IConPB 2022

3rd International Congress on Plant Biology

Congress Book

September 21-23, 2022
Rize, Türkiye

IConPB 2022

3rd International Congress on Plant Biology

September 21-23, 2022

Congress Book

Publishing Editors

Prof. Dr. Serdar MAKBUL
Assoc. Prof. Dr. Fatih Şaban BERİŞ
Assist. Prof. Dr. Seher GÜVEN
Assist. Prof. Dr. Şule GÜZEL İZMİRLİ

Date of Access : 05.12.2022

1st Edition

Address: Recep Tayyip Erdogan University
Zihni Derin Campus, Rize, Türkiye

https://iconpb2022.erdogan.edu.tr/

Rize, Türkiye

CONTENTS

HONORARY PRESIDENT

Prof. Dr. Yusuf YILMAZ
Rector of Recep Tayyip Erdoğan University / Türkiye

CONGRESS CHAIRMAN

Prof. Dr. Serdar MAKBUL
Recep Tayyip Erdoğan University / Türkiye

CONGRESS SECRETARIES

Assist. Prof. Dr. Seher GÜVEN
Assist. Prof. Dr. Şule GÜZEL İZMİRLİ

CONGRESS ORGANIZING COMMITTEE

Prof. Dr. Serkan GÜL
Prof. Dr. Şengül ALPAY KARAOĞLU
Prof. Dr. Yusuf BEKTAŞ
Prof. Dr. Vagif ATAMOV
Prof. Dr. Nurhayat ÖZDEMİR
Prof. Dr. Nuran DURMUŞ
Assoc. Prof. Dr. Fatih Şaban BERİŞ
Assoc. Prof. Dr. Muhammet Mustafa AKINER
Assist. Prof. Dr. Şule GÜZEL İZMİRLİ
Assist. Prof. Dr. Seher GÜVEN
Assist. Prof. Dr. Nurver ALTUN
Assist. Prof. Dr. Yeşim AKTÜRK DİZMAN
Assist. Prof. Dr. Tuğba ERGÜL KALAYCI
Research Assistant Cantekin DURSUN
Research Assistant Duygu AYDOĞMUŞ
Flora Research Association

CONGRESS HONOR COMMITTEE

Prof. Dr. Abdülkerim ALPINAR
Prof. Dr. Âdem TATLI
Prof. Dr. Adil GÜNER
Prof. Dr. Ali ENGİN
Prof. Dr. Asiye Gönül KAYNAK
Prof. Dr. Atabay DÜZENLİ
Prof. Dr. Baki EYCE
Prof. Dr. Bayram YILDIZ
Prof. Dr. Güler AYKULU
Prof. Dr. Hüseyin MISIRDALI
Prof. Dr. İsmet UYSAL
Prof. Dr. K. Hüsnü Can BAŞER
Prof. Dr. Kani IŞIK
Prof. Dr. Mahmut KILINÇ
Prof. Dr. M. Güven GÖRK
Prof. Dr. M. Yaşar AKSOYLAR
Prof. Dr. Hüseyin DURAL
Prof. Dr. Mecit VURAL
Prof. Dr. Mehmet KOYUNCU
Prof. Dr. Avni ÖZTÜRK
Prof. Dr. Memduh SERİN
Prof. Dr. Mustafa GÖKÇEOĞLU
Prof. Dr. Münir ÖZTÜRK
Prof. Dr. M. Tekin BABAÇ
Prof. Dr. Nazmi ORUÇ
Prof. Dr. Neriman ÖZHATAY
Prof. Dr. Neşe BİLGİN
Prof. Dr. Nezaket ADIGÜZEL
Prof. Dr. Osman BEYAZOĞLU
Prof. Dr. Özcan SEÇMEN
Prof. Dr. Rahim ANŞIN
Prof. Dr. Sadık ERIK
Prof. Dr. Şinasi YILDIRIMLI
Prof. Dr. Tuna EKIM
Prof. Dr. Yıldırım AKMAN
Uzm. Erkuter LEBLEBİCİ
Prof. Dr. Turhan USLU
Prof. Dr. Gülendam TÜMEN
Prof. Dr. Ayşen TÜRK

IN MEMORY OF

Prof. Dr. Ender YURDAKULOL
Prof. Dr. Sabri ÖZYURT
Prof. Dr. Hulisi MALYER
Prof. Dr. Osman KETENOĞLU

CONGRESS SCIENTIFIC COMMITTEE (ALPHABETICALLY)

Dr. Adnan ERDAĞ	Aydın Adnan Menderes Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ahmet AKSOY	Akdeniz Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ahmet İLÇİM	Hatay Mustafa Kemal Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ahmet KAHRAMAN	Uşak Üniversitesi (Flora Araştırmaları Derneği)
Dr. Alfonso SUSANNA	Botanic Institute of Barcelona (İspanya)
Dr. Ali KANDEMİR	Erzincan Binali Yıldırım Üniversitesi (Flora Araştırmaları Derneği)
Dr. Andraz CARNİ	Jovan Hadzi Institute of Biology (Slovenia)
Dr. Asım KADIOĞLU	Karadeniz Teknik Üniversitesi
Dr. Aykut SAĞLAM	Karadeniz Teknik Üniversitesi
Dr. Ayşe Mine GENÇLER ÖZKAN	Ankara Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ayşegül KÖROĞLU	Ankara Üniversitesi (Flora Araştırmaları Derneği)
Dr. Barbaros DİNÇER	Recep Tayyip Erdoğan Üniversitesi
Dr. Barış ÖZÜDOĞRU	Hacettepe Üniversitesi (Flora Araştırmaları Derneği)
Dr. Bedri SERDAR	Karadeniz Teknik Üniversitesi
Dr. Bengi ERDAĞ	Aydın Adnan Menderes Üniversitesi
Dr. Canan ÖZDEMİR	Manisa Celal Bayar Üniversitesi
Dr. Carmen GALAN	University of Córdoba (Spain)
Dr. Cem VURAL	Erciyes Üniversitesi (Flora Araştırmaları Derneği)
Dr. Cihan DARCAN	Bilecik Şeyh Edebali Üniversitesi
Dr. Deryanur DİNÇER	Recep Tayyip Erdoğan Üniversitesi
Dr. Dilek ORAL	İstanbul Üniversitesi- Cerrahpaşa (Flora Araştırmaları Derneği)
Dr. Dilzara N. AGHAYEVA	Azerbaijan National Academy of Sciences (Azerbaijan)
Dr. Çiler KARTAL	Trakya Üniversitesi
Dr. Ebru ATAŞLAR	Eskişehir Osmangazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ebru ÖZDENİZ	Çankırı Karatekin Üniversitesi
Dr. Erkan YALÇIN	Ondokuz Mayıs Üniversitesi
Dr. Eldar NOVRUZOV	Azerbaijan National Academy of Sciences (Azerbaijan)
Dr. Emine ALÇITEPE	Manisa Celal Bayar Üniversitesi (Flora Araştırmaları Derneği)
Dr. Emrah ŞİRİN	Selçuk Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ergin HAMZAOĞLU	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ernaz ALTUNDAĞ ÇAKIR	Düzce Üniversitesi
Dr. Ersin KARABACAK	Çanakkale Onsekiz Mart Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ersin MİNARECİ	Manisa Celal Bayar Üniversitesi
Dr. Esra MARTİN	Necmettin Erbakan Üniversitesi
Dr. Evren CABİ	Tekirdağ Namık Kemal Üniversitesi (Flora Araştırmaları Derneği)
Dr. Eyüp BAĞCI	Fırat Üniversitesi
Dr. Faruk MARAŞLIOĞLU	Hitit Üniversitesi
Dr. Fatih SATIL	Balıkesir Üniversitesi
Dr. Fatih SEYİS	Recep Tayyip Erdoğan Üniversitesi
Dr. Fatma GÜNEŞ	Trakya Üniversitesi (Flora Araştırmaları Derneği)
Dr. Fatma TEZCAN	Flora Araştırmaları Derneği
Dr. Fergan KARAER	Ondokuz Mayıs Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ferhat CELEP	Kırıkkale Üniversitesi (Flora Araştırmaları Derneği)
Dr. Feyza CANDAN	Manisa Celal Bayar Üniversitesi (Flora Araştırmaları Derneği)
Dr. Funda ERŞEN BAK	Artvin Çoruh Üniversitesi
Dr. Gençay AKGÜL	Nevşehir Hacı Bektaş Veli Üniversitesi (Flora Araştırmaları Derneği)
Dr. Graziela Cury GUAPO	ICBS-UFAL Setor de Botânica (Brazil)
Dr. Gökhan ABAY	Recep Tayyip Erdoğan Üniversitesi
Dr. Gül Nihan TUĞ	Ankara Üniversitesi (Flora Araştırmaları Derneği)

Dr. Gülcan ŞENEL	Ondokuz Mayıs Üniversitesi
Dr. Gülçin IŞIK	Eskişehir Teknik Üniversitesi
Dr. Gülden DOĞAN	Fırat Üniversitesi
Dr. Gülden YILMAZ	Trakya Üniversitesi
Dr. Gülderen YILMAZ	Ankara Üniversitesi (Flora Araştırmaları Derneği)
Dr. Güray UYAR	Ankara Hacı Bayram Veli Üniversitesi
Dr. Gürkan SEMİZ	Pamukkale Üniversitesi
Dr. Hasan AKAN	Harran Üniversitesi (Flora Araştırmaları Derneği)
Dr. Hasan ÇETİN ÖZEN	Dicle Üniversitesi
Dr. Hasan ÖZÇELİK	Süleyman Demirel Üniversitesi
Dr. Hasan YILDIRIM	Ege Üniversitesi (Flora Araştırmaları Derneği)
Dr. Hatice ÇÖLGEÇEN	Zonguldak Bülent Ecevit Üniversitesi
Dr. Hayri DUMAN	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Hazem KALAJI	Warsaw University (Poland)
Dr. Hülya TORUN	Düzce Üniversitesi
Dr. Hüseyin Aşkın AKPULAT	Sivas Cumhuriyet Üniversitesi (Flora Araştırmaları Derneği)
Dr. Hüseyin BAYKAL	Recep Tayyip Erdoğan Üniversitesi
Dr. İbrahim Sırrı YÜZBAŞIOĞLU	İstanbul Üniversitesi (Flora Araştırmaları Derneği)
Dr. İlkay ÖZTÜRK ÇALI	Amasya Üniversitesi
Dr. İlker GENÇ	İstanbul Üniversitesi (Flora Araştırmaları Derneği)
Dr. İsmail DEMİR	Karadeniz Teknik Üniversitesi
Dr. İsmail EKER	Bolu Abant İzzet Baysal Üniversitesi
Dr. Jogan JERNEC	University of Ljubljani (Slovenia)
Dr. Kamil COŞKUNÇELEBİ	Karadeniz Teknik Üniversitesi (Flora Araştırmaları Derneği)
Dr. Kemal YILDIZ	Manisa Celal Bayar Üniversitesi (Flora Araştırmaları Derneği)
Dr. Kerim GÜNEY	Kastamonu Üniversitesi (Flora Araştırmaları Derneği)
Dr. Kuddisi ERTUĞRUL	Selçuk Üniversitesi (Flora Araştırmaları Derneği)
Dr. Latif KURT	Ankara Üniversitesi (Flora Araştırmaları Derneği)
Dr. M. Erkan UZUNHİSARCIKLIOĞLU	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Mehmet SAĞIROĞLU	Sakarya Üniversitesi (Flora Araştırmaları Derneği)
Dr. Mehmet Ufuk ÖZBEK	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Mehmet Yaşar DADANDI	Erciyes Üniversitesi (Flora Araştırmaları Derneği)
Dr. Mehtap TEKŞEN	Aksaray Üniversitesi (Flora Araştırmaları Derneği)
Dr. Melahat ÖZCAN	Artvin Çoruh Üniversitesi (Flora Araştırmaları Derneği)
Dr. Meryem BOZKURT	Selçuk Üniversitesi
Dr. Mesut KIRMACI	Aydın Adnan Menderes Üniversitesi
Dr. Metin ARMAĞAN	Necmettin Erbakan Üniversitesi (Flora Araştırmaları Derneği)
Dr. Muhittin DİNÇ	Necmettin Erbakan Üniversitesi (Flora Araştırmaları Derneği)
Dr. Murat EKİCİ	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Murat KAYA	Aksaray Üniversitesi
Dr. Murat KOÇ	Ankara Yıldırım Beyazıt Üniversitesi
Dr. Murat ÜNAL	Van Yüzüncü Yıl Üniversitesi (Flora Araştırmaları Derneği)
Dr. Mutlu GÜLTEPE	Giresun Üniversitesi
Dr. Musa CABBAROV	Bakü Devlet Üniversitesi Azerbaycan
Dr. Mustafa KARGIOĞLU	Afyon Kocatepe Üniversitesi (Flora Araştırmaları Derneği)
Dr. Narin SADIKOĞLU	İnönü Üniversitesi (Flora Araştırmaları Derneği)
Dr. Necmi AKSOY	Düzce Üniversitesi (Flora Araştırmaları Derneği)
Dr. Neslihan SARUHAN GÜLER	Karadeniz Teknik Üniversitesi
Dr. Nursel İKİNCİ	Bolu Abant İzzet Baysal Üniversitesi (Flora Araştırmaları Derneği)
Dr. Nur Münevver PINAR	Ankara Üniversitesi (Flora Araştırmaları Derneği)
Dr. Osman EROL	İstanbul Üniversitesi
Dr. Osman TUGAY	Selçuk Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ömer ÇEÇEN	Karamanoğlu Mehmetbey Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ömer ERTÜRK	Ordu Üniversitesi

