik göstermiştir (veriler verilmemiştir).

Elektriksel iletkenlik *Freesia alba*'da DÖ %2 sakkaroz uygulaması diğer uygulamalardan yüksek değerde kalmıştır. DÖ ve 5 GDS vazo ömründe istatistiksel olarak süre ve 10 GDS vazo ömründe süre ve uygulama önemli bulunmuştur. *Freesia refracta*'da elektriksel iletkenlik DÖ Kontrol grubu her iki sakkaroz uygulamalarından yüksek değerde kalmış ve istatistiksel olarak süre önemli bulunmuştur. 5 GDS vazo ömründe elektriksel iletkenlik %1 sakkaroz uygulaması diğer uygulamalardan yüksek değerde kalmış ve istatistiksel olarak uygulama ve süre önemli bulunmuştur. 10 GDS vazo ömründe elektriksel iletkenlik ise istatistiksel olarak uygulama, süre ve uygulama*süre önemli bulunmuştur. Gul ve Tahir'in (2012) ve Demircioğlu ve ark (2013 b,c) elde ettiği sonuçlarla benzerlik göstermiştir (veriler verilmemiştir).

Çizelge 1. *Freesia alba* ve *Freesia refracta*'da vazo ömründe solusyon alımı **(**ml gün$^{-1}$ g$^{-1}$ taze ağırlık**, A)** ve oransal taze ağırlık (%, **B**) değişimleri

| | | DÖ Vazo Ömrü | | | | 5 GDS Vazo Ömrü | | | | 10 GDS Vazo Ömrü | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Vazo Süresi (Gün ) | | | Ort. | Vazo Süresi (Gün ) | | | Ort. | Vazo Süresi (Gün ) | | | Ort. |
| | Uygulama | 2 | 4 | 6 | | 2 | 4 | 6 | | 2 | 4 | 6 | |
| *Freesia alba A* | Kontrol | 0,2 | 0,16 | 0,08 | 0,15 | 0,21 | 0,11 | 0,2 | 0,17 | 0,31 a | 0,37 a | 0,21 c | 0,30 a |
| | %1 Sakkaroz | 0,32 | 0,17 | 0,12 | 0,2 | 0,15 | 0,07 | 0,18 | 0,13 | 0,30 ab | 0,22 bc | 0,13 d | 0,21 b |
| | %2 Sakkaroz | 0,25 | 0,19 | 0,07 | 0,17 | 0,16 | 0,14 | 0,21 | 0,17 | 0,19 cd | 0,34 a | 0,20 cd | 0,25 b |
| | Ort. | 0,26 a | 0,17 b | 0,09 c | | 0,17 a | 0,11 b | 0,20 a | | 0,27 a | 0,31 a | 0,18 b | |
| | LSD | *Ö.D. **0,06 ***Ö.D. | | | | *Ö.D. **0,04 ***Ö.D. | | | | *0,06. **0,06 ***0,08 | | | |
| *Freesia refracta A* | Kontrol | 0,14 | 0,13 | 0,06 | 0,11 b | 0,13 | 0,12 | 0,21 | 0,15 | 0,26 | 0,24 | 0,22 | 0,24 |
| | %1 Sakkaroz | 0,25 | 0,15 | 0,1 | 0,17 a | 0,15 | 0,14 | 0,21 | 0,16 | 0,26 | 0,23 | 0,18 | 0,22 |
| | %2 Sakkaroz | 0,22 | 0,18 | 0,11 | 0,17 a | 0,17 | 0,11 | 0,23 | 0,17 | 0,27 | 0,21 | 0,16 | 0,21 |
| | Ortalama | 0,21 a | 0,15 b | 0,09 c | | 0,15 b | 0,12 c | 0,22 a | | 0,26 a | 0,23 a | 0,19 b | |
| | LSD | *0,04 **0,04 ***Ö.D. | | | | *Ö.D. **0,06 ***Ö.D. | | | | *Ö.D. **0,03 ***Ö.D. | | | |
| *Freesia alba B* | Kontrol | 102,29 | 79,81 | 84,11 | 88,74 | 91,32 ab | 82,35 f | 81,96 f | 85,21 c | 81,4 | 85,8 | 89,59 | 85,59 b |
| | %1 Sakkaroz | 101,64 | 82,52 | 87,05 | 90,4 | 92,86 a | 87,97 cd | 86,67 de | 89,17 a | 84,51 | 89,05 | 91,06 | 88,21 a |
| | %2 Sakkaroz | 100,11 | 82,44 | 87,93 | 90,16 | 89,76 bc | 86,12 de | 85,85 e | 87,24 b | 83,35 | 87,38 | 90,49 | 87,07 ab |
| | Ortalama | 101,35 a | 81,59 c | 86,36 b | | 91,31 a | 85,48 b | 84,83 b | | 83,09 c | 87,41 b | 90,38 a | |
| | LSD | *Ö.D. **4,58***Ö.D. | | | | *1,48 **1,48 ***2,09 | | | | *2,43 **2,43 ***Ö.D. | | | |
| *Freesia refracta B* | Kontrol | 99,09 a | 91,03 bcd | 85,95 e | 92,02 | 87,09 | 80,29 | 88,4 | 85,26 | 88,19 d | 89,50 cd | 92,39 a | 90,03 b |
| | %1 Sakkaroz | 91,86 bcd | 94,77 ab | 89,13 de | 91,92 | 86,3 | 83,32 | 90,44 | 86,69 | 90,66 bc | 90,63 bc | 91,70 ab | 91,00 a |
| | %2 Sakkaroz | 88,82 de | 94,10 bc | 89,91 cde | 90,94 | 88,24 | 82,36 | 88 | 86,2 | 90,46 bc | 91,28 ab | 92,36 a | 91,36 a |
| | Ortalama | 93,26 a | 93,30 a | 88,33 b | | 87,21 a | 81,99 b | 88,95 a | | 89,77 b | 90,47 b | 92,15 a | |
| | LSD | *Ö.D. **3,40 ***4,80 | | | | *Ö.D. **4,22 ***Ö.D. | | | | *1,02 **1,02 ***1,44 | | | |

Depolama süresince ve vazo ömrünce görsel kalite değerlendirilmiştir. Tüm vazo ömründe görsel kalite zamanla azalan değer göstermiştir ve görsel kalite değişimi benzer sonuçlar vermiştir (veriler verilmemiştir). Deneme süresince tüm uygulamalarda çiçek sap rengi yeşil kalmıştır.

## Sonuç

Tüm bu değerlendirmelerin sonucunda, Frezyaların 4±1°C ve %95 oransal nem koşullarında biyosid içeren solüsyon içerisinde 10 gün yaş muhafaza edilebileceği belirlenmiştir. Vazo solüsyonu içinde 6 gün boyunca görsel kalite kriterlerini koruduğu, ancak geç derilen çiçeklerin depolama süresinin uzaması ile vazo ömrünün kısaldığı belirlenmiştir. %1'lik sakkarozun olumlu etkisi olduğu gözlenmiştir.

**Kaynaklar**


Barsen M., Bogan V., Gagnier J., Hageman J., Mannino P., Tuinstra M., Voight S. (2000). Cut Flower Senescence. BIO 391—Plant Physiology Course Project. www.scirus.com. 15.04.2016.

Demircioğlu H, Dündar Ö., Özkaya O. (2013 a). Bazı Kesme Çiçeklerin Derim Sonrası Fizyolojisi. V. Süs bitkileri Kongresi, 6-9 Mayıs 2013 Yalova Cilt II 581-585.

Demircioğlu H., Dündar Ö., Özkaya O., Valizadeh A. (2013 b). Adana'da Doğal Yetişen Nergis (*Narcissus tazetta subsp.*)'in Vazo Ömrü Koşullarının Araştırılması. İç Anadolu Bölgesi 1. Tarım ve Gıda Kongresi, Niğde, Bildiriler Cilt-1 Bitkisel Üretim, 464-471.

Demircioğlu H., Dündar Ö., Özkaya O. (2013 c). Tuzla'da Doğal Yetişen Nergis (*Narcissus tazetta subsp.*)'in Depolama ve Vazo Ömrünün Araştırılması. V. Süs bitkileri Kongresi, 6-9 Mayıs 2013 Yalova. Cilt II 573-580.

Demircioğlu H. (2010). Kesme Gülde (*Rosa hybrida* First Red) Farklı 1-MCP Dozu Uygulamalarının ve Farklı Depolama Koşullarının Vazo Ömrü Üzerine Etkileri. Yüksek Lisans Tezi. Çukurova Üniversitesi Fen Bilimleri Enstitüsü, Adana.

Gul F., Tahir I. (2012) .An efective protocol for improving vaselife and postharvest performance of cut Narcissus tazetta flowers. Journal of the Saudi Society of Agricultural Sciences.www.ksu.edu.sa. 15.04.2016

Ranwala A.P., Miller W.B. (2009). Comparison of the dynamics of non-structural carbohydrate pools in cut tulip stems supplied with sucrose or trehalose, Postharvest Biology and Technology 52, 91–96.

TÜİK, (2016). Gıda, Tarım ve Hayvancılık Bakanlığı 15.04.2016.

Zencirkiran M. (2002). Cold Storage of Freesia refracta "Cordula". New Zealand J.Crop Hort. Sci., 30: 171-174.

Zencirkiran M. (2010). Effects of 1–MCP (1–methylcyclopropene) and STS (silver thiosulphate) on the vase life of cut Freesia flowers. Scientific Research and Essays Vol. 5(17), pp. 2409-2412.

# P-32 Determination of Suitable Extraction Method for the Available Iron (Fe) Content of Calcareous Soils

Mehmet Rüştü Karaman[1], Aydın Adiloğlu[2], Ayhan Horuz[3]
M.Şefik Tüfenkçi[4], Metin Turan[5], Sevinç Adiloğlu[2]

[1]*Afyon Kocatepe University, Department of Medical and Aromatic Plants, Afyon, Turkey*
*e-mail: rkaraman2000@hotmail.com*
[2]*Namık Kemal University, Soil Science and Plant Nutrition Department, Tekirdağ, Turkey*
[3]*Ondokuz Mayıs Univ., Faculty of Agriculture, Dept. of Soil Sci. and Plant Nutrition, Samsun, Turkey*
[4]*Yüzüncü Yıl University, Agricultural Faculty, Dept. of Bioengineering, Van, Turkey*
[5]*Yeditepe Univ., Faculty of Engineering, Department of Genetics and Bioengineering, Istanbul, Turkey*

**Abstract:** The aim of this research was to determine the most suitable extraction method for the available iron contents of calcareous soils in Trakya Region, Turkey. For this purpose ten calcareous soil samples were taken from research area and five extraction methods (0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA, 0.05 M HCl + 0.012 M $H_2SO_4$, 1 M $NH_4OAc$, 0.005 M DTPA + 1 M $NH_4HCO_3$ and 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA methods) were used and three biological indices (dry matter yield, Fe concentration, Fe uptake) were compared. The plant biological indices were determined with wheat (*Triticum aestivum* L.) plant grown under greenhouse conditions. At the end of the experiment and according the experiment results, the highest correlation coefficients (r) were determined to be between the 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA, 0.005 M DTPA + 1 M $NH_4HCO_3$ methods and the biological indices. The correlation coefficients (r) for the 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA method and the three biological indices were 0.648**, 0.780** and 0.656** respectively. For the 0.005 M DTPA + 1 M $NH_4HCO_3$ method, these coefficients were determined 0.595**, 0.637** and 0.625**, respectively. Consequently, these extraction methods were suggested for the determination of the available Fe contents of the calcareous soils in Trakya Region, Turkey.

*Key words:* Iron, wheat, DTPA, extraction method, calcareous soil.

## 1. Introduction

Although required in very small amounts iron (Fe) is an essential nutrient and plays a major role in plant growth and development. The trend to more intensive crop production with higher yields and heavier use of nitrogen (N), phosphorus (P) and potassium (K) fertilizers increases the need for Fe and other trace elements in agriculture. Soil analyses are helpful in for determining whether a soil can supply adequate amounts of Fe for optimal growth (Karaman, 1999; Adiloğlu, 2006).

Fe deficiency is one of the most common trace element problems in the world nowadays. Iron deficiency is seen frequently in high pH, high lime, and insufficient organic matter content and sandy soils (Lindsay and Schwab, 1982; Karaman et al., 2012). Available Fe is inadequate in about 26.87 % of Turkey's soils and 10.4 % Trakya region soils (Eyüpoğlu et al., 1998; Adiloğlu, 2012). Despite the fact that several Fe extraction methods have been developed none of them was suitable to be a standard method (Loeppert and Iskeep, (1996). Lindsay and Norvell (1978) suggested DTPA (pH: 7.3) method for the determination of available Fe content with regards to neutral and alkaline soils.

The 0.001 M EDDHA method was suggested for the determination of available Fe content in the USA. Because, the highest correlation coefficient was determined between this method and biological indices (Johnson and Young, 1973). Adiloğlu (2006) has used eight extraction methods for the determination of available iron contents in Brown Forest Soils in Turkey. 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA and 0.005 M DTPA + 1 M $NH_4HCO_3$ methods were recommended by Adiloğlu for the determination of available iron contents in Brown Forest Soils in Turkey. A research was carried out as a suitable method of the determination of available iron content of North Greece Soils. DTPA, Mehlich 3, Soltanpour and Schwab methods were suggested for North Greece Soils (Chatzistathis, 2014). Krzysztof et al. (2015) have used six chemical extraction methods for the determination of available iron contents in Polish Soils. Researchers have determined the highest statistical relationships with Mehlich 3 and Yanai (0.2 M $CH_3COOH$ + 0.25 M $NH_4Cl$ + 0.005 M $C_8H_8O_7$ + 0.05 M HCl) methods. Consequently, these methods were recommended for Polish Soils by these researchers.

A research was carried out in order to find out the available iron contents and determine the most suitable extraction method of available iron contents of Oxsisols and Ultisols in Brazil. The highest correlation coefficient was determined with 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA and Mehlich 3 methods. Therefore, these methods were recommended by Sobral et al. (2013), as the most suitable methods for determination of available iron contents of Oxsisols and Ultisols

in Brazil. In this research, the most suitable method for the determination of available iron content in calcareous soils was investigated.

## 2. Materials and Methods

Soil samples were taken at 0- 20 cm depth from 10 different cultivated calcareous soils in Trakya Region (Jackson, 1967). Soil pH (Thomas, 1996), lime (Loeppert and Suarez, (1996), organic matter amount (Nelson and Sommers, 1996) and texture (Gee and Bauder, 1986) were determined for each soil sample. Some physical and chemical properties of the soil samples are given in Table 1. According to Table 1, pH values of soil samples ranged from 7.43 to 8.02, $CaCO_3$ contents were between 5.69 % and 17.23 %, organic matter amounts were between 0.23 % and 1.02 %, texture of soils samples were clay (C), generally.

Table 1. Some physical and chemical properties of the soil samples

| Soil No | pH (1: 2.5) | $CaCO_3$, % | Org. Mat. % | Clay, % | Silt, % | Sand, % | Tekstür Class |
|---|---|---|---|---|---|---|---|
| 1 | 7.66 | 12.20 | 0.52 | 38.42 | 27.66 | 33.92 | CL |
| 2 | 7.97 | 8.58 | 0.76 | 35.23 | 25.61 | 39.16 | CL |
| 3 | 7.85 | 5.69 | 0.23 | 40.42 | 15.78 | 40.80 | C |
| 4 | 8.02 | 13.27 | 0.78 | 42.45 | 30.07 | 27.08 | C |
| 5 | 7.62 | 17.23 | 0.67 | 38.85 | 12.10 | 49.05 | SC |
| 6 | 7.98 | 16.52 | 0.98 | 41.08 | 33.10 | 25.82 | C |
| 7 | 7.80 | 7.98 | 0.76 | 38.33 | 18.85 | 42.82 | SC |
| 8 | 7.65 | 9.52 | 0.53 | 44.32 | 28.05 | 27.63 | C |
| 9 | 7.52 | 6.67 | 1.02 | 43.28 | 24.30 | 32.42 | C |
| 10 | 7.43 | 7.86 | 0.87 | 47.60 | 21.72 | 35.68 | C |
| Min. | 7.43 | 5.69 | 0.23 | | | | |
| Max. | 8.02 | 17.23 | 1.02 | | | | |

The available Fe contents of the soil samples were determined through five different chemical extraction methods. These methods are 0.005 M DTPA + 0.01M $CaCl_2$ + 0.1 M TEA [6], 0.05 M HCl + 0.012 M $H_2SO_4$ [(Wear and Evans, 1968), 1 M $NH_4OAc$ [17], 0.005 M DTPA + 1 M $NH_4OAc$ (Olson, 1948) and 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA (Mehlich, 1984). Some properties of these extraction methods are given in Table 2.

A greenhouse experiment was designed in a randomized complete block replicated three times. Air dried 2.5 kg soil was filled into plastic pots. Wheat (*Triticum aestvium* L.) was used as a test plant because it is sensitive to Fe deficiency (Martens and Westermann, 1991). Each pot was fertilized with 150 mg $kg^{-1}$ N ($NH_4NO_3$) and 100 mg $kg^{-1}$ $P_2O_5$ ($KH_2PO_4$), according to average application rates of N and $P_2O_5$ to wheat in this region. Three different rates of Fe ($Fe_0$:0; $Fe_1$:15; and $Fe_2$:30 mg $kg^{-1}$) were applied to soils as $FeSO_4$ compound. Twenty plants were left in each pot after the germination. The water content of the pots was adjusted to 80 % of field capacity during the experiment period. Wheat shoots were harvested after 60 days. Harvested shoots were washed once tap water and twice distilled water and dried at 65 $^0$C. Dry matter yields were determined (Kacar, 2010).

Table 2. Chemical extraction methods were used for the determination of available Fe contents of the soil samples.

| Chemical extraction methods | Soil-solution ratio | Shaking time | References |
|---|---|---|---|
| 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA | 1: 2 | 120 min. | (Lindsay-Norwell, 1978) |
| 0.05 M HCl + 0.012 M $H_2SO_4$ | 1: 4 | 15 min. | Wear and Evans, 1968) |
| 1 M $NH_4OAc$ | 1: 4 | 30 min. | (Olon, 1948) |
| 0.005 M DTPA + 1 M $NH_4HCO_3$ | 1: 2 | 15 min. | (Soltanpur, 1991) |
| 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA | 1: 10 | 5 min. | (Mehlich, 1984) |

Dried and ground plant materials were digested using $HNO_3$ + $HClO_4$ and Fe content of plants were determined with ICP-OES (Kacar, 2010). Dry matter yield, Fe concentration and Fe uptake biological indices were used as biological method. Correlation coefficients (r) were measured between available Fe content of the soils according to five different methods and biological indices (dry matter yield, Fe content and Fe uptake) of wheat plants. Significance of the correlation coefficients (r) was checked at the 1 and 5 % levels (Düzgüneş et al., 1987).

## 3. Results and Discussion

### *3.1. The Effects of Increasing Iron Application Rates on Dry Matter Yield, Iron Content and Iron Uptake of Wheat Plant*

Dry matter yield of the wheat plants was affected by the Fe application. The highest dry matter yield was obtained from the $Fe_3$ (30 mg $kg^{-1}$). On the other hand, Fe content and Fe uptake of the plants increased with increasing Fe application (Table 3).

The reason of this result may be positive effect of iron application to high pH value and high lime contents of the soil samples. According to Table 3, dry matter yield of plants were determined between 2.22 and 3.18 mg $kg^{-1}$, Fe content of plants were determined between 92 and 147 mg $kg^{-1}$, and uptake of iron were determined between 226 ile 433 µg $pot^{-1}$. The effect of Fe application on the biological indices of the wheat plants was determined to be significant at 1 % level and the results obtained are in agreement with earlier reports (Başar and Özgümüş, 1999).