Dr. Ömer VAROL	Muğla Sıtkı Koçman Üniversitesi
Dr. Özer YILMAZ	Uludağ Üniversitesi (Flora Araştırmaları Derneği)
Dr. Özgün KALKIŞIM	Recep Tayyip Erdoğan Üniversitesi
Dr. Özgür EMİNAĞAOĞLU	Artvin Çoruh Üniversitesi (Flora Araştırmaları Derneği)
Dr. Öznur ERGEN AKÇİN	Ordu Üniversitesi
Dr. Rabiye TERZİ	Karadeniz Teknik Üniversitesi
Dr. Ramazan Süleyman GÖKTÜRK	Akdeniz Üniversitesi (Flora Araştırmaları Derneği)
Dr. Resad SALIMOV	Institute of Botany Azerbaijan National Academy of Science
Dr. Rıza BİNZET	Mersin Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ruziye (GÜNAY) DAŞKIN	Uludağ Üniversitesi
Dr. Salih TERZİOĞLU	Karadeniz Teknik Üniversitesi
Dr. Seher KARAMAN ERKUL	Aksaray Üniversitesi (Flora Araştırmaları Derneği)
Dr. Sema LEBLEBİCİ	Bilecik Şeyh Edebali Üniversitesi
Dr. Serdar Gökhan ŞENOL	Ege Üniversitesi
Dr. Sevim KÜÇÜK	Anadolu Üniversitesi (Flora Araştırmaları Derneği)
Dr. Svetlana BANCHEVA	Bulgarian Academy of Sciences (Bulgaria)
Dr. Şule ÖZTÜRK	Uludağ Üniversitesi (Flora Araştırmaları Derneği)
Dr. Talip ÇETER	Kastamonu Üniversitesi
Dr. Tamer ÖZCAN	İstanbul Üniversitesi (Flora Araştırmaları Derneği)
Dr. Tuna UYSAL	Selçuk Üniversitesi
Dr. Tuncay DİRMENCİ	Balıkesir Üniversitesi (Flora Araştırmaları Derneği)
Dr. Ümit BUDAK	Yozgat Bozok Üniversitesi
Dr. Valida ALİ-ZADE	Azerbaijan National Academy of Sciences (Azerbaijan)
Dr. Vladimir ONIPCHENKO	Moscow State University (Russia)
Dr. Vladimir VLADIMIROV	Bulgarian Academy of Sciences (Bulgaria)
Dr. Yaşar KIRAN	Fırat Üniversitesi
Dr. Yavuz BAĞCI	Selçuk Üniversitesi (Flora Araştırmaları Derneği)
Dr. Yavuz Bülent KÖSE	Anadolu Üniversitesi (Flora Araştırmaları Derneği)
Dr. Yeter YEŞİL	İstanbul Üniversitesi (Flora Araştırmaları Derneği)
Dr. Yusuf MENEMEN	Kırıkkale Üniversitesi (Flora Araştırmaları Derneği)
Dr. Zafer TÜRKMEN	Giresun Üniversitesi
Dr. Zeki AYTAÇ	Gazi Üniversitesi (Flora Araştırmaları Derneği)
Dr. Zekiye Ayşe EVEREST	Mersin Üniversitesi (Flora Araştırmaları Derneği)

PREFACE

Dear Participants,

As chair of the "International Congress on Plant Biology" organized for the third time this year in cooperation with Recep Tayyip Erdoğan University Department of Biology, and Flora Research Association, I am honoured to see you in our congress. It is a great pleasure for me to welcome the participants from different parts of the world to exchange their experiences and studies.

I would like to give brief information about the history of the congress. We are hosting the third of "International Congress on Plant Biology". The first congress was held in Konya in 2018, and the second one was held in Samsun in 2019 due to 100th anniversary of the Turkish war of independence. The third of the congress, approved to be held every two years, was planned to be held in 2021. However, we are fulfilling the congress today with a one-year postponement due to the pandemic conditions caused by the COVID-19 affecting the whole world. We made a great effort to organize the face-to-face congress while many people stood against us with the question of whether the congress should be cancelled. Moreover, we believed more each other for our purpose. Eventually, seeing you in this hall has been our greatest reward.

In fact, we had the opportunity to make online congress last year. However, we preferred to reorganize face-to-face congress. Since the effect of the pandemic, we see that the communication between junior researchers and senior academicians has considerably declined. At this point, one of our goals is to bring together junior researchers with senior scientists to strengthen the declined communication and to increase their motivation for starting scientific profession.

In the beginning of my career, the most exciting points of the profession were attending a congress, meeting with new scientists and being a partner in new studies. Especially, I will never forget the moment that I presented the study at the Biology Congress held in Malatya in 2002. Right now, it is a great honour for me to host scientists in Rize whom I hesitated to meet at that congress.

Rize province is leading all kinds of tourism activities and representing a world apart for botanists. The province is one of the important biodiversity centres with over 2000 species diversity, changing altitude from 0 to 3000 meters and different vegetation types. It is an important tourism centre for highland tourism, mountaineering activities in summer, and giving opportunities for different winter sports, especially skiing in winter. Regardless of following any valley, you will witness the riot of

colours of the forests in the autumn months. There are probably very few researchers who are botanists and do not do fieldwork in Rize highlands. In brief, every season of Rize is different and pleased.

Dear participants, our sole purpose during the congress preparation process was to host you in our province by presenting best opportunities. Therefore, we worked with great care. I can even say that we are more tired than ever before in our academic life. However, the tiredness replaced with thrilling to see you in the hall. I sincerely thank all the members of the organizing committee who contributed to this process with me. I would also like to thank our students for their support of the congress and congratulate them for their faithful behaviour. However, if we have any mistakes in the preparation process, during and after the congress, we ask forgiveness and expect your understanding.

I would also like to thank to our esteemed Rector Prof. Dr. Yusuf YILMAZ and his team for all the opportunities and support they provided. Besides, I would like to thank the academic, administrative, and support staff in process for their contributions. I would like to thank the city's official directors and business people, who paid attention to our congress, supported both me and the organization, and behaved in a friendly manner.

This congress has been financially supported by Recep Tayyip Erdoğan University, Scientific Research Projects Coordination Department (Project Number: FSD-2022-1382).

Prof. Dr. Serdar MAKBUL

Chair of the Congress

CLOSING DECLARATION

"3rd International Congress on Plant Biology" has been organized face to face between September 21 and 23, 2022 in Rize, in cooperation with Recep Tayyip Erdoğan University Department of Biology, and Flora Research Association.

A total of 120 scientists, 7 of whom from abroad, participated in the congress. In addition, three invited speakers made valuable presentations to all participants. The congress program which lasted 3 days included a total of 109 scientific studies. In total, 64 oral presentations and 46 poster presentations were presented.

In these days, congresses are more commercialized. The number of organizations aiming to make money rather than scientific content are increasing. Therefore, it has become even more important to hold congresses focused on scientific activities organized by universities. For this reason, it is necessary to ensure the continuity of the International Plant Biology Congress, which is periodically held.

"International Congress on Plant Biology" is planned to be held at different universities. Thus, the fourth edition of this international event will be organized by Pamukkale University, Denizli, Türkiye in 2024.

I would like to thank each participant for his or her contributions in this meeting, and I pay my respect to you.

Prof. Dr. Serdar MAKBUL

Chair of the Congress

CONGRESS PROGRAMME

21 September 2022 / WEDNESDAY	
	Convention and Cultural Center / Kongre ve Kültür Merkezi
10:00	Registration Start
12:00-13:00	Lunch
13:00-14:00	Opening Ceremony
14:00-14:30	Coffee break
14:30-15:15	Invited Speaker 1: Dr. Hakan Özkul Primary and Secondary Metabolites in Medicinal Plants
15:30-16:15	Invited Speaker 2: Konstantine Kereselidze Plant Diversity and Ecoregion of Caucasus
16:30-20:00	City Tour

ORAL PRESENTATION PROGRAM					
22 September 2022 / THURSDAY					
09:00-18:00	**Plant and Flower Illustrations Exhibition**			**Melike Çiğdem**	
HALL 1			**HALL 2**		
Tuna Ekim Session			**Mahmut Kılınç Session**		
Session Chair: Zeki Aytaç			**Session Chair: Levent Şık**		
09:00-09:20	**OP01**	2022 Year Studies on Turkey *Papaver* (Papaveraceae) Genus **Osman Tugay**, Ferhat Celep, Metin Armağan, Deniz Ulukuş, Bayram Atasagun, Aleyna Özbek	**OP33**	The Effects of Different Vernalization Models on Plant Growth, Seed Oil Content and Expression Levels of Some Genes Related to Vernalization and Fatty Acid Biosynthesis in Rapeseed (*Brassica napus* L.) **Çağla Sönmez**, İrem Çağlı, Büşra Elif Kıvrak
09:20-09:40	**OP02**	Stem, Leaf and Fruit Micro Morphological Characteristics of Turkish *Vincetoxicum* Wolf (Apocynaceae-Asclepiadoideae) Selin Meral Doğan, **Seher Güven**	**OP34**	Investigation of the Effect of Giberellic Acid on Gst Enzyme in Maize (*Zea mays* L.) Under Salt Stress Burcu Seçkin Dinler, **Hatice Çetinkaya**, Zafer Seçgin
09:40-10:00	**OP03**	Preliminary Results from Updated Phylogeny of the Genus *Lamium* (Lamiaceae) **Ferhat Celep**, Fatma Özmen, Fergan Karaer, Hayri Duman, Aslı Yılmaz, Bryan Drew	**OP35**	The Role of Exogenous Cysteine in High-Temperature Stress Tolerance in *Arabidopsis thaliana* **Selda Durmusoğlu**, Aykut Sağlam, Asım Kadıoğlu
10:00-10:20	**OP04**	The Preliminary Results of the Effect of White Mistletoe (*Viscum album* ssp. *abiteis*) on Radial Growth of Cilicican Fir (*Abies cilicica* ssp. *cilicica*) **Murat Özturk,** Kadir Alperen Coşkuner, Bedri Serdar, Ertuğrul Bilgili	**OP36**	Effect of Traffic Factor on Heavy Metal Content of Grapevine (*Vitis vinifera* L.) Grown in Salihli (Manisa) Gülistan Arslan, Ali Bilgin, **Şule Güzel İzmirli**
10:20-10:50	**Coffee break**			
Osman Ketenoğlu Session			**Hulisi Malyer Session**		
Session Chair: Osman Tugay			**Session Chair: Murat Koç**		
10:50-11:10	**OP05**	Taxonomic Problems and Preliminary Result of *Linaria* Mill. (Plantaginaceae) in Turkey **Deniz Ulukuş**, Osman Tugay, Ferhat Celep, Metin Armağan, Bayram Atasagun, Dilek Eda Yeniyayla	**OP37**	Comparison of Total Phenolic and Total Flavonoid Contents of Different Solvent Extracts of *Achillea sintenisii* and *Centaurea depressa* **Derya ALTAY**, Murat KOÇ
11:10-11:30	**OP06**	Pollen Studies in Some *Cirsium* Taxa Representing of the Sections *Epitrachys* and *Cirsium* **Funda Erşen Bak**, Melahat Özcan	**OP38**	Antioxidant Activities and Some Bioactive Component Contents of Essential Oils Obtained from Plant Parts of *Juniperus excelsa* M. Bieb. Emrah Saruhan, **Mehmet Öz**
Convention and Cultural Center / Kongre ve Kültür Merkezi					
11:45-12:30	**Invited Speaker 3: Asım Kadıoğlu** **Contributions to the Plant Biology Field of Turkish Botanical Journal**				
12:30-14:00	**Lunch**				