Table 3. The effect of iron application on biological indices of wheat plant*, **

| Soil No | Dry matter yield, g $pot^{-1}$ | | | Fe content of plant, mg $kg^{-1}$ | | | Uptake of Fe by shoots, µg $pot^{-1}$ | | |
|---|---|---|---|---|---|---|---|---|---|
| | $Fe_0$ | $Fe_1$ | $Fe_2$ | $Fe_0$ | $Fe_1$ | $Fe_2$ | $Fe_0$ | $Fe_1$ | $Fe_2$ |
| 1 | 2.46 a | 2.78 b | 2.96 c | 92 a | 112 b | 123 c | 226 a | 311 b | 364 c |
| 2 | 2.38 a | 2.63 b | 2.87 c | 102 a | 115 b | 126 c | 243 a | 302 b | 362 c |
| 3 | 2.22 a | 2.46 b | 2.69 c | 110 a | 121 b | 138 c | 244 a | 298 b | 371 c |
| 4 | 2.35 a | 2.70 b | 2.93 c | 98 a | 110 b | 120 c | 230 a | 297 b | 351 c |
| 5 | 2.53 a | 2.86 b | 3.12 c | 112 a | 127 b | 138 c | 283 a | 363 b | 431 c |
| 6 | 2.46 a | 2.85 b | 3.14 c | 102 a | 118 b | 132 c | 251 a | 336 b | 415 c |
| 7 | 2.52 a | 2.83 b | 3.18 c | 108 a | 128 b | 136 c | 272 a | 362 b | 433 c |
| 8 | 2.51 a | 2.74 b | 3.05 c | 102 a | 128 b | 137 c | 256 a | 351 b | 418 c |
| 9 | 2.42 a | 2.65 b | 2.89 c | 110 a | 135 b | 147 c | 266 a | 358 b | 425 c |
| 10 | 2.45 a | 2.78 b | 3.02 c | 110 a | 130 b | 146 c | 270 a | 361 b | 393 c |

*: values of three replication average, **: each biological indices was evaluated individually.

*3.2. The Available Iron Contents of Soils According to Different Extraction Methods*

Five extraction methods were used for the determination of available Fe content of the soil samples (Table 4). Available Fe varied widely depending on the extraction method used, reasons for which could be pointed out as the type, concentration, pH, shaking time, soil solution ratio of the extraction solution and variability observed in the physical and chemical properties of the soils used. As shown in Table 4, the highest available Fe content of soil samples were determined with 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA; 0.005 M DTPA + 1 M $NH_4HCO_3$ method in comparison to other extraction methods. On the other hand, the lowest available Fe content of soil samples were determined with 1 M $NH_4OAc$ and 0.05 M HCl + 0.012 M $H_2SO_4$ methods. These results also show that higher available Fe was determined using methods with chelate + salt (0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA) method in comparison to the methods using salt (1 M $NH_4OAc$ method) and acid (0.05 M HCl + 0.012 M $H_2SO_4$ method).

Table 4. Iron content in soils determined by different chemical extraction methods

| Chemical extraction methods | Available Fe content, mg $kg^{-1}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA | 4.78 | 5.52 | 3.24 | 7.86 | 4.45 | 6.53 | 2.12 | 5.07 | 3.19 | 6.32 |
| 0.05 M HCl + 0.012 M $H_2SO_4$ | 2.30 | 2.24 | 1.15 | 3.47 | 1.08 | 4.74 | 1.16 | 2.61 | 1.87 | 2.42 |
| 1 M $NH_4OAc$ | 2.12 | 1.89 | 1.02 | 3.41 | 2.16 | 2.87 | 0.56 | 3.21 | 1.16 | 2.45 |
| 0.005 M DTPA + 1 M $NH_4HCO_3$ | 4.42 | 4.89 | 2.76 | 5.41 | 3.20 | 4.98 | 1.46 | 4.24 | 2.62 | 5.27 |
| 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA | 3.46 | 2.96 | 4.21 | 6.85 | 4.27 | 4.87 | 1.02 | 3.64 | 3.04 | 5.12 |

The acid and salt methods of HCl + $H_2SO_4$, $MgCl_2$ and $NH_4OAc$, which gave lowest available Fe, are not recommended for the determination of Fe content in neutral and alkaline soils. The use of chelate and chelate + salt methods are suggested in these types of soils.

*3.3. The Relationships between Chemical Extraction Methods and Biological Indices*

The correlation coefficients (r) determined between chemical extraction methods and biological indices are given in Table 5. Significant correlation coefficients were observed between all chemical extraction methods, except 1 M $NH_4OAc$ method and the biological indices (dry matter yield, Fe content and Fe uptake) at 1 % and 5 % levels (Table 5). According to Table 5, the highest correlation coefficients (r) were determined between 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA and 0.005 M DTPA + 1M $NH_4HCO_3$ methods and biological indices. These correlation coefficients (r) determined were 0.648**, 0.780** and 0.656** for 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 TEA method and 0.595**, 0.637** and 0.625**, for 0.005 M DTPA + 1M $NH_4HCO_3$ method, respectively. The lowest correlation coefficient (r) was determined with 1 M $NH_4OAc$ method. These correlation coefficient were 0.310, 0.296 and 0.340* with biological indices, respectively.

According to the results the order of significance for the extraction methods are as follows: 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA > 0.005 M DTPA + 1 M $NH_4HCO_3$ > 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA >0.05 M HCl + 0.012 M $H_2SO_4$ > 1 M $NH_4OAc$.

Table 5. The correlation coefficients (r) for chemical extraction methods and biological indices

| Chemical extraction methods | Non application of Fe in pots ($Fe_0$) | | |
|---|---|---|---|
| | Dry matter yield | Fe concentration of plant | Uptake of Fe amount from soil |
| 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA | 0.648** | 0.780** | 0.656** |
| 0.05 M HCl + 0.012 M $H_2SO_4$ | 0.378* | 0.421* | 0.385* |
| 1 M $NH_4OAc$ | 0.310 | 0.296 | 0.340* |
| 0.005 M DTPA + 1 M $NH_4HCO_3$ | 0.595** | 0.637** | 0.625** |
| 0.2 M $CH_3COOH$ + 0.25 M $NH_4NO_3$ + 0.013 M $HNO_3$ + 0.015 M $NH_4F$ + 0.001 M EDTA | 0.578** | 0.460** | 0.526** |

*: P< 0.05 **: P < 0.01

**Conclusion**

According to the this research results, 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA and 0.005 M DTPA + 1 M $NH_4HCO_3$ methods, among the others, can be used confidently to determine the available Fe content of the calcareous soils of Trakya region because the highest correlation coefficients (r) were determined when these methods were used These methods were also suggested for various regional soils (Haddad and Evans, 1993). Consequently all of the following methods i.e. 0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA and 0.005 M DTPA + 1 M $NH_4HCO_3$ can be recommended in the determination of available Fe content of Trakya region calcareous soils because of the highest correlation coefficients (r) determined. On the other hand, these methods are suitable to certain physical and chemical properties of calcareous soils in this region. Results obtained can be applied to calcareous soils for determine of available Fe content.

**References**


Adiloğlu, A. (2006). Determination of suitable chemical extraction methods for the available iron content of Brown Forest Soils in Turkey. Eurasian Soil Science, 39: 961- 967.

Adiloğlu, A. (2012). Türkiye tarımı ve geleceği paneli, NKÜ Ziraat Fakültesi'nin 30. Kuruluş Yılı Etkinlikleri, 15 Mayıs, Tekirdağ.

Aydemir, O. (1981). Comparison of various chemical extraction methods in predicting plant available soil iron. Turk. J. of Agr. and Forestry, 5: 213– 220.

Başar, H. and Özgümüş, A. (1999). Effects of various ıron fertilizers and rates on some micronutrients contents of peach trees. Turk. J. Agric. Forest., 23 (3): 273– 281.

Chatzistathis, T., Alifragis, D., Therios, I. and Dimassi, K. (2014). Comparison of three micronutrient soil test extractants in three Greece soil types. Commun. in Soil Science and Plant Analysis, 45: 381- 391.

Düzgüneş, O., Kesici, T., Kavuncu, O. and Gürbüz, F. (1987). Araştırma ve deneme metodları (İstatistik metodları II). Ankara Üniversitesi, Ziraat Fak. Yay. No: 1021.

Eyüpoğlu, F., Kurucu, N. and Talaz, S. (1998). Türkiye topraklarının bitkilere yarayışlı mikro element (Fe, Cu, Zn, Mn) durumu. Toprak, Gübre Araştırma Enst. Yayınları No: 72.

Gee, G.W. and Bauder, J.W. (1986). Particle size analysis. In Methods of soil analysis, Part 1. Physical and mineralogical methods, Agronomy Monograph, No. 9, pp. 383– 411.

Jackson, M.L. (1967). Soil chemical analysis handbook. Micro-Macro Publishing, Inc, USA.

Johnson, G.V.P. and Young, R.A. (1973). Evaluation of EDDHA as an extraction and analytical reagent for assessing the iron status of soils. Soil Sci. 115: 11–17.

Haddad, K.S. and Evans, J.C. (1993). Assessment of chemical methods for extracting zinc, manganese, copper, and iron from New South Wales Soils. Commun. Soil Sci. Plant Anal., 24: 29– 44.

Karaman, M.R. (1999). Investigation of chlorosis in peach trees growing in the Tokat Region using soil and plant analysis and the effect of soil moisture on determination of the amounts of DTPA-extractable Fe, Cu, Zn and Mn. Tr. J. of Agriculture and Forestry, 3: 707-719.

Karaman, M.R., İşeri, İ., Er, F. and Susam, T. (2012). Predicting iron and zinc content of soils in an apple orchard using artificial neural network. Scientific Research and Essays, 7(36): 3172-3178.

Kacar, B. (2010). Toprak ve Bitki Analizleri. I. Bitki analizleri. Nobel Yayın No: 1241.

Krzysztof, G., Zofia, S., Urszula, P. and Krzysztof, B. (2015). Suitability of different extractants for determination of available Cu and Mn Contents in Polish soils. Communication in Soil Science and Plant Analysis, 46 (S1): 81- 93.

Lindsay, W.L. and Norvell, W.A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper, Soil Sci.

Am. J., 42: 421–428.
Lindsay, W.L. and Schwab, A.P. (1982). The Chemistry of iron in soils and its availability to plants. J. Plant Nutr., 5: 821–840.
Loeppert, R.H. and Iskeep, W.P. (1996). Iron. Methods of soil analysis: Part 3. Chemical methods, Ed. by D. N. Sparks et al., SSSA Book Series, No. 5, pp. 639–664, Madison.
Loeppert, R.H. and Suarez, D.L. (1996). Carbonate and gypsium. In D. L. Sparks et al. (ed.). Methods of soil analysis, Part 3, Chemical methods, SSSA Book series no: 5, p: 437-474, SSSA and ASA, Madison.
Martens, D.C. and Westermann, D.T. (1991). Fertilizer applications for correcting micronutrient deficiencies. Micronutrients in Agriculture, 2nd ed., SSSA Book Series, No. 4, Madison.
Mehlich, A. (1984). Mehlich 3 soil test extractant: A Modification of Mehlich 2 extractant. Commun. in Soil Science and Plant Analysis, 15: 1409- 1416.
Nelson D.W. and Sommers L.E. 1996. Total Carbon, organic carbon and organic matter. Methods of soil analysis: Part 3. Chemical methods, Ed. by D.L. Sparks et al., SSSA Book Series, No. 5, pp. 961–1010, Madison.
Olson, R.V. (1948). Iron solubility in soils asa by pH and free iron oxide content. Soil Sci. Soc. Am. Proc., 12: 153–157.
Sobral, L.F., Smyth, J.T., Fageria, N.K. and Stone, L.F. (2013). Comparison of copper, manganese and zinc extraction with Mehlich 1, Mehlich 3 and DTPA solutions for soils of the Brazilian Coastal Tablelands. Commun. in Soil Sci. and Plant Anal., 44: 2507- 2513.
Soltanpur, P.N. (1991). Determination of nutrient availability and elemental toxicity by AB-DTPA soil test and ICP- OES. Adv. Soil Sci., 16: 165–190.
Thomas, G.W. (1996). Soil pH and soil acidity. In D.L. Sparks et al. (ed.). Methods of soil analysis, Part 3, Chemical methods, SSSA Book series no: 5, p: 475-490, SSSA and ASA, Madison.
Wear, J.I. and Evans, C.E. (1968). Relationship of zinc uptake by corn and sorghum to soil zinc measured by three extractions. Soil Sci. Soc. Am. Proc., 32: 543–546.

# P-33 Compairing of Geostatistical Interpolation Methods in Predicting of Spatial Variability of Available Phosphorus on the Wheat Field

**Mehmet** Rüştü KARAMAN[1], Tekin SUSAM[2]
Ayhan HORUZ[3], M. Şefik TÜFENKÇİ[4], Aydın ADİLOĞLU[5]

[1]Afyon Kocatepe University, Department of Medical and Aromatic Plants, Afyon, Turkey
[2]Gaziosmanpaşa University, Department of Geodesy and Photogrammetry, Tokat, Turkey
[3]Ondokuz Mayıs University, Agricultural Fac., Dept. of Soil Sci. and Plant Nutrition, Samsun, Turkey
[4]Yüzüncüyıl University, Agricultural Fac., Dept. of Soil Sci. and Plant Nutrition, Van, Turkey
[5]Namık Kemal University, Agricultural Fac., Dept. of Soil Sci. and Plant Nutrition, Tekirdağ, Turkey
e-mail: rkaraman2000@hotmail.com

**Abstract:** Many physical and chemical properties of soils greatly affect the phosphorus (P) availability on the agricultural soils. Hence, a great variability in the available P values occurs on these areas that leads to the environmental pollution and economical losses. Geostatistical interpolation methods will help to the monitoring of spatial variability of soil P on the large agricultural fields. Evaluation of these computer based geostatistical methods for large agricultural areas will improve the decision support on the field management practices in a more healthy and moderate way. For this aim, a study was conducted on the calcareous field soil under the wheat plants located on a flat plain. The soil samples, collected from the study area based on a grid system, were prepared for some chemical analyses. The data were analyzed according to varied interpolation methods of Ordinary Kriging and Simple Kriging. The results have revealed that available soil P distribution faces on the wheat field were adequately predicted by using selected kriging interpolation method with suitable semivariogram model, which had the lowest RMSE value.

*Key words:* Geostatistical methods, interpolation, soil available phosphorus, wheat field

## 1. Introduction

Commonly, the total levels of P in the soil may be high, but also P deficiency can occur in plants. The some physical and chemical properties of soils may greatly affect the P availability on these soils. On the other hand, some of the applied fertilizer P remains in fields as residual part, and there may be considerable site specific P accumulations in field soil (Hedley et al., 1995; Karaman et al. 2005). Further, it is important to emphasize that P levels in some soils increases over the years as a result of repeated annual P fertilization (Nyborg et al., 1999; Schepers et al., 2000; Mizota, 2006). Whereas, convensional soil sampling methods only estimate average soil P levels in the fields. Hence, a realistic P budget estimation is required for optimal crop yield and quality with reduced P fertilizer use together with reduced environmental pollution. Evaluating the new strategies eliminating the high heterogeneity of the available soil P will be valuable for more realistic soil fertility management and sustainability of agro-ecosystems (Legreid et al, 1999).

Monitoring of spatial changes of soil properties on large agricultural areas will provide valuable data for precision agriculture and environmental aspect. In many studies, importance of spatial analysis of soil fertility properties has been emphasized (Cahn et al., 1994; Gupta et al., 1997; Gaston et al., 2001). Geostatistical based interpolation methods often require a large amount of data to produce accurate high-resolution soil maps, because it has been assumpted that the spatial distributions and changes of the interpolated properties are continuous. Recently, various geostatistical interpolation methods have been used to understand the spatial variations and heterogeneities of soil properties on small or large scale parcels to minimize the errors of measured variables (Yost et al., 1982; Bo et al, 2003; Stamatopoulou et al, 2003; Basaran et al., 2006; Karaman et al, 2010). Some kriging methods have also been developed in order to improve the interpolation accuracy with sparsely distributed sample points (Heuvelink and Bierkens, 1992; McBratney et al., 2003; Zhengyong et al., 2009). There are several kriging techniques such as ordinary kriging, simple kriging, universal kriging, indicator kriging, which are a variation of the interpolation methods. On the other hand, some variograms such as Spherical, Exponential, Gaussian

are essential step on the way to determining optimal weights for interpolation. A variogram is a geostatistical technique which can be used to examine the spatial continuity of a regionalized variable as a function of distance and direction (Burrough and McDonnell, 1998).

Hence, these applications have proved to solve complex spatial databases in more precise way. Interpolation methods often require a large amount of data to produce accurate high-resolution soil maps, because it has been assumpted that the spatial distributions and changes of the interpolated properties are continuous. In this study, computer based geostatistical interpolation methods were compaired in monitoring of spatial variability of available soil P levels on the wheat field.

## 2. Materials and Methods

The study was conducted on a calcareous field soil under the wheat plants located on a flat plain in Tokat city (Turkey). The soil samples were taken from the study area at the depths of 0-20 cm (topsoil) and 20-40 cm (subsoil) on a grid system with 10 x 10 m intervals. The sample position was defined X and Y directions, and totally 70 sampling points were measured. The soil samples were prepared for some physical and chemical analyses by the standard methods. In soil samples, available soil P levels were determined by the method of Olsen et al., 1954. Determinations were also made for saturation percent (Richards, 1954), $CaCO_3$ (Allison and Moodie, 1965), pH (Jackson, 1958), electrical conductivity (E.C.) (Richards, 1954) and organic matter (Walkley, 1947). In the experimental soil; the texture was clay-loam having 24 % of sand, 52 % of clay and 24 % of silt. It had also the following chemical properties: calcium carbonate content = 195.3 g $kg^{-1}$, pH = 8.22, organic matter = 1.87 % and EC = 174 µmhos $cm^{-1}$. Experimental data were subjected to the definitive statistical analysis using StatMost (StatMost, 1995).

Geostatistical analyses of research data were studied by Geostatistical analyst module of ArcMap 9.3.1. GIS software by ESRI (ESRI, 2005) were used for predicting the spatial structure of soil available P levels. The data were analyzed comparatively according to interpolation methods of Ordinary Kriging (OK) and Simple Kriging (SK), which are used in geostatistic. Ordinary Kriging and Simple Kriging interpolation methods were also tested with varied semivariogram models of Spherical, Exponential and Gaussian in order to comparing. The semivariogram was defined as: $\gamma(\mathbf{s}_i,\mathbf{s}_j) = ½\ var\ (Z(\mathbf{s}_i) - Z(\mathbf{s}_j))$, where *var* was the variance. Computation of a variogram involves plotting the relationship between the semivariance *(γ(h))* and the lag distance *(h)* (Lacozza and Barber, 1999). In variogram, this arises as nugget variance "Co". The spatial variability variogram stops its increase after a certain distance and the peak variance (sill) starts having values around "Co+C". The distance at which the variogram reaches the sill value is named as the effect area or range "a". To compare interpolation results, the values of Mean Error (ME) and Root Mean Squared Error (RMSE) were used. The RMSE was a measure of prediction performance of the varied interpolation methods. The ME and RMSE was calculated using the following equation (Burrough and Mcdonnell, 1998);

(1) $$ME = \frac{1}{2} \sum_{i=1}^{n} [Z(S_i) \quad z(s_i)]$$

(2) $$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^{n} [Z(S_i) \quad z(s_i)]^2}$$

Where : $Z(_{Si})$: the prediction value, $Z(s_i)$: the actual value of the validating point *I*, n: the number validation points, ME: Mean prediction error, RMSE: Root mean square error $_i$: a validating point and $s_i$: the position of validating point *i*.