22 September 2022 / THURSDAY				
HALL 1			**HALL 2**	
Osman Beyazoğlu Session			**Şinasi Yıldırımlı Session**	
Session Chair: Kamil Coşkunçelebi			**Session Chair: Şinasi Yıldirimlı**	
14:00-14:20	**OP07**	Invasive Alien Plants in Flora of Türkiye Kamil Coşkunçelebi, **Salih Terzioğlu**	**OP39**	Syntaxonomy of *Quercus* Communities in Euxine Region **Hüseyin Baykal**
14:20-14:40	**OP08**	Morpho-Anatomical Study of Rare Endemic *Lilium akkusianum* R.Gamperle Hüseyin Ümit Ömeroğlu, **Öznur Ergen Akçin**, Bekir Gökçen Mazı, Şükran Öztürk, Yaşar Akçin	**OP40**	Nectar and Pollen Sources Plants and Beekeeping in Senoz Valley (Çayeli RIZE) **Esra Demir Kanbur**, Vagif Atamov, Turan Yüksek
14:40-15:00	**OP09**	*Crocus pallasii* Goldb. Complex in Turkey Revisited: Comparative Leaf Anatomy and Its Taxonomic Implications **Osman Erol**, Bilge Saadet Kaleli, Levent Şık, Almıla Çiftçi	**OP41**	Investigation of Vegetation and Bedrock Relationship in Anatolian Steppes Ali Demir, **Bilal Şahin**
15:00-15:20	**OP10**	Morpho-Anatomical Study of *Centaurea carduiformis* DC. subsp. *carduiformis* var. *carduiformis* **Şükran Öztürk**, Öznur Ergen Akçin	**OP42**	The Bryophyte Flora of Aydın Mountain (Aydın/Türkiye) **Gözde Aslan**, Uğur Çatak, Hatice Özenoğlu, Mesut Kırmacı
15:20-15:40	**OP11**	Mericarp Anatomy of *Tordylium* Tourn. ex L. Species grown in Turkey **Golshan Zare**, Aslı Doğru-Koca	**OP43**	Plant Biodiversity of Gaziantep New Botanical Garden Banu Gökçek, **Fatih Yayla**, Ebru Bozlar, Abdulkadir Akgün, Ülker Ömür
15:40-16:10	**Coffee break**			
Sabri Özyurt Session			**Mecit Vural Session**	
Session Chair: Ergin Hamzaoğlu			**Session Chair: Asım Kadıoğlu**	
16:10-16:30	**OP12**	Micromorphological and Anatomical Studies on the Leaves and Woods of Turkish *Daphne* (Tymelaeaeceae) Species **Melahat Özcan**, Funda Erşen Bak	**OP44**	Effect of Different Withering Times on Peptidase Activity of Turkish Tea Leaves Ahmet Gökkaya, **Şule Güzel İzmirli**
16:30-16:50	**OP13**	Taxonomical Contributions to Turkish *Polygonum* (Polygonaceae) Taxa Based on Tepal Morphology **Suzan Kundakçı**, Kamil Coşkunçelebi, Mutlu Gültepe, Serdar Makbul	**OP45**	Investigation of the Biological Activity of Methanolic Extract of Hazelnut Leafy Cover Sevgi Pirinc, Huseyin Avni Uydu, Mehtap Atak, **Ertuğrul Yiğit**
16:50-17:10	**OP14**	An Updated Protocol for Fast and Simple Venation Analysis Of Small and Difficult to Image Leaves **Rachel Mollman**, Almıla Çiftçi, Osman Erol	**OP46**	Determination of Antimicrobial and Quorum Sensing Inhibition Potentials of *Arbutus unedo*, *Aronia melanocarpa*, *Cornus mas*, *Fragaria vesca*, *Frangula alnus*, *Rosa canina*, *Solanum nigrum*, *Sorbus torminalis*, *Vaccinium myrtillus*, *Vitis labrusca* from Rize **Ülkü Zeynep Üreyen Esertaş**, İnci Durukan, Ali Osman Kılıç, Saliha Ekşi
17:10-17:30	**OP15**	On the Hunt for Characters: Seperating *Crocus balansae* J.Gay ex Maw from Its Close Relatives **Almıla Çiftçi**, Rachel Mollman, Levent Şık, Osman Erol	**OP47**	Investigation of Antioxidant and Antibacterial Properties of Extracts of Rize Tangerine Peel Obtained with Different Solvents Eda Yılmaz Kutlu, Erva Rakıcı, **Mehtap Atak**
17:30-17:50	**OP16**	The Usefulness of Scanning Electron Microscopy and Micromorphological Characters for Taxonomic Study of Genus *Festuca* L. (Poaceae) in Türkiye **Jelena Erdal**, Gencer Yaprak, Musa Doğan	**OP48**	Total Qualitative Analysis on *Fumaria officinalis* and *Paronychia kurdica* Species Grown in Inonu University Faculty of Pharmacy Medicinal and Aromatic Plants Garden **Narin Sadıkoğlu**

23 September 2022 / FRIDAY					
09:00-18:00	Plant and Flower Illustrations Exhibition			Melike Çiğdem	
HALL 1			HALL 2		
Özcan Seçmen Session			Neriman Özhatay Session		
Session Chair: Kuddisi Ertuğrul			Session Chair: Osman Erol		
09:00-09:20	OP17	The Seed Coat Morphology of *Aethionema* Genus (Brassicaceae) in Turkey Kuddisi Ertuğrul, **Burcu Yılmaz Çıtak**, Kağan Çiçek, Tuna Uysal, Hakkı Demirelma, Emrah Şirin, Meryem Bozkurt	OP49	Biological Evaluation of Safrole oil and Safrole oil Nanoemulgel as Antioxidant, Antidiabetic, Antibacterial, Antifungal and Anticancer **Mohammed Hawash**, Ahmad M. Eid
09:20-09:40	OP18	Comparison of Turkish *Epilobium tetragonum* (Onagraceae) Taxa Based on Macro-Micromorphological Properties **Seda Okur**, Serdar Makbul, Mutlu Gültepe, Kamil Çoşkunçelebi	OP50	Phytochemical Profile and In Vitro Antioxidant, Antimicrobial, Vital Physiological Enzymes Inhibitory and Cytotoxic Effects of *Artemisia jordanica* Leaves Essential Oil from Palestine **Nidal Jaradat**
09:40-10:00	OP19	Palynological Studies on Species of the Section Linum of the Genus *Linum* L. (Linaceae) with Clavate–Filiform Stigma **Gülce Bayhun**, Nadim Yılmazer	OP51	Cytotoxicity and Genotoxicity Evaluation of Aqueous Extracts of Medicinal Plant *Helichrysum* Mill. with Allium assay **Ayşe Nihal Gömürgen**
10:00-10:20	OP20	Contribution to Taxonomy of Turkish *Epilobium* and *Chamaenerion* Taxa Based on Leaf Micro Morphology **Seher Güven**, Serdar Makbul, Seda Okur, Züleyha Mercan Özmen, Kamil Coşkunçelebi	OP52	Comparative Cytotoxic Effects of *Centaurea fenzlii* Extracts on Prostate Cancer and Leukaemia Cell Lines **Ela Nur Şimşek Sezer**, Tuna Uysal
10:20-10:40	OP21	Taxonomic Investigation of *Bellevalia sarmatica* and *Bellevalia glauca* Species Gizem Kaymaz, Yaşar Kıran, **Gülden Doğan**		
10:40-11:10	Coffee break				
Tekin Babaç Session			Ender Yurdakulol Session		
Session Chair: Tuna Uysal			Session Chair: Aslı Doğru Koca		
11:10-11:30	OP22	Ocrea Morphology of Turkish *Polygonum* (Polygonaceae) Taxa and Its Taxonomic Significance **Suzan Kundakçı**, Serdar Makbul, Mutlu Gültepe, Kamil Coşkunçelebi	OP53	Determination of Barley Nitrogen Nutrition Status Based on Image Colour Analysis **Onur Hocaoğlu**
11:30-11:50	OP23	The Pollinator Groups of Plant Families in Ergan Mount, Erzincan, Turkey. **Ali Kandemir**, Mert Elverici, Engin Kılıç, Halil İbrahim Türkoğlu, Faruk Yıldız, Etem Osma, Tuğçe Varol, Aysel Akverdi, Kader Kuş, Abdullah Hasbenli	OP54	In vitro Ag Nanoparticles Application Enhanced Rosmarinic Acid Accumulation in *Clinopodium nepeta* subsp. *glandulosum* **Ersan Bektaş**, Kaan Kaltalıoğlu, Hüseyin Şahin
11:50-12:10	OP24	Plant Resources of the Mountain Xerophytic Communities of Azerbaijan Musa Cabbarov, **Vagif Atamov**	OP55	Effect of Different Auxin Types on Adventitious Root Induction from Leaf Explants of *Echinacea pallida* **Münüre Tanur Erkoyuncu**, Havva Çağlar, Mustafa Yorgancılar
12:10-12:30			OP56	The Effects of Some Antimitotic Chemicals on the Induction of Polyploidy in Red Globe Grape Cultivar **Heydem Ekinci**, Kevser Yazar
12:30-14:00	Lunch				

23 September 2022 / FRIDAY				
HALL 1			**HALL 2**	
Rahim Anşin Session			**Adil Güner Session**	
Session Chair: Salih Terzioğlu			**Session Chair: Gürkan Semiz**	
14:00-14:20	**OP25**	Taxonomic problems and distribution of the genus *Gundelia* L. (Asteraceae) **Metin Armağan**, Osman Tugay, Aslı Doğru-Koca, Golshan Zare, Osman Kola, Mahmut Miski, Nur Tan, Ernst P. Vitek	**OP57**	Biological Control with *Trichoderma* Species Against Fungal Disease (*Cylindrocladium buxicola*) on Boxwood Trees in Meydan Village **Şengül Alpay Karaoğlu**, Arif Bozdeveci, Şeyma Suyabatmaz
14:20-14:40	**OP26**	Phylogenetic Relationships of *Cichorium* L. (Asteraceae) Species in Turkey Based on Multilocular Dataset **Nilay Şen**, Golshan Zare, Aslı Doğru-Koca	**OP58**	Determination of Plant Growth Incentive Properties and Bioremidant Potentials of *Bacillus mycoides* and *Bacillus thuringiensis* Isolated from the Rhizosphere of *Dactylorhiza urvilleana* Belonging to the Orchidaceae Family **Ülkü Zeynep Üreyen Esertaş**, Emel Uzunalioğlu, Arif Bozdeveci, Şengül Alpay Karaoğlu
14:40-15:00	**OP27**	Taxonomical Notes on *Paronychia beauverdii* Czecz. (Caryophyllaceae) Based on nrDNA ITS in Turkey **Zeynep Türker**, Kamil Coşkunçelebi, Ümit Budak	**OP59**	Evaluating of the Effects of Arbuscular Mycorrhiza and *Piriformospora indica* on Growth, Root Morphology, and Stress Tolerance of Wheat Grown in Soilless Culture **Elif Özlem Günçaldı**, Halil Yılmaz, Bahar Yıldız Kutman, Sedef Tunca Gedik, Ümit Barış Kutman
15:00-15:20	**OP28**	Chromosomal Evolution of *Muscari* and Closely Related Genera **Tuna Uysal**, Meryem Bozkurt, Ela Nur Şimşek Sezer, Hakkı Demirelma, Ahmet Aksoy, Kuddisi Ertuğrul	**OP60**	Effects Of Some Chemical Applications on Seed Germination and Vegetative Development of Ekşi Kara Cultivar and 41 B Rootstock seeds **Kevser Yazar**
15:20-15:40	**OP29**	Karyological Investigation of *Ornithogalum oligophyllum* E.D. Clarke and *Ornithogalum orthophyllum* Ten. Species Sibel Öğer, Yaşar Kıran, **Gülden Doğan**	**OP61**	Investigating the Growth Promoting Potential of Bacteria Isolated from Soils of Turkey **Elif Özlem Günçaldı**, Fatih KARABULUT, Ümit Barış KUTMAN
15:40-16:10	**Coffee break**			
Mehmet Koyuncu Session			**Gülendam Tümen Session**	
Session Chair: Ferhat Celep			**Session Chair: Gülden Doğan**	
16:10-16:30	**OP30**	A Sectional Overview of *Tragopogon* L. (Asteraceae) in Turkey **Mutlu Gültepe**, Kamil Coşkunçelebi, Serdar Makbul, Tuğçe Pelin Gençkaya, Gülay Kaya, Murat Erdem Güzel	**OP62**	Investigation of the Effect of Sulfate Deficiency on Temperature Tolerance of *Heliotropium thermophilum* **Ece Nisa Imamoğlu**, Aykut Sağlam, Asım Kadıoğlu
16:30-16:50	**OP31**	Potential Distribution and Reassessment of Threat Category of *Adonis paryadrica* (Ranunculaceae) Endemic to Turkey in the Light of New Records **Murat Erdem Güzel**, Mutlu Gültepe, Ali Kandemir, Kamil Coşkunçelebi	**OP63**	Milestones in Agricultural Revolutions: From Agriculture 1.0 to Agriculture 4.0 **Beyazıt Abdurrahman Şanlı**, Zahide Neslihan Öztürk Gökçe
16:50-17:10	**OP32**	Phenetic Variation Among Wild *Vaccinium arctostaphylos* L. (Ericaceae) Populations in Türkiye **Gülşah Yılmaz**, Murat Erdem Güzel, Serdar Makbul, Kamil Coşkunçelebi	**OP64**	The Importance of Arboretums in the Selection of Woody Plants That Can Be Used in Urban Landscape: Case of the National Botanical Garden of Türkiye Arboretum **Şahin Çimen**, Mehtap Öztekin, Aysel Ulus
Convention and Cultural Center / Kongre ve Kültür Merkezi				
17:10-18:00	**Closing Ceremony**			