## 3. Results and Discussion

The descriptive statistical informations for the sample point data have been given in Table 1. The coefficient of variance (C.V.), kurtosis and skewness values revealed that a great spatial variability occurred in available P for both topsoil and subsoil. According to variation coefficients, C.V. variation of 38 % was found for site specific available P levels of topsoil. Wilding (1985) classified the C.V. values as 0-15 (low), 16-35 (medium) and 36 < (high) variable, respectively. Based on the descriptive statistics, the coefficient of variance (C.V.), kurtosis and skewness values indicated that a high spatial variability occurred for available soil P levels in the experimental area. However, subsoil P distribution levels (C.V. variation of 25 %) were lower than topsoil P distribution.

Table 1. Descriptive statistical results for site specific available soil P levels

| Parameters | Min. | Max. | Mean | SD | C.V., % | Kurtosis | Skewness |
|---|---|---|---|---|---|---|---|
| Topsoil P | 11.73 | 38.73 | 22.55 | 6.112 | 38 | 2.54 | 0.317 |
| Subsoil P | 9.22 | 40.18 | 21.94 | 5.395 | 25 | 2.91 | 0.268 |

In a similar study, with the introduction of GPS and GIS, the results also indicated that available P exhibits moderate spatial variability, and the errors increased with the decrease of the sampling points (He et al., 2005). Similar studies on agricultural fields have also revealed that soil nutrient status had a high spatial variance (Halloran et al., 2000; Lauzon et al., 2005). The data for site specific available soil P levels were analyzed through computer based interpolation methods (Table 2). The best optimal interpolation and semivariogram model with the lowest Mean-Square Error (RMS) have been obtained by Ordinary Kriging method and Spherical semivariogram model with RMSE = ± 0.213 for each data group. Whereas, the highest RMSE of ± 0.309 were observed in Simple Kriging method with Exponential semivariogram model.

Spatial distribution faces of site specific soil P levels were performed using the varied interpolation methods. Distribution surfaces processed by geostatiscial analyst module have also clearly indicated soil P levels variability borders on the field soil, meaning that evaluation of site specific soil P maps using the suitable interpolations will help more realistic P fertilizer use efficiency. The findings were also supported by other studies, in which spherical and exponential variogram models were also best fitted to all these soil properties, and maps of soil P levels were generated through interpolation of measured values by ordinary kriging (Sunila and Kollo, 2008; Karaman et al. 2010; 2011). Some results by other studies have also revealed that these methods could present different fertility maps for the same data (Ulson et al 2000).

Table 2. Mean and root mean square errors for predicted values

| Interpolation Methods | ME* | RMSE** |
|---|---|---|
| Ordinary Kriging – Spherical | 0.011 | 0.213 |
| Ordinary Kriging – Exponantial | 0.014 | 0.227 |
| Ordinary Kriging – Gaussian | 0.009 | 0.255 |
| Simple Kriging – Spherical | 0.009 | 0.256 |
| Simple Kriging – Exponantial | 0.008 | 0.309 |
| Simple Kriging – Gaussian | 0.006 | 0.278 |

* Mean Prediction Error, should be near 0, **Root Mean Square, as small as possible

In the present study, the experimental data concerning with soil available P levels on the calcareous wheat field were analyzed by using different geostatistical interpolation methods (Table 3). The interpolation methods of SK and OK were compared according to their predicting performance of site specific soil P values. Simple Kriging and Ordinary Kriging interpolation methods were also tested with the semivariogram models of Spherical, Exponential and Gaussian in order to comparing. Cross-validation was achieved to calculate the difference between the actual and estimated value at each location.

The range was also expressed as distance and can be interpreted as the diameter of the zone of influence, this value represents the average maximum distance over which a soil property of two samples is related. At a

distance less than the range, the measured properties of two samples become more alike with decreasing distance between them. Thus, the range provides an estimate area of similarity (Ganawa et al., 2003). In the present study, the range varied between 41.25 m and 48.83 m for OK, it was 54.39 m and 75.64 m for SK. The short range of the available P is probably due to the influence of crop and fertilizer management, which varied based on spatial dependence. The findings were also supported by other studies (Ganawa et al., 2003; He et al., 2005).

Table 3. Geostatistical parameters for site specific soil P values

| Interpolation method / Model | Nugget $C_0$ | Sill $C_0 + C$ | Nugget / Sill $C_0/(C_0 + C)$ | Spatial class* | Range m |
|---|---|---|---|---|---|
| SK/ Spherical | 0.1345 | 0.2856 | 47.09 | M | 57.80 |
| Exponential | 0.1264 | 0.2472 | 51.13 | M | 75.64 |
| Gaussian | 0.1195 | 0.1824 | 65.51 | M | 54.39 |
| OK/ Spherical | 0.1249 | 0.2535 | 49.27 | M | 42.12 |
| Exponantial | 0.1385 | 0.2850 | 48.60 | M | 41.25 |
| Gaussian | 0.1290 | 0.2348 | 54.94 | M | 48.83 |

* Nugget ratio <25 strongly spatial dependent (S), Nugget ratio 25-75 moderately spatial dependent (M), Nugget ratio >75 weakly spatial dependent (W).

## 4. Conclusion

The main problems for additional soil sampling and analyses are economical limitations and other obstacles. It has been emphasized that the problems for intensive soil samplings depending on spatial variability could be decreased by using package computer programs and geostatistical methods. Geostatistical approaches for determining of site specific effects of chemical contaminants such as agricultural P will provide valuable data especially for more precise managements. Recently, these methods have been used for the design of maps to understand the spatial variations and heterogeneities of soil properties on small or large fields. In the present study, the experimental data concerning with site specific soil P levels on the calcerous wheat field were analyzed by using different geostatistical interpolation methods. To compare interpolation results, the values of ME and RMSE were used, which was a measure of prediction performance of the varied interpolation methods at each location.

As a result of the cross validations, ordinary kriging method with spherical semivariogram model was found as the most suitable model for the experimental data group. Available soil P distribution faces on soil were adequately predicted by using selected kriging interpolation method with suitable semivariogram model, which had the lowest RMSE value. The results have revealed that spatial distribution faces of available soil P levels were adequately predicted based on the suitable interpolation methods. Evaluation of these computer based geostatistical methods for large agricultural areas will improve the decision support on the field management practices in a more healthy and moderate way.

## References

Allison, L.E. and C.D. Moodie, 1965. Carbonate, In: Methods of Soil Analysis. Part 2., *Agronomy J.,* 9:1379-1400.

Basaran, M., Ozcan, A.U., Erpul, G. and M.R. Canga, 2006. Spatial variability of organic matter and some soil properties of mineral topsoil in Cankiri Indagi Blackpine Plantation Region. *Journal of Applied Sci.,* 6 (2):445-452.

Bo, S., Shenglu, Z. and Z. Qiguo, 2003. Evaluation of spatial and temporal changes of soil quality based on geostatistical analysis in the hill region of subtropical China. *Geoderma*, 115:85-99.

Burrough, P.A. and R.A. McDonnell, 1998, "Principles of geographical information systems" Oxford University Press, 333 pp, U.K.

Cahn, M.D., Hummel, J.W. and B.H. Brouer, 1994. Spatial analysis of soil fertility for site-specific crop management. *Soil Sci. Soc. Am. J.,* 58:1240-1248.

ESRI, 2005. Geostatiscial Analysis Module Hand Book. ESRI Inc. Publication, The Netherland.

Ganawa, E.M., Soom, M.M., Musa, M.H., Shariff, A.M. and Wayayok, A., 2003. Spatial variability of total nitrogen and available phosphorus of large rice field in Sawah Sempadan Malaysia. Science Asia 29:7-12.

Gaston, L.A., Locke, M.A., Zablotowicz, R.M. and K.N. Reddy, 2001. Spatial variability of soil properties and weed populations in the Mississippi Delta. *Soil Science Society of America Journal,* 65:449-459.

Gupta, R.K., Motaghimi, S., McClellan, P.W., Alley, M.M. and D.E. Brann, 1997. Spatial variability and sampling strategies for $NO_3$-N, P, and K determinations for site-specific farming. Trans. ASAE., 40:337-343.

He, Y., Song, H., Zhangand, S. and H. Fang, 2005. Study on the spatial variability and the sampling scheme of soil nutrients in the field based on GPS and GIS" Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China, September 1-4.

Hedley, M.J., Mortvedt, J.O., Bolan, N.S. and Syers, J.K., 1995. Phosphorus Fertility Management in Agroecosystems. *In:* Phosphorus in the Global Environment, Transfer, Cycles and Management. pp. 59-92, Tiessen, H. (Ed.), Wiley Press, Chichester, UK.

Heuvelink, G.B.M. and M.F.P. Bierkens, 1992. Combining soil maps with interpolations from point observations to predict quantitative soil properties. *Geoderma,* 55:1-15.

Jackson, M.L., 1958. Soil Chemical Analysis. Prentica-Hall Inc., Englewood Cliffs, New Jersey, USA.

Karaman, M.R., Şahin, S., Çoban, S. and Sert, T., 2005. Site specific phosphorus status of wheat plants (Triticum aestivum) on calcareous Soils. Journal of Revue De Cytologie Et Biologie Végétales. 28:128-134, France.

Karaman, M.R., Susam, T., Er, F., Yaprak, S. and Oğuz, İ., 2010. Mapping strategies of site specific phosphorus contaminations in the barley field using the GIS based interpolation methods. Proceedings of the Fourth Central Asia GIS Conference – GISCA'10 'Water: Life, Risk, Energy and Land Use, pp. 87-94, 27-28 May, Bishkek, Kyrgyzstan.

Karaman, M.R., Susam, T., Şahin, S., Bice, S., 2011. Comparison of Ordinary Kriging and Co-Kriging Methods in Geostatistical Prediction of Site Specific Plant N levels on a Strawberry Field. International GIS Conference 2011, 19-21 May, Almaty, Kazakhstan, 3-115.

Lacozza, J. and Barber, D., 1999. An Examination of the Distribution of Snow on Sea-Ice. Atmosphere-Ocean, 37(1):21-51.

Lauzon, J.D., Halloran, I.P., Fallow, D.J., Bertoldi, A.P. and Aspinall, D., 2005. Spatial variability of soil test phosphorus, potassium, and pH of Ontario soils. Agron. Journal, 97:524-532.

Legreid, M., Bockman, O.C. and Kaarstad, O., 1999. Agriculture, Fertilizers and the Environment. CABI Publ., pp. 150-157. CAB Int., UK.

McBratney, A.B., Santos, M.L.M. and B. Minasny, 2003. On digital soil mapping. *Geoderma,* 117:3-52.

Mizota, C., 2006. Effects of Soil Management and Fertilization on Phosphate Accumulation in Andisols of Northern Japan. Future Challenges in P Fertilization and the Environment, 18th World Congress of Soil Science. July 9-15, Philadelphia, Pennsylvania, USA.

Nyborg, M., Malhi, S.S., Mumey, G., Penney, D.C. and Laverty, D.H., 1999. Economics of phosphorus fertilization of barley as influenced by concentration of extractable phosphorus in soil. Communications in Soil Science and Plant Analysis, 30:1789-1795.

Olsen, S.R., Cole, C.V., Watanable, F.S. and L.A. Dean, 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate" Agricultural Handbook, U.S. Soil Dept. 939, Washington D.C.

Richards, L.A., 1954. Diagnosis and improvement of saline and alkaline soils. USDA Agric. Handbook, 60, Washington, D.C.

Schepers, J.S., Schlemmer, M.R. and Ferguson, R.B., 2000. Site-specific considerations for managing phosphorus. J. Environ. Qual. 29:125-130.

Stamatopoulou, I.G., Mitsios, I.K., Floras, S. and G. Zerba, 2003. Study of spatial variability of available potassium, calcium, magnesium and sodium in central Greece using geostatistics. Geographical Information Systems and Remote Sensing: Environmental Applications," Proceedings of Int. Symp., 07-09 November.

Sunila, R. and K. Kollo, 2008. A comparison of geostatistics and fuzzy application for digital elevation model. The Int. Archives of the Photogrammetry. Remote Sensing and Spatial Information Sciences, Vol. 34, Part XXX.

StatMost, 1995,. Dataxiom Software Inc. User's Guide: StatMost. 5th Ed. Dataxiom Soft. Inc., LA., USA.

Ulson, J.A.C., Nunes, S.I., Benez, S.H. and Boas, R.V., 2000. Modeling and identification of fertility maps using

Artificialneural Networks. IEEE International Conference. Vol:4, pp. 2673-2678.

Yost, R.S., Uehara, G. and R.L. Fox, 1982, "Geostatistical analysis of soil chemical properties of large land areas" I. Semivariograms. *Soil Sci. Soc. Amer. J.,* 46:1028-1032.

Walkley, A., 1947. A critical examination of a rapid method for determining organic carbon in soils: effect of variations in digestion conditions and inorganic soil constituents. *Soil Sci.,* 63:251-263.

Zhengyong, Z., Chow, T.L., Rees, H.W., Yang, Q, Xing, Z. and F.R. Meng, 2009. Predict soil texture distributions using and artificial neural network model" *Computers and Electronics in Agriculture,* 65:36-48.

# Р-35 ОЗЕЛЕНЕНИЕ ПРОМЫШЛЕННОЙ ЗОНЫ ТЭЦ Г. БИШКЕК В КОНТЕКСТЕ УСТОЙЧИВОГО РАЗВИТИЯ

Тотубаева Н.[1] – Кыргызско-Турецкий университет Манас, Талайбекова Гулжан[2]- **Кыргызско-Турецкий университет Манас, Раимов Умутбек[3]** – Госагентство по охране окружающей среды и лесного хозяйства при ПКР

Ключевые слова: озеленение, экосистема, урбосистема, загрязняющие вещества, ландшафт

**Введение**

Город Бишкек является столицей Кыргызской Республики, расположенного в Чуйской долине у северного подножия Кыргызского Ала-Тоо, на наклонной равнине, на высоте 700-900 метров над уровнем моря. Численность наличного населения которого на 01.01.2017 года составило995,7 тыс. жителей. С каждым годом численность населения города Бишкек возрастает, что несомненно сказывается и на качестве урбосистемы. По данным Бишкекского городского управления государственной статистики (2002 г.) на территории города расположено 138 промышленных, коммунальных и транспортных предприятий, имеющих организованные и неорганизованные источники выброса загрязняющих веществ. Загрязнение атмосферного воздуха города Бишкек превышает ПДК в 5-10 раз. Согласно Национального доклада о состоянии окружающей среды Кыргызской Республики за 2006-2011 годы в 2011 году на одного жителя города Бишкек приходилось по 19,5 кг загрязняющих веществ. Основные промышленные предприятия-загрязнители размещены в восточной и западной промышленных зонах. Основным загрязнителем западной зоны является ТЭЦ г.Бишкек. 40% загрязняющих веществ приходится на ТЭЦ города. В атмосферу города ТЭЦ выбрасывает 9 загрязняющих веществ, из них наши исследования были обращены на 6 загрязняющих веществ, существенно превышающих ПДК: сернистый ангидрид, окислы азота, аммиак, формальдегид и пыль. Сокращение негативных последствий этих загрязнений может осуществляться, с одной стороны, путем модернизации технологий, а с другой – через оптимизацию состояния и функционирования природных компонентов городской среды и создание новых элементов средозащитного фонда. В этом плане одним из наиболее значимых направлений улучшения экологической ситуации является создание различных типов и категорий зеленых насаждений. Как отмечают многие ученые экологи, именно деревья и кустарники выполняют основные средообразующие и санитарно-защитные функции, и рассматриваются как главнейший компонент озеленения. К сожалению озеленение промышленных зон города Бишкек не отвечает требованиям экологических критериев. Озеленение в основном представлено хвойными породами такими как сосна обыкновенная (Pinussylvestris), елью Тянь-Шаньской (Piceaschrenkiana) и тополью пирамидальным (Populus pyramidalis). Однако, хвойные породы наиболее пыле-газово чувствительные виды и поэтому выращивание этих видов в промышленных зонах не эффективно ни с экологической ни с экономической стороны.

В связи с этим целью настоящей работы являлось изучение компонентов загрязняющих веществ атмосферного воздуха города Бишкек и в зависимости от загрязняющих веществ осуществить подбор подходящих видов зеленых насаждений для экоозеленения загрязненной зоны ТЭЦ и составить проект озеленения с помощью компьютерных программ.

**МАТЕРИАЛЫ И МЕТОДЫ ИССЛЕДОВАНИЯ**

Объектом исследования являлись проспект Чуй, где расположен ТЭЦ г.Бишкек до улицы Гоголя (рис.1.)


**ул. Гоголя** рис.1. Объект исследования

Запыленность воздуха определяли гравиметрическим методом, при помощи аспиратора А-01 и аспиратора АПВ-4-12/220В-40

Определение двуокиси серы, двуокиси азота, оксида углерода и аммиакка в воздухе проводили с помощью газоанализатора Н-100.

Проект экоозеленения изучаемых улиц проводили с помощью программ ArchiCAD и Lumion.

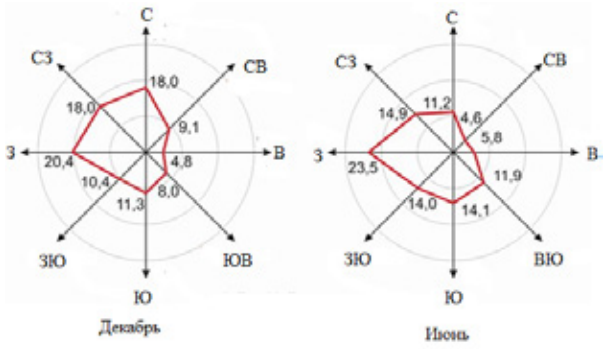
## РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЯ И ИХ ОБСУЖДЕНИЕ

Бишкек - крупный промышленный и культурный центр республики. Примерно 40% выбросов в городе приходится на ТЭЦ. Экологи делят г. Бишкек на две зоны загрязнения - восточную и западную. Основными загрязнителями в восточной зоне являются ТЭЦ - 1, Кыргызавтомаш и др. По данным КыргызГидромета, общий уровень загрязнения в этом районе в 5-10 раз превышает предельно допустимые концентрации (ПДК). Уровень формальдегида колеблется от 2 до 10 ПДК, частиц - от 1,3 до 3,8 ПДК, диоксида азота - от 1,7 до 3,0 ПДК и углекислого газа - от 3,2 до 4,8 ПДК. В западной зоне общий уровень загрязненности также в несколько раз превышает ПДК [4].

Бишкекская ТЭЦ — крупнейшая тепловая электростанция Кыргызстана, расположенная в городе Бишкек. Входит в состав крупнейшей генерирующей компании республики ОАО «Электрические станции». Теплоэлектроцентраль расположена в Восточной части города Бишкек на расстоянии 3,5 километра от его центра. Основная промплощадка граничит с юга железнодорожной станцией Аламедин, с севера от жилого массива индивидуальной застройки ТЭЦ отделяет проспект Чуй, с востока ТЭЦ граничит с территорией совхоза “Тепличный”, с запада – с улицей Достоевского [12].

В районе расположения ТЭЦ отмечаются ветры почти всех направлений, т.е. роза ветров близка к симметричной, но наибольшую повторяемость имеют западные ветры (рис.2) [4].

Рисунок 2. Роза ветров в районе ТЭЦ




В настоящее время на Бишкекской ТЭЦ выработка энергии производится за счет сжигания или переработки природного органосодержащего сырья - угля Шабыр-Кульского месторождения (Казахстан) и Кара-Кеченского месторождения, природного газа, мазута.

По данным ряда ученых в атмосферу от деятельности ТЭЦвыбрасываются 9 наименований загрязняющих веществ [11]:

- зола,пятиокись ванадия, сернистый ангидрид,окислы азота (в пересчете на NO2), угольная пыль, предельные углеводороды, ароматические углеводороды, сероводород, тяжелые металлы.

Выбросы от ТЭЦ рассеиваются за несколько километров, которое показано на рисунке 3:

Рисунок 3. Рассеивание выбросов загрязняющих веществ от источника ТЭЦ в атмосфере

Далее, после анализа основных видов загрязняющих веществ нами был произведен подбор древесно-кустарниковых пород способных произрастать при наличии вышеуказанных загрязнителей в воздухе при данных климатических условиях.