POSTER PRESENTATION PROGRAM	
22 September 2022 / THURSDAY / 13:00-16:00 / POSTER HALL	
PP01	Asteraceae Family Inventory and APG III Revision of Gaziantep University Faculty of Arts and Sciences, Biology Department Herbarium **Ebru Bozlar**, Şeyda Yılmaz, Serap Şahin Yiğit, Fatih Yayla
PP02	Flora of Altındağ (Nizip/Gaziantep) **Ebru Bozlar**, Muhittin Doğan, Fatih Yayla
PP03	Ancestral Character State Reconstruction of Some *Heptaptera* Margot & Reut. (Apiaceae) Species Büşra Süzener Adak, **Aslı Doğru-Koca**
PP04	Caryophyllaceae Family Inventory and APG III Revision of Gaziantep University Faculty of Arts and Sciences, Biology Department Herbarium **Şeyda Yılmaz**, Ebru Bozlar, Serap Şahin Yiğit, Fatih Yayla
PP05	Effects of CuO Nanoparticle on Growth and Photosynthetic Pigment Contents in *Lemna gibba* L. **Şeyda Yılmaz**, Muhittin Doğan
PP06	Changes in Physiological and Biochemical Parameters in Pepper Varieties Under Drought Stress Şule Demir, **Nuran Durmuş**
PP07	Effects of Auxin and Paclobutrazol on Reactive Oxygen Species Regulation in Soybean (*Glycine max* L.) Under Salt Stress Ufuk Ayvacı, Hatice Çetinkaya, **Fatma Nur Koç**, Burcu Seçkin Dinler
PP08	Aydın Mountains; Biodiversity Reserve Area for *Riccia* (Marchantiophyta) Taxa **Mesut Kırmacı**, Hatice Özenoğlu, Uğur Çatak, Gözde Aslan
PP09	From Rare To Common: *Festuca pontica* E. Alekseev Ex Markgr.-Dann. Geographic Range Extension and New IUCN Category Suggestion **Jelena Erdal**, Gencer Yaprak, Musa Doğan
PP10	Observations on some Endemic and Narrowly Distributed Species in Çankırı Province, Türkiye **Bilal Şahin**, Aicha Mahamoud Bouh
PP11	Fruit Morphology and Anatomy of the Genus *Eleutherospermum* K.Koch (Apiaceae) **Hamdiye Alatlı**, Mustafa Çelik, Zehra Altındaş, Özlem Çetin
PP12	Investigation of Morphological and Anatomical Characteristics of *Bolanthus turcicus* Grown in Turkey **Derya Altay**, Murat Koç
PP13	The Morphological and Anatomical Changes of Leaf of *Laurocerasus officinalis* M. Roem Along an Elevation Gradient İsmail Zoroğlu, **Öznur Ergen Akçin**
PP14	Wood Anatomy of Two Endemic Lamiaceae Species from Türkiye **Funda Erşen Bak**, Nazmiye Merttürk
PP15	Leaf Anatomical Investigations on Some Cardueae (Asteraceae) Taxa from Northern Anatolia (Türkiye) **Melahat Özcan**, Zuhal Altun
PP16	Anatomical Properties of *Primula auriculata* Lam. Species Öznur Ergen Akçin, **Şükran Öztürk**, Gülcan Şenel
PP17	Melissopalynological and Physico-Chemical Properties of Cimil Plateau Honey **Gülsüm Yetkin**, Suzan Kundakçı, Esra Demir, Serdar Makbul
PP18	Pollen Morphology of the Genus *Gundelia* L. (Asteraceae) Grown in Türkiye and Its Taxonomic Significance **Golshan Zare**, Aslı Doğru-Koca, Osman Tugay, Osman Kola, Mahmut Miski, Nur Tan, Ernst P. Vitek, Metin Armağan
PP19	Proximate Composition and Extraction of Cell Wall Carbohydrates of Fruits and Seeds of *Phœnix canariensis* L. Grown in Algeria **Aicha Bouhafsoun**, Amina Rouan-Serik, Jidjia Ouali, Nassima Draou, Kheira Errouane, Arbia Tebib, Rayene Anouche, Hassiba Bokhari, Riad Mezemaz
PP20	Phytochemical Screening and Antioxidant Activity of *Citrus clementina* Peels **Aicha Bouhafsoun**, Fadéla Cherifi, Hassiba Bokhari, Nourhan Abdelhadi, Nour Arnouz
PP21	Removal of Harmful Dyes Using Some Algae **Özgür Eren Zariç**, İrem Yeşildağ, Sidar Yaygır, Abuzer Çelekli
PP22	Microbial Enemies of the Pine Processionary Beetle (*Thaumetopoea wilkinsoni* Tams), A Pest of the Red Pine (*Pinus brutia* Ten.) **İsmail Demir**

23 September 2022 / FRIDAY / 13:00-16:00 / POSTER HALL	
PP23	A New Record For the Flora of Turkey: *Erigeron Karvinskianus* DC. (Asteraceae) **Batıkan Günal**, David Merrick, Gürkan Semiz
PP24	Anti-İnflammatory Effects of Essential Oil Extracted from *Salvia syriaca* L. on RAW264.7 Cells **Batıkan Günal**, Doğukan Mutlu, Sevki Arslan, Gürkan Semiz
PP25	*Ex Vitro* Symbiotic Germination of *Gymnadenia conopsea* Seeds **Erdi Can Aytar**, Hamdiye Şehirli, İnes Harzlı, Yasemin Özdener Kömpe
PP26	*Ex Vitro* Symbiotic Germination of Endemic *Dactylorhiza osmanica* subsp. *osmanica* **Hamdiye Şehirli**, Erdi Can Aytar, Buse Çökmez, Vildan Akın Mutlu, Bengisu Sentürk, Yasemin Özdener Kömpe
PP27	Effect of Drought on *Camellia sinensis* Shoot Growth **Hamdiye Şehirli**, Yasemin Özdener Kömpe, Vildan Akın Mutlu
PP28	Orchids in Tunisia **Ines Harzlı**, Yasemin Özdener Kömpe
PP29	IUCN Categories of Endemic Plants of Sorgun Pond Nature Park **Duygu Aydoğmuş**, Murat Ekici
PP30	Flora of Ambarlık Plateau (Çamlıhemşin/Rize) **Abdülkadir Süzen**, Vagif Atamov
PP31	Impact of Some Entomopathogenic Fungi on the Growth of *Zea mays* L. and *Helianthus annuus* L. Fadime Donbaloglu Bozca, Ardahan Eski, **Sema Leblebici**
PP32	The Anatomical Properties of Endemic *Achillea alimeana* Semiz & Uysal (Asteraceae) **Gülşen Karaçoban**, Sevay Ayse Ulubeli, Batıkan Günal, Gürkan Semiz
PP33	The Anatomical Studies on Endemic *Linum punctatum* Presl subsp. *pycnophyllum* (Boiss. & Heldr.) Gustavsson (Linaceae) **Gülşen Karaçoban**, Sevay Ayse Ulubeli, Batıkan Günal, Gürkan Semiz
PP34	The General Leaf Structure of Some Representative Turkish *Tragopogon* L. (Asteraceae) Taxa **Gülay Kaya**, Mutlu Gültepe, Kamil Coşkuncelebi, Serdar Makbul
PP35	The Anatomical Studies on *Ekimia* (Apiaceae) Species in Turkey Gülşen Karaçoban, Sevay Ayse Ulubeli, Batıkan Günal, **Gürkan Semiz**
PP36	Pollen Morphology of Endemic *Thlaspi leblebicii* Gemici & Görk (Brassicaceae) Abouzar Hassanpour, **Gürkan Semiz**
PP37	Pollen Morphology of *Astragalus pelliger* (Fabaceae) **Bayram Atasagun**
PP38	Palynological and Micromorphological Characteristics of *Rhaponticoides hierroi* Ö. Eren (Asteraceae) **Foroogh Tavakoli**, Batıkan Günal, Gürkan Semiz
PP39	Preliminary Results from Biogeography and Character Evolution of *Lamium* (Lamiaceae) **Ferhat Celep**, Fergan Karaer, Aslı Yılmaz, Jeffrey P. Rose, Bryan Drew
PP40	Preliminary Results from Fruit Micromorphology of the genus *Lamium* **Ferhat Celep**, Çiğdem Can Özker, Zeynep Atalay
PP41	Chromosome Numbers of *Ornithogalum nallihanense* and *Ornithogalum armeniacum* **Simge Öztürk**, Ayse Nihal Gömürgen, Nilay Sen, Dila Çana, Arda Burak Karagöz, Aslı Doğru-Koca
PP42	In Vitro Asymbiotic Seed Germination of *Gymnadenia conopsea* (L). R. Br. **Buse Çökmez**, Yasemin Özdener Kömpe
PP43	Fungal Diversity of Four Co-Occuring *Orchid* Species **Vildan Akın Mutlu**
PP44	Genome Wide Association Studies Accelerate Forest Trees Breeding Rate for Disease Resistance **Mehdi Younessi-Hamzekhanlu**, Oliver Gailing
PP45	Traditional Use and Therapeutic Effects of Comfrey (*Symphytum officinale* L.) Plant **Fatma Gül Delimustafaoğlu**, Ayse Baldemir Kılıç
PP46	The Callus Formation in *Vaccinium arctostaphylos* and Effect of Sucrose Amount on Anthocyanin Production **Elif Onan**, Hatice Çölgeçen, Havva Karahan

INVITED SPEAKERS

Invited Speaker 1
Oral Presentation

Primary and Secondary Metabolites of Medicinal Plants

Hakan Özkul[1*]

[1]Yeşilova Mah. D: No: 38/1 34295 Küçükçekmece, İstanbul, Türkiye

*Corresponding author e-mail: iletisim@hakanozkulresmi.com

Abstract

Medicinal plants are used directly in the treatment of diseases in humans and animals. Various parts of the medicinal plants or the effective substances are used in phytotherapy. Worldwide, between 50,000 and 80,000 plants are used medicinally. In Turkey there are thousands of plant species approximately 3 thousand 649 of which are endemic plants. About 1000 of these Turkish endemics are being used for medicinal and aromatic purposes due to their secondary metabolites. And their agricultural production should be done. These are important for successful phytotherapy and human health. Phytotherapy; to protect health, to protect against diseases, to cure diseases or to assist in treatment of diseases with herbal preparations prepared in various forms by using various parts of medicinal and aromatic plants, algae, fungi and lichens, exudates such as gum, balsam and resin secreted by plants, extracts, essential oils, waxes and fixed oils as raw materials. The basis of the treatment with medicinal plants (phytotherapy) is the chemical substances (primary and secondary metabolites) synthesized by these plants. Primary metabolites are involved in primary metabolic processes of plants such as respiration and photosynthesis. These primary metabolites are important for human especially for nutrition. Secondary metabolites are not required for primary metabolic processes for plant but they are very important for the plant. With them plant could adapt itself to environmental stress factors. These secondary metabolites cause some physiological changes in human body and are useful in curing some diseases. Secondary metabolites have various health benefits in human such as cardiotonic, blood thinner, anti-inflammatory, antiaging, neuroprotector, nephroprotector, cardioprotector, hepatoprotector, anthelmintic, antibacterial, antiviral, antifungal, antineoplastic, antioxidant, antidiabetic, antihypertensive, antidepressant, vasodilator, immunomodulator etc. These helpful secondary metabolites are produced by plant to increase its own strength against stress factors. Stress factors are biotic stress factors or abiotic stress factors. Plants biotic stress factors are insects, nematodes, bacteria, fungi and viruses. Plants abiotic stress factors are temperature, rough, cold, heat, salinity and light. Productions of secondary metabolites which are important for phytotherapy are affected by these biotic and abiotic stress factors. When agricultural production of medicinal plants via artificial or naturally, by recomposing biotic and abiotic stress factors or changing them we could

manage more potent medicinal plants which are rich in secondary metabolites. Endophytes are also important in secondary metabolites production for medicinal plants. For high amount of secondary plant metabolites and for specific acquired secondary metabolites these endophytic bacteria should be used also. Endemic plants have a significant role for discovering new secondary metabolites.

Keywords: Human health, medicinal plants, phytotherapy, secondary metabolites.

Invited Speaker 2
Oral Presentation

Plant Diversity and Ecoregion of Caucasus

Konstantine Kereselidze[1*]

[1]Ilia State University, Institute of Botany, Department of Phytosociology

*Corresponding author's e-mail: Konstantine.Kereselidze.1@iliauni.edu.ge

Abstract

Today the Caucasus ecoregion is one of the 34 biodiversity hotspots around the world, indicating that the area is characterized by a huge variety of endemic species and also undergoing a huge loss of habitats and natural vegetation. The Ecoregion itself covers an area of approximately 580,000 km² and is located between 39˚N - 47˚N and 40˚E -50˚E. There is a complex mix of lowland and mountain landscapes, ranging between 0 and approximately 5600 meters above the sea-level. A high diversity of different landscapes, biomes and ecosystems is what makes the ecoregion so unique and beautiful. The vegetation types mainly include semi-deserts, steppes, arid open woodlands, different types of forests, near-timberline (treeline biotopes and biotope complexes), high-mountain vegetation (subalpine, alpine, subnival), hydrophytic and synanthrophic vegetation etc. There are approximately 2791 species of vascular plants endemic to the Caucasus ecoregion. A lot of research projects nowadays focus on the study of the biodiversity of the ecoregion and conservation aspects. One of the examples is the CaBOL (Caucasus Barcode of Life), which aims to barcode all living organisms within the Caucasus ecoregion and create the international database for the future studies. The procedure includes sampling, data collecting, photographing, making PCR, Extracting DNA, collection storing, sequencing, validating the data and finally uploading it to the international database (NCBI). The cryptogam (algae, lichens, mosses, ferns, fungi, slime molds and bacteria) diversity is also one of the key aspects of the biodiversity of the Caucasus ecoregion. A research has been conducted recently about the species diversity of biological soil crusts (biocrusts) and their interaction with the vascular plants (taxonomic composition, beta diversity, Ellenberg ecological indices, correlation and regression analyses). The results show quite the diversity in both aspects: species composition of biocrusts and their complex facilitative, neutral and competitive interactions with the vascular plants.

Keywords: Ecoregion, biodiversity, vegetation, endemism, biocrust.

Invited Speaker 3
Oral Presentation

Contributions of Turkish Journal of Botany to Plant Biology

Asım Kadıoğlu[1*]

[1]Department of Biology, Science Faculty, Karadeniz Technical University, Trabzon, Türkiye

*Corresponding author's e-mail: kadioglu@ktu.edu.tr

Abstract

The Turkish Journal of Botany (TJB) was published in 1987. The journal, indexed in Scopus since 1992 and in SCI-E since 2011, has been electronically published since 2016. TJB is an international, bi-monthly, peer-reviewed, open access journal by the Scientific and Technological Research Council of Turkey (TUBITAK) - Turkish Academic Network and Information Center (ULAKBIM). The final 5 years' analysis showed that the acceptance ratio of the article in the journal is between 7.5 and 10.1. The acceptance ratio of the manuscripts with a scientific review is also between 47.8 and 61.5. The ratio of manuscripts that the decision process takes less than 6 months is between 94.8 and 97.8. According to Clarivate analysis, 1004 articles were published in the journal between the years 2009 and 2022. These articles were cited by 6498 journals. Articles published in the journal have been cited 8790 times. For the year 2021, journal impact factors (JIF) and Journal citation indicators (JCI) were 1.429 and 0.41, respectively. According to Scopus analysis, 1627 articles were published in the journal between 1990 and 2021. Articles published in the journal have been cited 10614 times. According to the data above, the Turkish Journal of Botany published around 1800 publications and received over 11000 citations for those publications, making a substantial contribution to the field of plant biology. Being ranked 155th out of 258 plant biology journals by the JCI rankings and having a JIF that increases every year is a major accomplishment for the journal.