В результате проведенных исследований нами предложены варианты озеленения в районе ТЭЦ и представляют собой комплекс древесных и кустарниковых пород способных произрастать в условиях загрязнения характерными для ТЭЦ города. Это комплекс состоящий из туи + самшит + сирень + форзиция, в дизайнерском сочетании. Это сочетание которое отвечает двум основным критериям: обеспечивает красоту ланшафта и выполняет средозащитные функции.

Так туя и самшит вечнозеленые породы, устойчивые к загрязнению атмосферы сернистым ангидридом, окислам азота и аммиаку.

Форзиция является необычайно красивым кустарником способным произрастать в условиях загрязнения атмосферы формальдегидом.

Сирень, порода которая, привлекла своим внешним видом ландшафтных дизайнеров, а экологов способностью очищать атмосферный воздух промышленных зон городов от пыли.Наши исследования по способности очищать воздух от пыли показали, что из четырех видов наиболее результативным была сирень обыкновенная (диаграмма 1.).

Диаграмма 1

Способность разных видов древесно-кустарниковых пород очищать воздух от пыли.

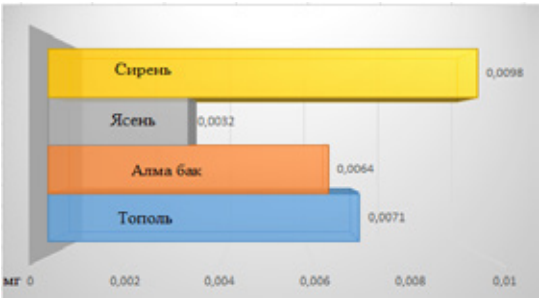



*Схема комплекс предлагаемого озеленения на основе экологического подхода указана на рисунке 4.*

Рисунок 4. Разработанная схема для озеленения

На основе вышеуказанной схемы комплекса нами при помощи программ Lumion жана ArchiCAD подотовлен проект озеленения проспекта Чуй, где расположен ТЭЦ-1. На рисунке 5 показана существующая картина озеленения в районе ТЭЦ.

Рис.5. Реальная картина и рекомендованный проект озеленения района ТЭЦ

| | |
|---|---|
|  |  |
| Настоящая ситуация | |
|  |  |
| Рекомендуемый проект озеленения | |

Таким образом, при проектировании озеленения промышленного района необходимо руководствоваться не только климатическими условиями района, но и учитывать уровень и характер загрязнения. Только правильно подобранная система озеленения обеспечит и красоту ландшафта и экологическое равновесие урбанизированного ландшафта, и здоровье населения соответственно.

**Список использованной литературы.**


1. Боконбаев К. Дж, Дылдаев М.М. Экологические проблемы города Бишкек.-Б.:2008.-116с
2. Банников А.Г., Рустамов А.К., Вакулин А. (2004) «Охрана природы», Под редак. А.Г. Банникова,стр. 75 – 77.
3. Владимиров В.Вю и др. Город и ландшафт: (Проблемы, конструктивные задачи и решения)/Е.М.Микулина, З.Н. Яргина.-М.:Мысль, 1996
4. Ежегодник Кыргызгидромета.-Б., 2000г.
5. Интродукция и приемы культуры цветочно-декоративных растений. — М.: Наука, 1997. — 168 с.
6. КР:Экологический мониторинг и укрепление потенциала управления.- Б.2000г.
7. Камчыбеков Д.Состояние и перспективы развития угольной промышленности Кыргызстана, Б, 2003.стр. 123
8. Национальный доклад о состоянии окружающей среды Кыргызской Республики за 2006-2011 годы.Б.- 2011 г.
9. Национальный план охраны окружающей среды. Приоритеты 1995 – 1977, Бишкек, 1975. – стр. 137 – 138
10. Рубцов Л.И. и др. (1980). Виды и сорта сирени, культивируемые в СССР. — Киев: Наукова Думка
11. Осмонбетов К.О., СадыковЖ.Д. Радиоэкологическая обстановка г.Бишкек//Экологический вестник.-2001.-№4
12. Экологический паспорт ТЭЦ г.Бишкек, Б:2016
13. Юскевич Николай Николаевич и Лунц Леонид Борисович. (1986). Озеленение городов. М: Россельхозиздат.

# P-45 İris Kesme Çiçeğinin Sakkaroz İçeren Vazo Solüsyonunda Vazo Ömrünün Araştırılması

Ö.Dündar, **H. Demircioğlu, O. Özkaya**

Çukurova Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü Balcalı, Adana.

*odundar@cu.edu.tr

**Özet**

Bu çalışmada, İrisin (İris *germanica*) sakkaroz içeren vazo solüsyonunda vazo ömrü araştırılmıştır. Çiçekler tomurcuk halinde derilip 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve %1 sakkaroz ve biyosid içeren, düşük pH'lı vazo solüsyonu içerisinde bekletilerek, iki gün aralıklarla kalite analizleri yapılmıştır. Araştırmada çiçeklerde etilen üretimi, solunum hızı, solüsyon alımı, oransal taze ağırlık, mevcut su içeriği, elektriksel iletkenlik, tomurcuk açılma oranı ve görsel kalite değişimleri incelenmiştir. Tomurcuk halinde derilen irisler iki gün içinde açılmış ve 3. günde petal yaşlılığı görülmüştür. İriste yapılan analizler sonucunda, 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve %1 sakkaroz ve biyosid içeren, düşük pH'lı vazo solüsyonu içinde 3 gün boyunca görsel kalite kriterlerini koruduğu bulunmuştur.

**Anahtar Kelimeler:** İris, Sakkaroz, Görsel Kalite, Vazo Ömrü

**Investigation of Vase Life of The Iris Cut Flower in Vase Containing Sucrose Solution**

**Abstract**

İris (İris *germanica*) flower vase life that was containing sucrose solution was investigated in this research. Flowers were harvested in the bud stage and waited at 20±5°C, 12 hours of natural light, 60% RH, and containing low pH biocide solution including 1% sucrose solution. Quality analyses were done 2 days intervals. The amount of ethylene production of the flower, respiratory rate, solution uptake, fresh weight proportionate, available water content, electrical conductivity, bud opening rate and visual quality were examined. The buds of the Iris were opened within two days after harvest and flower senescence of petals under mentioned conditions were started after 3 days. The results of this study showed that Iris flower that were harvested at bud stage can maintain the overall quality within 3 days of vase life.

**Keywords:** İris, Sucrose, Quality, Vase Life

## Giriş

İris, İridaceae (Süsengiller) familyasındandır. İris çiçeğinin renk ve şekil bakımından birbirinden çok farklı türleri vardır. Ana vatanı Türkiye'dir (MEGEP 2009). İris çiçekleri etilene hassas olup, çiçekleri tomurcuk renklendiğinde derilmektedir. Oda sıcaklığında (vazo ömrü) 2 ile 5 gün dayanmaktadır. 0°C'de 5 gün süreyle, 2-5°C sıcaklıkta da depolanabilmektedir (Dole ve Wilkins 2005). Birçok çiçekte vazo solüsyonuna şeker eklenmesiyle vazo ömrü uzatılabilmektedir. Son araştırmalarda indirgen olmayan disakkarit olan iki glikoz içeren trehaloz ve sakkaroz uygulamasının çiçek ömrünü uzattığı bulunmuştur. Sakkaroz eklenmesi hem yapraklarda hem de petallerde fruktoz, glikoz ve sakkaroz konsantrasyonunu artırmıştır (Ranwala ve Miller 2009).

Demircioğlu ve ark. (2013a), nergis (*Narcissus tazetta subsp*.)'in farklı şeker konsantrasyonlarında (%0, 2.5, 5 ve 7.5) düşük pH'lı solüsyon içinde 18±2°C'de, 12 saat doğal ışık, %60 oransal nem koşullarında vazo ömrü incelenmiştir. Nergislerde yapılan analizler sonucunda, nergislerin vazo solüsyonu içinde 6 gün boyunca görsel kalite kriterlerini koruduğu bulunmuştur. Vazo solüsyonundaki farklı sakkaroz içeriklerinin etkili olduğu gözlenmiştir.

Nergis (*Narcissus tazetta subsp.tazetta*) %5 sakkarozlu, düşük pH'lı solüsyon içinde 1°C'de % 95 oransal nem koşullarında 10 gün yaş depolanmıştır. Periyodik olarak yapılan vazo ömrü çalışmaları arasında farlılık gözlenmiştir. Genel olarak nergisler vazo ömründe 6 gün boyunca görsel kalite kriterlerini korumuştur (Demircioğlu ve ark. 2013b).

Farklı sıcaklıkta depolama sonrası 20°C'de vazo ömrü, karanfil, nergis, iris, kasımpatı ve güllerin artan depolama sıcaklığında azalmıştır. 0°C'den 10°C'ye değişen depolama sıcaklığında kuru ve yaş depolama sonrası vazo ömründe önemli farklılık olmamıştır. 12,5°C'de yaş depolama sonrası vazo ömrü ve büyüklük tüm çiçeklerin bu sıcaklıkta kuru depolamasından belirgin olarak daha yüksek bulunmuştur (Cevallos ve Reid 2001).

First Red güllerinde yapılan araştırmada farklı (Tanık, 100 nl/l, 200 nl/l) 1-MCP doz uygulamalarının ve farklı (kuru-yaş) depolama koşullarının vazo ömrüne etkili olduğu bulunmuştur. Farklı 1-MCP dozları uygulanan güllerin; %1°'lik sakkarozlu, düşük pH'lı vazo solüsyonu içinde, +4°C, %70 oransal nemde 21 gün yaş olarak muhafaza edilebileceği bulunmuştur. (Demircioğlu 2010).