Keywords: Turkish Journal of Botany, performance data, citation metrics, plant biology.

FULL TEXTS

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-38
Thursday
Hall-2 Hulusi Malyer Session
Full Text

Antioxidant Activities and Some Bioactive Component Contents of Essential Oils Obtained from Plant Parts of *Juniperus excelsa* M. Bieb.

Emrah Saruhan[1], Mehmet Öz[1*]

[1]Graduate Education Institute, Department of Forestry and Environment Sciences, Gümüşhane University, Gümüşhane, Türkiye.

*Corresponding author's e-mail: mehmetoz@gumushane.edu.tr

Abstract

Present research was conducted to determine the antioxidant activities and some bioactive component contents properties of essential oil obtained from the parts of the plant called *Juniperus excelsa* M. Bieb. In this study, essential oils of cone, leaf and twig (branch wood) of *J. excelsa* plant, which is a naturally grown plant in Gümüşhane province, were obtained hydrodistillation method in a Clevenger type device. The antioxidant activities of the obtained essential oils were determined based on free radical scavenging (DPPH and ABTS) activity and Ferric (III) ion reducing antioxidant power (FRAP) capacity methods. Additionally, some bioactive component contents were defined via total phenolic substance amounts (TPC), total flavonoid substance amounts (TFC), total antioxidant activity (TAC) examinations. The DPPH amounts from the essential oil samples of this species plants parts were found between 19.09±5.61 and 175.44±12.56 mg AA eq./kg. DPPH % inhibitions were determined between 0.32±0.11% and 3.01±0.22%. The amount of ABTS●+ from *J. excelsa* samples were detected between 145.21±0.52 mg AA eq./kg and 156.10±1.22 mg AA eq./kg. ABTS●+ % inhibitions were determined between 98.73±0.77% and 98.83±0.77%. The FRAP amounts of essential oil samples were found between 2875.16±14.88 and 3011.62±61.51 mg $FeSO_4$ eq./kg. TPC were found between 113.64±5.73 and 295.07±9.16 mg GA eq./kg. TFC from the plant parts essential oil samples were determined between 3653.92±142.28 and 9249.13±367.84 mg Catechin eq./kg. TAC were detected between 2398.53±124.17 and 3072.18±163.93 mg AA eq./kg. The results of the antioxidant activity and some bioactive component contents determination of the essential oils of the *J. excelsa* plant in general suggest that the antioxidant properties were quite high.

Keywords: Antioxidant activity, bioactive component, essential oil, *Juniperus excelsa* M. Bieb.

INTRODUCTION

Forests do not only meet important human functions such as shelter and food, but they also possess an important economic value alongside with products like wood, food, fiber medicine, etc. The use of plants in the treatment of diseases is almost as old as the history of humanity. Plants have been used by humans since their existence to feed and meet their medical needs. Medicinal and aromatic plants, which have always been considered important by people throughout history, are still used for food, medicine, condiment and therapeutic purposes today (Başaran 2012).

In our country, Medicinal and Aromatic Plants are classified as "Medical and aromatic plants produced by agriculture", "Medical and aromatic plants produced within the scope of organic agriculture" and "Medical and aromatic plants produced by collecting from nature". With the developments in technology, various chemical properties (phenolic, antioxidant, essential oil, etc.) found in medicinal and aromatic plants are determined by using different methods. These compounds are used in different fields such as medicine, cosmetics and food (Faydaoğlu and Sürücüoğlu 2011).

Forest areas constitute approximately 1/3 (22.9 million ha) of Türkiye's surface area. There are a total of 1.472.988 ha juniper taxa in these areas (OGM 2020). There are seven juniper taxa that grow naturally in Turkey. (*Juniperus excelsa* Bieb., *J. phoenica* L., *J. sabina* L., *J. foetidissima* Willd., *J. drupacea* Labill., *J. communis* L. and *J. oxycedrus* L.) Among these species, the tall juniper (*J. excelsa* Bieb.) has the largest share in terms of area (Gülcü *et. al.* 2019). *J. excelsa* (Crimean Juniper) species grows naturally in the provinces of Central West Anatolia, especially in Antalya, Kayseri, Hakkari, Sinop, Bilecik, Tokat, Eskişehir, Muğla, Balıkesir, Van, Gümüşhane, Burdur and Kahramanmaraş (Gültekin *et. al.* 2003).

Essential oils are secondary metabolites with strong odor, volatile and oily complex mixtures, which are usually obtained by distillation or various extraction methods and can rarely solidify at room temperature. Antioxidants are substances that remove or mitigate damage to cells by free radicals, unstable molecules that the body produces in response to environmental and other stresses. Antioxidants are sometimes called "free radical scavengers". It is stated that these free radicals in our body can be neutralized thanks to antioxidants and this improves general health. Antioxidants are produced by body cells as well as ingested through food (Saruhan, 2022).

In this study, it was intended to contribute to reveal the medicinal importance of the plant by determining the antioxidant activities and some bioactive component contents properties of essential oils obtained from *J. excelsa* plant parts.

MATERIALS AND METHODS

Plant material

Cone, leaf and twig (branch wood) samples of the *J. excelsa*, which is the focus of the study, were gathered from the natural areas where human activities are absent in the central Hacıemin District of Gümüşhane province. Identification of plants' species was performed by Assoc. Dr. Sefa AKBULUT, Faculty Member of Department of Forestry Engineering, Faculty of Forestry at Karadeniz Technical University (Kato Herbarium No:19555). The samples which were collected for analysis were reserved in the shade and airy environment to dry.

Extraction of essential oils

Essential oils were obtained by hydrodistillation process. Samples of 100 grams from dried cones, leaves and twigs of *J. excelsa* species were collected and grounded. Respectively, 100 g of homogenized cones, leaves and twigs samples were weighed in a 2000 mL round Clevenger device flask, by adding 1000 mL of distilled water, it was done with a modified Clevenger apparatus with +4 ^{o}C cooler for 4 hours. 2 mL of n-Hexane was placed in the collection part of the Clevenger device.

Antioxidant activity determination

Free radical scavenging (DPPH and ABTS) activity analysis

Samples were prepared from 0.2% essential oils obtained from the cones, leaves and twigs of *J. excelsa*. Methanol in HPLC purity, DPPH in Analytical purity and L-Ascorbic acid (AA) in Analytical purity were used. Ascorbic acid working solutions in methanol were prepared at the concentrations of 20, 50, 100, 150, 200 and 250 mg/L. The mixture was vortexed and stored in the dark for 30 minutes. Then, the absorbance of the obtained solution was read in Spectrophotometer (UV-vis spectrophotometer-Optizen MECASYS) at 517 nm. Methanol was utilized as the blank solution. The same procedures were conducted by taking from the standards (Ascorbic acid). DPPH free radical scavenging amounts of cone, leaf and twig samples were calculated, using the equation of the calibration graph obtained with ascorbic acid solutions. Results are provided as mg AA eq./kg and % inhibition (Ahmed *et. al.* 2015).

150 µL of the essential oil samples obtained from the cone, leaf and twig parts of *J. excelsa* species were taken and 2850 µL of ABTS working solution was added. Solutions of ascorbic acid of 2, 5, 10, 15, 20 and 50 mg/L were prepared for the study. The mixture was vortexed and incubated for 120 min in the dark. Afterwards, for the obtained solution, Spectrophotometer absorbance at 734 nm was calculated. 150 µL of methanol was used as blank.150 µL of the standards (Ascorbic acid) was

taken and the same procedures were performed. ABTS cation removal activity amounts of cone, leaf and twig samples were calculated, using the equation of the calibration graph obtained with ascorbic acid solutions. The results were given as mg AA eq./kg and % inhibition (Ahmed *et. al.* 2015).

Ferric (III) ion reducing antioxidant power (FRAP)

Essential oils samples were prepared from 0.04% essential oils obtained from the cone, leaf and twig plant parts. Research standards: solutions were prepared at concentrations of 10, 25, 50, 75, 100 and 150 mg/L from the main stock ferric (II) sulphate heptahydrate ($FeSO_4$. $7H_2O$) solution. The mixture was vortexed and kept in the dark for 30 minutes. The absorbance of the obtained solutions was then read in a spectrophotometer at 593 nm. Pure water was used as the blank. Total ferric reducing antioxidant capacity was determined as mg $FeSO_4$ eq./kg for cone, leaf and twig samples, using the equation of the calibration graph from the solutions (Ahmed *et. al.* 2015).

Bioactive component contents

Total amount of phenolic and flavonoid substances

Samples were prepared from 0.2% essential oils obtained from the cone, leaf and twig plant parts. 0.5 mL methanol was added to the mixture and then 200 µL folin-ciocalteu reagent was added. The mixture was vortexed and incubated under room conditions for 10 minutes, then 600 µL 10% (m/v) Na_2CO_3 solution was added. After the final mixture was vortexed again, it was incubated in the dark at room conditions for 120 minutes and the absorbance of the mixture at 760 nm was read at the end of the incubation period. 3.7 mL water, 500 µL methanol, + 100 µL folin-ciocalteu reagent, + 600 µL Na_2CO_3 mixture was used as the blank. The phenolic substance amounts in the cone, leaf and twig samples; the total phenolic value was declared as mg GA eq./kg by using the equation of the calibration graph obtained with the solution of gallic acid (20, 40, 60, 80, 120 and 160 mg/L) (Kasangana *et. al.* 2015).

Samples were prepared from 0.2% essential oils obtained from the cone, leaf and twig plant parts. The mixture was vortexed and 150 µL of 0.5 M sodium nitrite solution was added and then 150 µL 0.3 M Aluminum chloride was added. It was kept for 5 minutes. 1 ml of 1 M NaOH solution was added. The mixture was vortexed again and after storing for 10 minutes, its absorbance was read at 506 nm in the spectrophotometer. 500 µL distilled water was used as the blank. The same procedures were carried out by taking 500 µL from the standards. The total flavonoid was determined as mg Catechin eq./kg by using the equation of the calibration graph obtained with standard solutions at 25, 50, 100, 200, 400 and 800 mg/L concentrations (Kasangana *et. al.* 2015).

Total antioxidant substance

Samples were prepared from 0.2% essential oils obtained from the cone, leaf and twig plant parts. Ascorbic acid was utilized for the calibration curve. The mixture was vortexed and was incubated in a 95 °C water bath with caps closed for 90 minutes. It was recovered from the water bath and was kept for 20-30 minutes until it reached to room temperature. 500 µL distilled water was used as the blank sample instead of a sample. The absorbance of the reaction mixtures obtained was read as 695 nm in the spectrophotometer. The same procedures were conducted by taking 500 µL from the standards. Total antioxidant amount from cone, leaf and twig samples; was determined as mg AA eq./kg by using the equation of the calibration graph obtained with the solution of ascorbic acid (50, 100, 150, 200, 400 and 800 mg/L) (Kasangana *et. al.* 2015).

RESULTS

Antioxidant activity determination data

The results of the antioxidant activities and some bioactive component contents determination of the cone, leaf and twig essential oil samples are demonstrated in Table 1.

Table 1. The amount of antioxidant capacity of the *J. excelsa* cone, leaf and twig essential oils

The properties antioxidant capacity	Cones Avg.* ± SD.**	Leaves Avg.* ± SD.**	Twigs Avg.* ± SD.**
Antioxidant capacity amounts			
DPPH (mg AA eq./kg)	26.18 ± 5.95	19.09 ± 5.61	175.44 ± 12.56
DPPH (% Inhibition)	0.42 ± 0.11	0.32 ± 0.11	3.01 ± 0.22
ABTS (mg AA eq./kg)	154.04 ± 1.20	145.21 ± 0.52	156.10 ± 1.22
ABTS (% Inhibition)	98.83 ± 0.77	98.73 ± 0.35	98.73 ± 0.77
FRAP (mg $FeSO_4$ eq./kg)	3005.06 ± 46.05	2875.16 ±14.88	3011.62 ± 61.51
Bioactive components			
TPC (mg GA eq./kg)	295.07 ± 9.16	189.61 ± 4.58	113.64 ± 5.73
TFC (mg Catechin eq./kg)	9249.13 ± 367.84	8403.39 ± 61.59	3653.92 ± 142.28
TAC (mg AA eq./kg)	3072.18 ± 163.93	2812.94 ± 17.43	2398.53 ± 124.17

*: Results are given as average, **±: Standard deviation

Result of free radical scavenging (DPPH and ABTS) activity analysis

The DPPH free radical scavenging amounts from the samples of this species were found as 26.18±5.95 mg AA eq./kg in the cone part, 19.09±5.61 mg AA eq./kg in the leaf part and 175.44±12.56 mg AA eq./kg in the twig part. DPPH free radical scavenging % inhibitions were determined as 0.42±0.1% in the cone part, 0.32±0.11% in the leaf part and 3.01±0.22% in the twig part. It is seen that twig essential oils show more activity in terms of amount and have higher inhibition % than cones and leaves (Table 1).

The amount of ABTS●+ radical cation removal from *J. excelsa* samples were detected as 154.04±1.20 mg AA eq./kg in the cone part, 145.21±0.52 mg AA eq./kg in the leaf part and

156.10±1.22 mg AA eq./kg in the twig part. ABTS●+ radical cation removal % inhibitions were determined as 98.83±0.77% in the cone part, 98.73±0.35% in the leaf part and 98.73±0.77% in the twig part. It was understood that twig essential oils showed more activity when compared with cones and leaves in terms of amount, and cone essential oils showed more activity in terms of % inhibition compared to twigs and leaves (Table 1).

Result of ferric (III) ion reducing antioxidant power (FRAP) analysis

The total ferric reduction antioxidant capacity amounts of *J. excelsa* samples were found as 3005.06±46.05 mg $FeSO_4$ eq./kg in the cone part, 2875.16±14.88 mg $FeSO_4$ eq./kg in the leaf part and 3011.62±61.51 mg $FeSO_4$ eq./kg in the twig part. When the FRAP values are examined, it is seen that the twigs have a higher value than the cones and leaves (Table 1).

Bioactive component contents

Determination of total phenolic and flavonoid substance

In our study, the total phenolic substance was found as 295.07±9.16 mg GA eq./kg in the cone part, 189.61±4.58 mg GA eq./kg in the leaf part and 113.64±5.73 mg GA eq./kg in the twig part. Considering the total phenolic substance values, it is concluded that cones have a better value than leaf and twig essential oils (Table 1).

As a result of the analysis, it was determined as 9249.13±367.84 mg Catechin eq./kg in the cone, 8403.39±61.59 mg Catechin eq./kg in the leaf and 3653.92±142.28 mg Catechin eq./kg in the twig. Considering the total amount of flavonoid substances, it was determined that cones had a better value than leaf and twig essential oils (Table 1).

Determination of total antioxidant substance

As a result of the study, it was determined as 3072.18±163.93 mg AA eq./kg in the cone part, 2812.94±17.43 mg AA eq./kg in the leaf part and 2398.53±124.17 mg AA eq./kg in the twig part. In view of the total amount of antioxidant substances, it was decided that cones had a better value than leaf and twig essential oils (Table 1).

DISCUSSION

Ataş *et. al.* (2012) concluded that essential oils in Crimean Juniper seeds displayed moderate antioxidant properties as a result of DPPH and β-carotene-linoleic acid experiments. In the study conducted with the leaf of *J. excelsa* species, DPPH value was 16.10±1.01 mg/mL and it was 20.36±2.62 mg/mL in cones, and it was determined that the antioxidant value showed strong activity (Lesjak *et. al.* 2017).

In the study conducted with the leaves of the *J. excelsa* species, the FRAP value contents were determined as 132.18 mg $FeSO_4$ eq./100g, and the cones were 86.73 mg $FeSO_4$ eq./100g, and they emphasized that the antioxidant value was important (Lesjak *et. al.* 2017). Comparison of antioxidant capacity amounts analysis results is given in Figure 1.

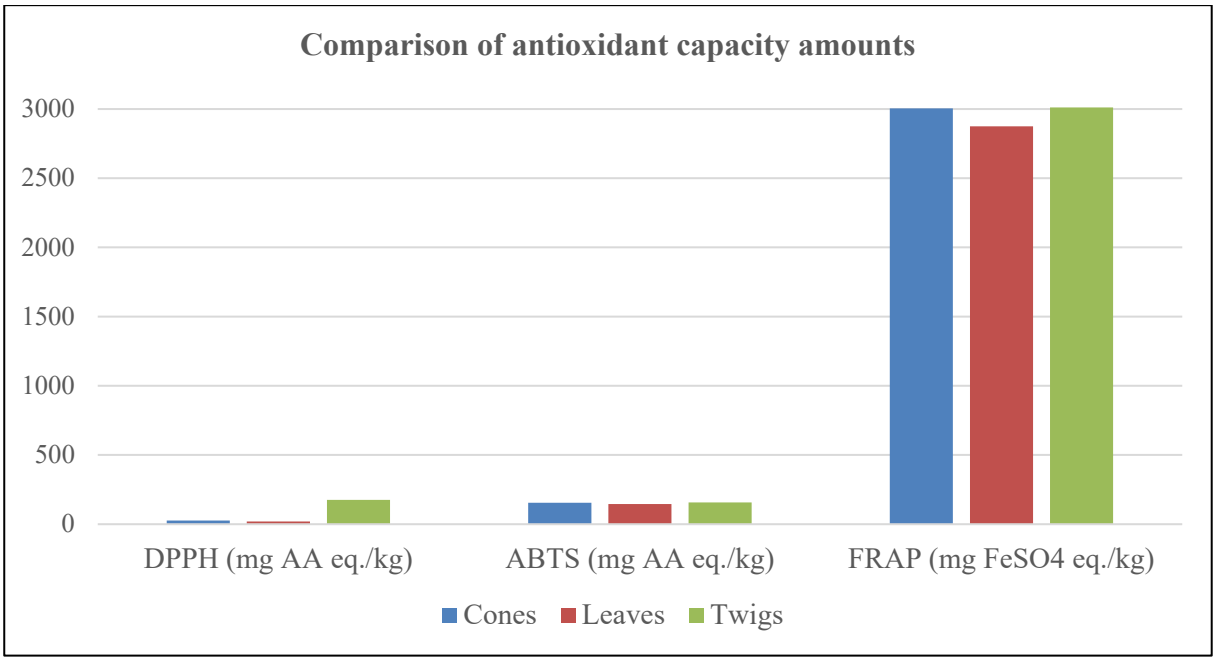

Figure 1. Comparison of antioxidant capacity amounts analysis results

Overall, when compared in terms of antioxidant capacity in our study, it was determined that twig essential oils showed more activity than cone and leaf essential oils (Figure 1). Based on these studies in the literature, it is understood that *J. excelsa* is rich in compounds with antioxidant properties.

Lesjak *et. al.* (2017) determined the phenolic content as 187.73 mg in the leaf and 94.71 mg in the seed. Stankov *et. al.* (2020) calculated the total content of phenols in Crimean Juniper with 70% and 95% ethanol solvent and decided that it varied between 12.3 and 0.9 mg GA eq./g (dw). It can be claimed that Crimean Juniper plant parts are quite rich in phenolic content. It is acknowledged in the literature that the dominant phenolics determined in *J. excelsa* express great bioactivity, prevent various diseases like cancer, cardiovascular diseases, neurodegenerative diseases, obesity and infectious diseases, and have been used as a spice in meals for many years and it has been reported that they can be considered as potent nutraceuticals in the protection and improvement of general health regarding processed food products (Jang *et. al.* 2011; Johnson *et. al.* 2012; Bahadori *et. al.* 2017).

Lesjak *et. al.* (2017) reported that 41.8% of the leaves and 13.7% of the seed cone extracts contained flavonoids in Crimean Juniper seeds and leaves, respectively. In their study, they specified

that the most abundant region of flavonoids was the leaves. Comparison of bioactive component contents analysis results is given in Figure 2.

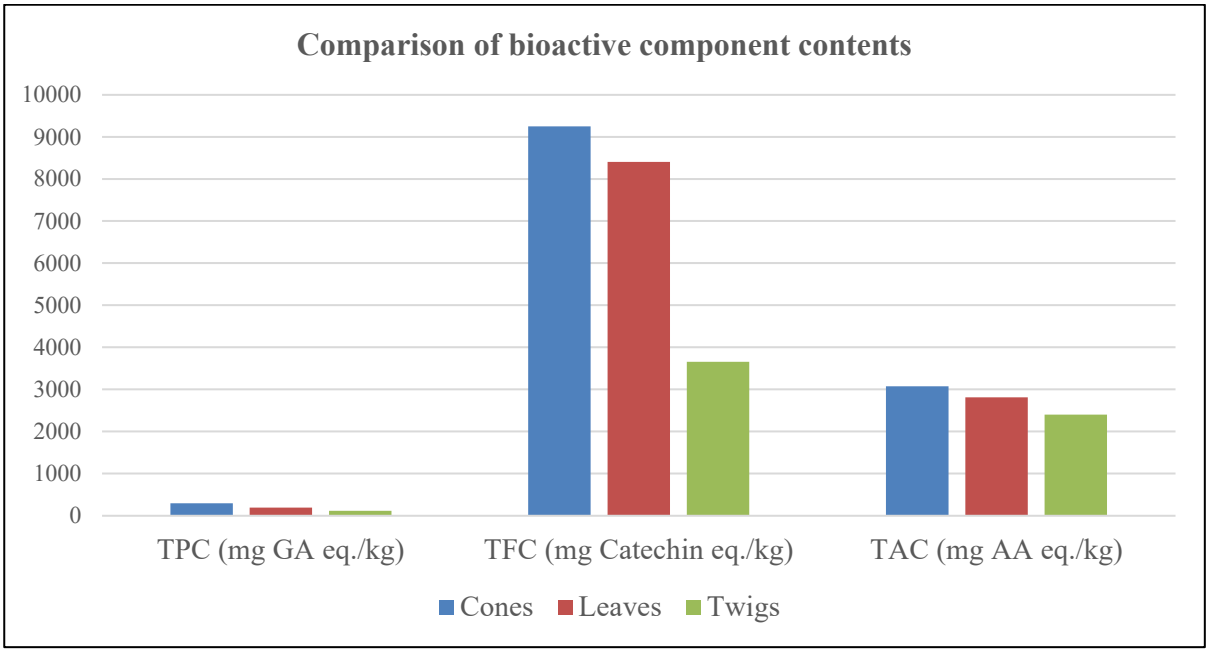

Figure 2. Comparison of bioactive component contents analysis results

In general, when the bioactive components were compared in our study, it was seen that the essential oils of the cone showed more activity than the leaf and twig essential oils (Figure 2).

The chemical profile of the essential oil obtained from *J. excelsa* showed that phenolic acids and flavonoids could aid its use as a possible source of therapeutic agents, especially in traditional medicine, and the oil which is rich in *α*-pinene and cedrol could be used effectively as a local antiseptic (Jeong *et. al.* 2014). Öztürk *et. al.* (2011) in their study, evaluated that *J. excelsa, J. oxycedrus* subsp. *oxycedrus, J. sabina* and *J. phenicia can* be used as a preservative in the food industry or to extend the shelf life of raw and processed foods.

CONCLUSIONS

Within the scope of this study, the antioxidant activities and some bioactive component contents properties of essential oil obtained from cones, leaves and twigs of *Juniperus excelsa* were examined. Twig essential oils were found the plant part with the highest activity values in terms of DPPH free radical scavenging amounts, ABTS●+ radical cation removal amounts and total ferric (III) ion reducing antioxidant capacity amounts (Antioxidant capacity amounts). Cone essential oils were determined the plant part with the highest activity values in terms of Total phenolic substance, Total flavonoid substance and Total antioxidant substance amounts (Bioactive components).

ACKNOWLEDGEMENTS

This study is a part of a master thesis entitled "Chemical Content and Biological Activities of Essential Oils Obtained from Plant Parts of *Juniperus excelsa* M. Bieb. of Gümüşhane Region" prepared by Emrah SARUHAN under the supervision of Assistant Professor Dr. Mehmet ÖZ in Gümüşhane University. This research has been supported by Gümüşhane University, Scientific Research Projects Coordination Department (Project Number: 20.E3105.07.01). For his support and contributions to laboratory studies, many thanks to Assoc. Dr. Cemalettin Baltacı.

REFERENCES

Ahmed D, Khan MM & Saeed R (2015). Comparative analysis of phenolics, flavonoids, and antiooxidant and antibacterial potential of methanolic, hexanic and aqueous extracts from *Adiantum caudatum* leaves. *Antioxidants* 4: 394-409.

Ataş AD, Göze İ, Alim A, Cetinus SA, Durmus N, Vural N & Çakmak O (2012). Chemical composition, antioxidant, antimicrobial and antispasmodic activities of the essential oil of *Juniperus excelsa* subsp. *excelsa*. *Journal of Essential Oil Bearing Plants* 15(3): 476-483.

Bahadori MB, Dinparast L, Zengin G, Sarikurkcu C, Bahadori S, Asghari B & Movahhedin N (2017). Functional components, antidiabetic, anti-alzheimer's disease, and antioxidant activities of *Salvia syriaca* L. *International Journal of Food Properties* 20: 1761-1772.

Başaran AA (2012). Ülkemizdeki bitkisel ilaçlar ve ürünlerde yasal durum. *Türk Eczacıları Birliği Yayını, Meslek İçi Sürekli Eğitim Dergisi (MİSED)* 27-28, 22-26.

Faydaoğlu E & Sürücüoğlu MS (2011). History of the use of medical and aromatic plants and their economic importance. *Kastamonu University Journal of Forestry Faculty* 11(1): 52-67.

Gülcü S, Demir S & Dirlik S (2019). Variations in cone and seed traits of Crimean juniper (*Juniperus excelsa* Bieb.) populations. *Turkish Journal of Forestry* 20(3): 187-194.

Gültekin HC, Gülcü S, Gültekin ÜG & Divrik A (2003). Studies on determination the effects of some practicable classification methods on seed germination of Crimean juniper (*Juniperus excelsa* Bieb.) before sowing process. *Artvin Coruh University Journal of Forestry Faculty* 4(1), 111-120.

Jang SY, Bae JS, Lee YH, Oh KY, Park KH & Bae YS (2011). Caffeic acid and quercitrin purified from *Houttuynia cordata* inhibit DNA topoisomerase I activity. *Natural Product Research* 25: 222-231.