'Ideal' iris, 'Preludium' lale ve 'Bloemfontein' nergislerde yapılan bir araştırmada derim öncesi ve sonrası çeşitli işlemler araştırılmıştır. Bu araştırmaya göre irislerin farklı depolama sıcaklığı sonrası biyosid ve sakkaroz içeren diyonize suda vazo ömrü gelişmemiştir. Tüm çeşitlerde artan sıcaklıkta vazo ömrü azalmıştır. Aynı şekilde artan depolama sıcaklığında da benzer sonuç gözlenmiştir. İris ve nergislerde 25 ppm $AgNO_3$ ve %6 (w/v) sakkarozlu solüsyon içinde depoda tutulan çiçeklerin vazo ömrü suda ve kuru bulundurulanlardan daha uzun olmuştur. Azotlu atmosferde depolanan iris ve nergislerde açıkta depolamadan vazo ömrü daha uzun gözlenirken lalelerde gözlenmemiştir. Nemlendirilmiş ve etilen uzaklaştırılmış depo atmosferinde depolanan çiçeklerin vazo ömrü açıkta depolanana göre azalmıştır. Tüm çiçekler sıkı tomurcuk evresinde derildiğinde gevşek tomurcuk evresinde derilenlerden daha uzun vazoda kalmıştır. Taze kesilmiş gövdelerin vazo suyuna yerleştirilmesiyle, kuru olarak tutulanlardan daha uzun vazo ömrü iris ve nergislerde görülürken lalelerde görülmemiştir. 20°C'de tutulan çiçeklerin vazo ömrü, 15°C'de tutulan çiçeklerin vazo ömründen farklı olmamıştır (Doss 1986). Bu çalışmada İris *germanica* kesme çiçeğinin sakkaroz içeren vazo solüsyonunda vazo ömrü araştırılmıştır.

## Materyal ve Yöntem

Ç.Ü. Ziraat Fakültesi, Bahçe Bitkileri Bölümü bahçesinden temin edilen çiçekler, Derim Sonrası Fizyolojisi laboratuvarına getirilmiştir. Çiçekler vazo ömrü için 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve %1 sakkaroz ve biyosid içeren düşük pH'lı vazo solüsyonu içerisinde tutulmuştur. Vazo ömründe İriste solüsyon alımı (ml $gün^{-1}$ $g^{-1}$ taze ağırlık) ve oransal taze ağırlık (%) yapılmıştır. Vazo solüsyonu 2 günde bir değiştirilmiştir (Dole ve Wilkins 2005). Vazo ömründe mevcut su içeriği (g), taze çiçek ağırlığı alınarak 70°C 48 saat etüvde kurutulmuş ve mevcut su içeriği=Taze ağırlık-Kuru ağırlık formülüyle bulunmuştur (Eason ve ark., 1997). Solunum hızının belirlenmesi $CO_2$ PBI Dansensor CheckPoint $O_2/CO_2$ cihazı ve çiçekte etilen üretim miktarı Bioconservacion Ethylene ölçüm cihazı ile ölçülmüştür. Elektriksel iletkenlik (µS) vazo ömründe (Gul ve Tahir 2012), EC 300 EcoSense® iletkenlik ölçer ile ölçülmüştür. Görsel kalite değerlendirmesi ve tomurcuk açılımı vazo ömrü süresince yapılmıştır. İriste iki gün aralıklarla 4 gün kalite analizleri yapılmış ve her gün görsel kalite incelenmiştir.

Denemede 3 tekerrür ve her tekerrürde 3'er çiçekli gruplar kullanılmıştır. Veriler JMP'de analiz edilerek, LSD, $\alpha$=0,05 önem seviyesine göre gruplandırılmıştır.

## Bulgular ve Tartışma

İriste vazo ömrünce görsel kalite değerlendirilmiş ve görsel kalite zamanla azalan değer göstermiştir. Vazo ömründe tomurcuk çiçek açılımı 2. günde %25 iken 3. günde %100 olmuştur. Demircioğlu ve ark. (2013 a, b) nergiste vazo ömründe çiçek açılımıyla benzerlik göstermiştir (Çizelge 1).

Solüsyon alımı irisin vazo ömründe azalmıştır. Süre istatistiksel olarak önemli bulunmuştur. Demircioğlu (2010) ve Dündar ve ark. (2012) yaptığı çalışmalarla vazo ömründe solüsyon alımındaki değişimler benzerlik göstermektedir (Çizelge 1).

Vazo ömründe oransal taze ağırlık değeri azalan değer almıştır ve istatistiksel olarak süre önemli bulunmuştur (Çizelge 1). Demircioğlu (2010) ve Demircioğlu ve ark.'nın (2013 a,b) yaptıkları çalışmalardaki vazo ömründe oransal taze ağırlık değişim sonuçları arasında benzerlik bulunmuştur.

Mevcut su içeriği irisin vazo ömründe artan değer göstermiştir (Çizelge 1). Demircioğlu ve ark. (2013 a, b) elde ettiği nergiste oransal su içeriği sonuçlarıyla benzerlik göstermiştir. Mevcut su içeriğinde İstatistiksel olarak süre önemli bulunmuştur.

İriste solunum hızı vazo ömründe artan değer almıştır. Çiçek açılımıyla solunum hızı atmıştır. Demircioğlu (2010) kesme gülde vazo ömründe solunum hızındaki değişimlerle benzer bulunmuştur. İstatistiksel olarak süre önemli bulunmuştur. Çizelge 1'de solunum hızı değişimleri verilmiştir.

İrisin vazo ömründe etilen üretim miktarı 2. günde azalan değer alırken 4. gün de artan değer almıştır. İstatistiksel olarak süre önemli bulunmuştur (Çizelge 1).

Elektriksel iletkenlik (µS) vazo ömründe artan değer almıştır. Bu sonuçlar nergiste Gul ve Tahir'in (2012) ve Demircioğlu ve ark. (2013 a, b) elde ettiği sonuçlarla benzerlik göstermiştir. Vazoda süre istatistiksel olarak önemli bulunmuş ve süreler farklı gruplarda yer almıştır (Çizelge 1).

Çizelge 1. Vazo ömründe İris kesme çiçeğinde yapılan analizler

| Süre (gün) | Tomurcuk Açılımı (%) | Solüsyon Alımı (ml gün$^{-1}$ g$^{-1}$ taze ağırlık) | Oransal Taze Ağırlık (%) | Mevcut Su İçeriği (g) | Solunum (ml $CO_2$/kg. s) | Etilen (µl.kg$^{-1}$s$^{-1}$) | Elektriksel İletkenlik (µS) |
|---|---|---|---|---|---|---|---|
| 0 | - | - | - | 6,80 c | 1,51 c | 82,18 a | 0,30 b |
| 2 | 25 | 0,41 a | 126,95 a | 9,50 b | 6,07 b | 29,67 c | 8,40 a |
| 4 | 100 | 0,15 b | 104,56 b | 17,00 a | 10,86 a | 70,82 b | 8,60 a |
| LSD $_{(0.05)}$ | Ö.D. | 0,14 | 11,60 | 0,29 | 0,02 | 0,02 | 0,39 |

## Sonuç

İris *germanica*'da yapılan analizler sonucunda 20±5°C, 12 saat doğal ışık, %60 oransal nem koşullarında ve %1 sakkaroz ve biyosid içeren, düşük pH'lı vazo solüsyonu içinde İris çiçeklerinin 3 gün boyunca görsel kalite kriterlerini koruduğu bulunmuştur.

### Kaynaklar


Cevallos, J.C., Reid M.S. (2001). Effect of Dry and Wet Storage at Different Temperatures on the Vase Life of Cut Flowers. Postharvest Biol. Technol. www.google.com 15.04.2016.

Demircioğlu H. (2010). Kesme Gülde (*Rosa hybrida* First Red) Farklı 1-MCP Dozu Uygulamalarının ve Farklı Depolama Koşullarının Vazo Ömrü Üzerine Etkileri. Yüksek Lisans Tezi. Çukurova Üniversitesi Fen Bilimleri Enstitüsü, Adana.

Demircioğlu H., Dündar Ö., Özkaya O., Valizadeh A. (2013 a). Adana'da Doğal Yetişen Nergis (*Narcissus tazetta subsp.*)'in Vazo Ömrü Koşullarının Araştırılması. İç Anadolu Bölgesi 1. Tarım ve Gıda Kongresi, Niğde, Bildiriler Cilt-1 Bitkisel Üretim, 464-471.

Demircioğlu H., Dündar Ö., Özkaya O. (2013 b). Tuzla'da Doğal Yetişen Nergis (*Narcissus tazetta subsp.*)'in Depolama ve Vazo Ömrünün Araştırılması. V. Süs bitkileri Kongresi, 6-9 Mayıs 2013 Yalova. Cilt II 573-580.

Dündar Ö., Demircioğlu H., Özkaya O., (2012). Gülde (First Red) Farklı 1-MCP Dozu ve Kuru Depolamanın Vazo Ömrüne Etkisi. V. Bahçe Ürünlerinde Muhafaza ve Pazarlama Sempozyumu İzmir, 256-265.

Dole JM, Wilkins HF (2005) Floriculture Principles and Species 619-628.

Doss R.P. (1986). Prelımınary Examınatıon of Some Factors That Influence The Vase Lıfe of Cut Bulb Flowers ISHS Acta Horticulturae 177: IV International Symposium on Flower Bulbs www.google.com 15.04.2016.

Eason J.R., de Vre´ L.A., Somerfield S.D., Heyes J.A. (1997). Physiological changes associated with Sandersonia aurantiaca flower senescence in response to sugar. Postharvest Biology and Technology 12 (1997) 43–50.

Gul F., Tahir I. (2012). An efective protocol for improving vaselife and postharvest performance of cut Narcissus tazetta flowers. Journal of the Saudi Society of Agricultural Sciences.www.ksu.edu.sa. 15.04.2016.

MEGEP (2009). Soğanlı Kesme Çiçeklerin Yetiştiriciliği. www.megep.meb.gov.tr. 15.04.2016.

Ranwala A.P., Miller W.B. (2009). Comparison of the dynamics of non-structural carbohydrate pools in cut tulip stems supplied with sucrose or trehalose, Postharvest Biology and Technology 52, 91–96.

# THE EURASIAN AGRICULTURE AND NATURAL SCIENCES CONGRESS

KYRGYZSTAN - 20 - 23 SEPTEMBER 2017

*Honorary Committee*

*Sponsors*

*Organization*

NOV
EVENT / ORGANIZASYON
www.novevent.com