Jeong HU, Kwon SS, Kong TY, Kim JH & Lee HS (2014). Inhibitory effects of Cedrol, β–Cedrene, and Thujopsene on cytochrome p450 enzyme activities in human liver microsomes. *Journal of Toxicology and Environmental Health, Part A.* 77: 1522-1532.

Johnson R, Bryant S & Huntley AL (2012). Green tea and green tea catechin extracts: An overview of the clinical evidence. *Maturitas* 73: 280-287.

Kasangana PB, Haddad PS & Stevanovic T (2015). Study of polyphenol content and antioxidant capacity of *Myrianthus arboreus* (cecropiaceae) root bark extracts. *Antioxidants (Basel)* 4(2): 410–426.

Lesjak M, Beara I, Orcic D, Anackov G, Knezevic P, Mrkonjic Z & Mimica-Dukic N (2017). Bioactivity and chemical profiling of the Juniperus excelsa, which support its usage as a food preservative and nutraceutical. *International Journal of Food Properties* 20 (2): 1652-1663.

OGM, 2020. *Türkiye Orman Varlığı*, T.C. Tarım ve Orman Bakanlığı, Orman Genel Müdürlüğü, Orman İdaresi ve Planlama Dairesi Başkanlığı. https://www.ogm.gov.tr/tr/ormanlarimizsitesi/TurkiyeOrmanVarligi/Yayinlar/2020%20T%C3%BCrkiye%20Orman%20Varl%C4%B1%C4%9F%C4%B1.pdf

Öztürk M, Tümen İ, Uğur A, Aydoğmuş–Öztürk F & Topçu G (2011). Evaluation of fruit extracts of six Turkish *Juniperus* species for their antioxidant, anticholinesterase and antimicrobial activities. *Journal of the Science of Food and Agriculture* 91: 867-876.

Saruhan E (2022). *Chemical Content and Biological Activities of Essential Oils Obtained from Plant Parts in Juniperus excelsa M. Bieb. of Gumushane Region*. MSc, Graduate Education Institute, Gümüşhane University, Gümüşhane, Turkey.

Stankov S, Fidan H, Petkova Z, Stoyanova M, Petkova N, Stoyanova A, Semerdjieva İ, Radoukova T & Zheljazkov, DV (2020). Comparative study on the phytochemical composition and antioxidant activity of Grecian juniper (*Juniperus excelsa* M. Mieb.) unripe and ripe galbuli. *Plants* 9: 1207-1225.

Oral Presentation OP-45
Thursday
Hall-2 Mecit Vural Session
Full Text

Investigation of the Biological Activity of Methanolic Extract of Hazelnut Leafy Cover

Sevgi Pirinc[1], Huseyin Avni Uydu[1], Mehtap Atak[1], Ertugrul Yigit[2*]

[1]Recep Tayyip Erdogan University, Faculty of Medicine, Department of Medical Biochemistry, Rize, Türkiye

[2]Karadeniz Technical University, Faculty of Medicine, Department of Medical Biochemistry, Trabzon, Türkiye

*Corresponding author e-mail: ertugrulyigit@ktu.edu.tr

Abstract

Many diseases such as cardiovascular diseases, diabetes, cataract and nervous system diseases occur as a result of failure removing free radicals or lack of antioxidants in the organism. The most important source of natural antioxidants are plants and taken into our body with diet. The hazelnut leafy cover waste that is surrounding the hard shell of it and by-product formed after blending is used as an animal bad or burned, so an important part of this waste is not evaluated accordingly. The aim of this research is to determine the total phenolic content and antioxidant properties of hazelnut leafy cover. We examined the total polyphenol capacity, total flavonoid capacity, cupric reducing antioxidant capacity (CUPRAC), ferric reducing antioxidant power (FRAP) and DPPH (2,2-difenil-1-pikrilhidrazil) radical scavenging activity of hazelnut leaf shell. We also investigated the effect of hazelnut leafy cover on MDA levels by creating H_2O_2-induced oxidative stress in erythrocytes. The contents of polifenol and flavanoid of the methanolic extract were 128 mg gallic acid equivalent/g extract and 5.8 mg quercetin/g extract respectively. Activities of FRAP, CUPRAC and DPPH reduction (IC50) were 173 mg trolox/g extract, 285 mg trolox/g extract and 0.060 mg/mL, respectively. MDA levels were found to be lower in the group with hazelnut leafy cover (344±79 mg/g Hb) compared to the oxidative stress group (824±79 mg/g Hb). According to the results in the study, it can be considered that hazelnut leafy cover has a high antioxidant feature and preserves this effect in the cellular microenvironment although it is a waste product. Hazelnut leafy cover might be having the potential to be industrial evaluated as a food additive for different purposes such as medical and cosmetic.

Keywords: Antioxidant activity, erythrocyte, hazelnut leafy cover waste, oxidative stress.

INTRODUCTION

It has been reported by the World Health Organization (WHO) that the number of plants used for medicinal purposes and as spices in the world is around 20,000. Since ancient times, plants have been used to add flavor, smell, color to foods and as medicine (Faydaoğlu and Sürücüoğlu, 2013). It is also used in nutrition as nutritional supplements in the form of herbal tea, flavor and condiment. In addition to being used in perfumery and cosmetics, it finds a wide area of use in different branches of industry as a brightener and even as insecticides. For this purpose, dried and prepared plant parts of plants (root, root-stem, tuber, stem or woody structure, bark, leaf, flower, fruit, seed and herb) are used (Temel *et. al.*, 2018).

Archaeological findings from ancient times show that humans have started to relate to plants since their existence. People have used many plants, known as medicinal plants, in the treatment of diseases by trial and error method. The preparation of extracts from plants and their use as medicine began in China in the BC. It is thought to date back to 2700 B.C. (Faydaoğlu and Sürücüoğlu, 2013). It is accepted that the first written records of the use of plants were found in excavations in Ancient Egypt. BC in Egypt. It has been seen that various plants, especially mint, were used in the mummification of corpses in the 2500 BC, and it was possible to preserve the corpses for centuries by treating the corpses with the extracts obtained from these plants, together with other methods applied (Başoğlu, 1982).

Many factors such as developing and advancing technology, radiation, environmental pollution, contaminated water, pesticides, heavy metals and oxygen metabolism in living cells cause the formation of free radicals in the human body (Kasnak and Palamutoğlu, 2015). Free radicals damage the membrane of cells, lipids, proteins, nucleic acids and DNA in the cell structure, and as a result, they cause many diseases such as cancer, coronary heart diseases, diabetes, cataracts, liver damage (Velioğlu, 2000). In order to eliminate the negative effects of free radicals and to prevent the formation of related diseases, the antioxidant system in the body comes into play (Kasnak and Palamutoğlu, 2015). There is a balance between the levels of free radicals and antioxidants, and when this balance is disrupted in favor of radicals, the amount of oxidants in the body increases and many pathological conditions occur as well as cell damage called oxidative stress (Büyükoğlu and Aslan, 2018). Antioxidants we get from natural food sources; It is molecular that prevents oxidation caused by free radicals, has the ability to capture and stabilize free radicals (Elliot, 1999). The natural antioxidant properties of plants are due to some chemical compounds in their structures. These include amino acids, carotenoids, flavonoids, phenolic compounds, vitamins C and E, organic acids, melanoidins,

sulfites, phytates, gluconates, coumarins, terpenes, lignins, indoles, isothiocyanates, phthalides (Velioğlu, 2000).

Thanks to its geographical location, climate and plant diversity, agricultural potential, and large area, Turkey is one of the prominent countries in terms of medicinal and aromatic plants as well as plants with economic value (Bayram *et. al.*, 2010).

As of 2017, there is 1 million tons of hazelnut production in an area of 672 thousand hectares in the world. Being the largest hazelnut producer in the world, Turkey has 65.3% of the world production area and 67.1% of the production amount. Italy (13.1%), Azerbaijan (4.3%) and the United States (USA) (2.9%) follow Turkey in world hazelnut production, while the remaining 12.6% share belongs to other countries. Hazelnut cultivation in Turkey first started in the provinces of Ordu, Giresun and Trabzon in the Eastern Black Sea region, then spread to the provinces in the Western Black Sea and Marmara regions. According to Turkey Statistical Company (TUIK), 2019 data, hazelnut cultivation is carried out in 33 provinces and 502 thousand enterprises as of 2017, and according to 2014 data, Turkey is 6 times (85 thousand tons) ahead of its closest follower Italy, with 660 thousand tons of in-shell hazelnut production (Topuz *et. al.*, 2019).

The Black Sea Region has an important potential in hazelnut cultivation due to the hazelnut waste/residues remaining after the harvest and threshing processes. A portion of the hazelnut leafy cover waste surrounding the hard shell of the hazelnut, which is released after the blending process of the in-shell hazelnut, is used as a bedding for animals in the village areas, however, a significant part of it is not used in any way and is mostly randomly burned and disposed of (Demirel and Gurdil, 2017). The aim of this research is to determine the total phenolic content, flavonoid content, antioxidant capacity of hazelnut leaf cover waste obtained from Giresun region by various methods and to determine its possible protective activity against oxidative damage in erythrocytes.

MATERIALS AND METHODS

Harvesting and Grinding of Hazelnut Leafy Cover

Hazelnut leafy cover waste belonging to *Corylusavellana L.* type Turkish hazelnut was collected from the central village of Bulancak in Giresun province in August 2018. Hazelnut leafy cover sample was dried in an oven at 37 °C. The dried samples were pulverized in the grinder. It was stored in a deep freezer at -20 °C for use in extraction processes.

Preparation of Extracts

A total of 10 g of the powdered hazelnut leafy cover waste sample was weighed, and 200 mL of methanol (5 g each, 100 mL of methanol) was added, and it was left to incubate for 16 hours in a

shaker incubator (160 ppm). After this process, the filtrates were combined and methanol was evaporated in the evaporator. The obtained extracts were dissolved in DMSO with a dry gram weight of 100 mg/mL and stored at -20 °C to be used in the next assays.

Determination of Total Polyphenolic Content (TPC)

The total amount of phenolic substances was determined on the basis that phenolic compounds dissolved in methanol in alkaline medium form colored (purple-violet) complexes with the Folin reagent and this purple-violet colored complex gave maximum absorbance at 700 nm (Slinkard and Singleton, 1977).

Determination of Total Flavonoid Content (TFC)

After mixing the total amount of flavonoid substance, aluminum (III) chloride solution and potassium acetate solutions, methanolic flavonoid solution was added. Following this process, it was determined spectrophotometrically according to the Aluminum Chloride/Potassium Acetate method based on the measurement of the absorbance value at 415 nm against the reference 30 minutes later (Kalita *et. al.*, 2013).

Determination of Cu(II) Reducing Antioxidant Capacity (CUPRAC)

In the CUPRAC method, Cu(II)-Nc complex formed by 2,9-dimethyl-1,10-phenanthroline (Nc) with Cu (II) [copper(I)-neocuproin(Cu(I)) The antioxidant capacity was calculated based on the maximum absorbance of the -Nc] chelate at a wavelength of 450 nm (Apak *et. al.*, 2004).

Determination of Ferric Reducing Antioxidant Power (FRAP)

In the FRAP determination method, the maximum absorbance of the blue colored Fe(II)-TPTZ complex, which is formed by the reduction of the Fe(III)-TPTZ (2,4,6-tris(2-pyridyl)-S-triazine) complex in the presence of antioxidant substance, at 595 nm wavelength determination was made on the basis of (Benzie and Strain, 1999).

Determination of DPPH Free Radical Scavenging Activity

The DPPH radical is a commercially available radical. In this study, hazelnut leafy cover extracts and a daily and freshly prepared 100 µM methanolic solution of this radical were used. By using the Coundent method, the bleaching of the DPPH radical, which is purple-violet in the presence of antioxidant compounds, and the decrease in its maximum absorbance at a wavelength of 517 nm were detected, and its radical scavenging activity was examined (Cuendent *et. al.*, 1997).

Preparation of Erythrocyte Packets

The blood taken from Recep Tayyip Erdoğan University (RTEU) Training and Research Hospital was centrifuged at 1690 g (Thermo Hereaus) for 10 minutes and plasma was removed. Isotonic saline solution up to three times of their volume was added to the blood cells and then centrifuged. After the leukocyte and platelet cells were removed, the erythrocyte package was isolated. Prepared erythrocyte packets were pooled and stored at +4 °C. The hematocrit (Hct) and hemoglobin (Hb) values of the erythrocyte packet were measured in the Biochemistry Laboratory of RTEU Training and Research Hospital.

Determination of MDA Levels

MDA, one of the most important end products of lipid peroxidation, was measured spectrophotometrically at 532 and 600 nm according to the method developed by Stocks and Dormandy (Stocks and Dormandy, 1971). MDA concentrations were calculated using the formula [MDA] = (A532 – A600) x 900 = nmol MDA/g Hb.

Statistical Analysis

Statistical analysis of the obtained results was performed using the SPSS program. The significance of the relevant parameters of the study groups was determined by One-way Analysis of Variation (One-way ANOVA). Results are given as mean and standard deviation. A P value of <0.05 was considered statistically significant.

RESULTS

TPC, TFC, CUPRAC, FRAP, DPPH Capacity

The antioxidant capacity results of hazelnut leafy cover waste extract are given in Table 1.

Table 1. Antioxidant capacity results of hazelnut leafy cover waste extract.

Methods	**Results**
Total Polyphenol Capacity (TPC)	128 mg gallic acid equivalent/g extract
Total Flavonoid Capacity (TFC)	5.8 mg quercetin equivalent/g extract
Cupric Reducing Antioxidant Capacity (CUPRAC)	285 mg trolox equivalent/g extract
Ferric Reducing Antioxidant Power (FRAP)	173 mg trolox equivalent/g extract
DPPH(2,2-Diphenyl-1-picrylhydrazyl) Radical Scavenging Activity (IC50)	0.060 mg/mL

Protective effects of hazelnut leafy cover waste extract against H_2O_2-induced oxidative damage in erythrocytes

The protective efficacy of the extracts against H_2O_2-induced oxidative damage in erythrocyte packages was evaluated by measuring MDA level, are given in Table 2.

Table 2. MDA levels

Sample (n=8)	**MDA (mg / g Hb) (x̄ ±SD)**
Erythrocyte	18 ± 2
Erythrocyte + H_2O_2	824 ± 79
Erythrocyte + Hazelnut Leafy Cover Waste + H_2O_2	*344 ± 17
Erythrocyte + Butylated Hydroxy Toluene(BHT) + H_2O_2	109 ± 10

*Statistically, the protective efficacy of hazelnut husk waste against H_2O_2-induced oxidative damage in erythrocytes was demonstrated ($p<0.05$).

DISCUSSION

Oxidative stress, which occurs as a result of the imbalance in the production of free radicals, causes many diseases such as aging, cancer, diabetes, atherosclerosis, ischemic diseases, cardiovascular diseases, neurodegenerative disorders (such as Alzheimer's and Parkinson's), emphysema, and hypertension (Lobo *et. al.*, 2010). In order to prevent the formation of these diseases caused by free radicals, antioxidant systems come into play, and when they are insufficient, herbal antioxidants must be taken from outside. The natural antioxidant properties of plants are due to the phenolic compounds they produce as secondary metabolites (Bilaloğlu and Harmandar, 1999). In this study, in order to determine the antioxidant capacity of hazelnut leafy cover waste, methanolic extracts of this waste were first prepared. Besides TPC, TFC, DPPH radical scavenging activity, FRAP and CUPRAC determinations of these extracts, MDA levels, which is one of the final and stable products of lipid peroxidation, were determined in the extract-treated erythrocytes. In this study, TPC levels of hazelnut leafy cover waste were measured and gallic acid was used as a standard. Our TPC value (128±3 mg GAE/g extract) showed similar results to the ethanolic extract made by Shahidi *et. al.* (2007). In our study, the TFC value was found to be 5.8±0.2 mg quercetin/g extract. TFC has not been studied in extracts of hazelnut leafy cover waste made with different solvents. However, it was determined that it showed a high TFC capacity when compared with different plant wastes in the literature (Rahimipanah *et. al.* 2010, Shi *et. al.* 2018). In our study, the FRAP and CUPRAC activities of the extracts were compared with trolox as a standard, and mg trolox equivalent FRAP activity per gram extract (173 ± 2.4 mg TEFA/g extract) and CUPRAC activity (285 ± 9 mg TECA/g extract) were

found. In the literature review, these results were the first study to determine the FRAP and CURPAC activities of hazelnut leafy cover waste. The IC50 value of DPPH in hazelnut leafy cover waste was 0.060 ± 0.002 mg /mL and 0.059 ± 0.004 in Butylated hydroxy toluene (BHT). According to the literature, in one study, the IC50 value of 100% methanolic extract of hazelnut leafy cover waste was found to be 0.003 mg/mL, while in another study, they found the IC50 values of 80% acetone and 80% ethanol extracts as 0.065 mg/mL and 0.074 mg/mL, respectively (Oğuzkan *et. al.*, 2016, Alasalvar *et. al.*, 2006). In the study, erythrocytes were used as a cell model to examine the cellular damage level of free radicals in the presence of hazelnut leafy cover waste extract. Erythrocytes have a simple cell structure. They are considered as the main target for free radical attack because they cannot eliminate the damage caused by the presence of a high amount of polyunsaturated fatty acids in their structure, carrying oxygen molecules, and having transition metals such as iron attached to hemoglobin (Gaetani *et. al.*, 1989; Van der Berg *et. al.* , 1992). In order to determine the ideal H_2O_2 concentration to cause damage to erythrocytes, concentrations of 10-20-30-40-50 mM were studied and the optimum dose was determined as 20 mM. It was determined that hazelnut leafy cover waste extract significantly decreased MDA levels ($p<0.05$). However, it was determined that it was less effective than BHT, which was used as a positive control in the study. Again, this is the first study to examine the protection of hazelnut leafy cover waste extract against cellular oxidative damage.

CONCLUSIONS

According to the results in the study, it can be considered that hazelnut leafy cover waste has a high antioxidant feature and preserves this effect in the cellular microenvironment although it is a waste product. Hazelnut leafy cover waste might be having the potential to be industrial evaluated as a food additive for different purposes such as medical and cosmetic.

ACKNOWLEDGEMENTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Alasalvar C, Karamaca M, Amarowıcz R & Shahıdı F (2006). Antioxidantand Antiradical Activities in Extracts of Hazelnut Kernel (Corylusavellana L.) and Hazelnut Green Leafy Cover *J. Agric. Food Chem* 54, 4826-4832.

Apak R, Güçlü K, Özyürek M & Karademir SE (2004). Novel Total AntioxidantCapacity Index for Dietary Polyphenols and Vitamins C and E, Using Their CupricIon Reducing Capability in the Presence of Neocuproine: CUPRAC Method. *J Agric Food Chem* 52,26: 7970-7981.

Başoğlu F (1982). Gıdalarda kullanılan bazı baharatların mikroorganizmalar üzerine etkileri ve kontaminasyondaki rolleri. *Gıda* 7(1), 19-24.

Bayram ÖS, Bayram Ö, Valerius O, Park HS, Irniger S, Gerke1 J, Ni M, Han K, Yu JH & Braus GH (2010). LaeA Control of Velvet Family Regulatory Proteins for Light-Dependent Development and Fungal Cell-Type Specificity. *Plos Genetic* 6(12): e1001226.

Benzie FF & Strain JJ (1999). Ferricreducing/antioxidantpowerassay: Direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of total antioxidant power and ascorbic acid concentration. *Methods in Enzymology* 299: 15-27.

Bilaloğlu GV & Harmandar M (1999). Flavonoidler, Bakanlar Matbaacılık Ltd. ŞTİ. İstanbul, 336.

Büyükoğlu T & Aslan AN (2018). Oksidatif Stres ve Geçiş Dönemi Süt Sığırlarında Oksidatif Stresin Etkileri.*Turkiye Klinikleri J Vet Sci* 9(2):33-41.

Cuendent M, Hostettmann K & Potterat O (1997). "Iridoid glucosides with free radical scavenging properties from Fagreae blumei". *Helvetica Chimica Acta* 80, pp 1144-1152.

Demirel B & Gürdil GAK (2017). Fındık zurufu atığından yakıt briketi elde edilmesi ve brikete ait bazı özelliklerin belirlenmesi. *Anadolu J Agr Sci* 33.

Elliot JG (1999). Application of antioxidantvitamins in foodsandbeverages. *Food Tech* 53: 46-48.

Faydaoğlu E & Sürücüoğlu MS (2011). Geçmisten Günümüze Tıbbi ve Aromatik Bitkilerin Kullanılması ve Ekonomik Önemi. *Kastamonu Üni., Orman Fakültesi Dergisi* 11 (1): 52 – 67.

Gaetani GF, Galiano S, Caanepa L, Ferraris AM & Kirkman HN (1989). Catalase and glutathione peroxidasearee quallyactive in detoxification of hydrogenperoxide in humanerythrocytes. *Blood* 73: 334-339.

Kalita P, Barman Tapan K, Pal Tapan. K & Kalita R (2013). Estimation of total flavonoids content (TFC) and anti oxidant activities of methanolic whole plant extract of Biophytum sensitivum Linn. *Journal of Drug Delivery and Therapeutics* 3(4): 33 – 37.

Kasnak C & Palamutoğlu R (2015). Doğal Antioksidanların Sınıflandırılması ve İnsan Sağlığına Etkileri. *Türk Tarım- Gıda Bilim ve Teknoloji Dergisi* 3(5): 226-234.

Lobo V, Patil A, Phatak A & Chandra N (2010). Free radicals, antioxidants andf unctional foods: İmpact on humanhealth. *Pharmacognosy Reviews* 4: 118-126.

Oğuzkan BS, Uğraş S, Can M, Uzun A, Ülger S, Üzmez Ş, KaragüL B, Kılıç Hİ, Özaslan M & Uğraş Hİ (2016) Fındık (Corylusavellana L.) Yeşil Kabuk ve Yaprak Ekstraklarında Biyolojik Aktivite Tayini. *KSÜ Doğa Bil Derg* 19(4), 373-378, 2016.

Rahimipanah M, Hamedi M & Mirzapour M (2010). Antioxidant activity and phenolic contents of Persianwalnut (Juglans regia L) green husk extract A frican *Journal of Food Science and Technology* Vol. 1(4) pp. 105-111.

Shahidi F, Alasalvar C & Chandrıka M (2007). Antioxidant Phytochemicals in Hazelnut Kernel (Corylusavellana L.) and Hazelnut Byproducts *J. Agric. Food Chem* 2007, 55, 1212-1220.

Shi B, Zhang W, Li X & Xuejun P (2018). Seasonal variations of phenolic profiles and antioxidant activity of walnut (Juglans sigillata Dode) green husks. *International Journal of Food Properties.*

Slinkard K & Singleton VL (1977). Total phenolanalysis: AutomationandComparisonwith Manuel Methods. *Am. J. Enol. Viticult* 28: 49-55.

Stocks J & Dormandy TL (1971). The Autoxidation of Human Red Cell Lipids Induced by Hydrogen Peroxide. *British Journal of Haematology* 575.

Temel M, Tinmaz A. B, Öztürk M & Gündüz O (2018). Dünyada ve Türkiye'de Tıbbi -Aromatik Bitkilerin Üretimi ve Ticareti. *KSÜ Tarım ve Doğa Derg* 21:198-214.

Topuz BK, Kılıç O, Boz İ & Eryilmaz GA (2019). Türkiye'de fındık üretim alanlarının daraltılması politikası. *Akademik Ziraat Dergisi* 8(1): 141-148.

Van der Berg JJ, Op den Kamp JA, Lubin BH, Roelofsen B & Kuypers FA (1992). Kinetics and sitespecificity of hydroperoxide-induced oxidative damage in red bloodcells. *Free Radical Biology and Medicine* 12(6):487-498.

Velioğlu S (2000). Doğal Antioksidanların İnsan Sağlığına Etkileri. *Gıda* 25: 167-176.

Oral Presentation OP-47
Thursday
Hall-2 Mecit Vural Session
Full Text

Investigation of Antioxidant and Antibacterial Properties of Extracts of Rize Tangerine Peel Obtained with Different Solvents

Eda Yılmaz Kutlu[1], Erva Rakıcı[2], Mehtap Atak[1*]

[1]RecepTayyip Erdogan University, Faculty of Medicine, Department of Medical Biochemistry, Rize, Türkiye.

[2]Recep Tayyip Erdogan University, Faculty of Medicine, Department of Medical Microbiology, Rize, Türkiye.

*Corresponding author e-mail: mehtap.atak@erdogan.edu.tr

Abstract

Citrus fruits are the fruit group with the highest production and commercial volume in the world. Satsuma tangerine, known as Rize tangerine, is the most exported species in our country with its early harvest and seedless nature. Today, the use of antioxidant and antimicrobial compounds from natural sources plays an important role in the fighting against diseases. In this context, this study examined the antioxidant and antibacterial properties of extracts obtained from Rize tangerine peel. Previously, methanol, ethanol and ethyl acetate extracts were obtained from tangerine peel. Then, Total Flavonoid Amounts (TFA) and Total Phenolic Matter Amounts (TPMA) were determined to determine the antioxidant capacity in each of these extracts. FRAP, CUPRAC, and DPPH activities were studied to reveal their antioxidant activity. Antibacterial properties *Staphylococcus aureus* ATCC 25923, *E. coli* ATCC 25922, *Pseudomonas aeroginosa* ATCC 27853, *Bacillus subtilis* ATCC 6633, *Enterococcus faecalis* ATCC 29212, *Enterobacter aerogenes* ATCC 13048, *Acinetobacter haemolyticus* ATCC 19002, *Klebsiella pneumoniae* ATCC 13883, *Salmonella typhimurium* ATCC 14028 investigated in different bacterial species. As a result of the studies, it was determined that while no antibacterial activity was found in any methanol, ethanol and ethyl acetate extract of Rize tangerine peel, the antioxidant properties changed depending on the solvent difference. TFA and DPPH activity was higher in methanolic extracts than in ethanolic and ethyl acetate extracts ($p<0,002$), TPMA and CUPRAC ethyl acetate extracts were higher than in methanolic and ethanolic extracts ($p<0,03$, $p<0,01$) and FRAP was higher in ethanolic extracts than in methanolic and ethyl acetate extracts ($p<0,05$). The results obtained reveal that the peels of Rize tangerines, which have a high market volume and value, have the potential to be evaluated as an antioxidant. Thus, it is foreseen that it can contribute to both alternative treatment methods and sustainability in agriculture.

Keywords: Satsuma, Rize tangerine, antioxidant, antibacterial, peel extract.

INTRODUCTION

Plants from the beginning of human history; It is used for many different purposes such as nutrition, shelter, defense, warming and treatment. This centuries-old bond between humans and plants is supported by the findings of archaeological studies. People have benefited from plants to obtain nutrients and to develop solutions to health problems (Kendir & Güvenç, 2010). Especially the chemical drugs used in modern medicine have many negative side effects as well as a single healing active ingredient, which is effective in directing people to natural resources. In recent years, the use of plants in the field of health has become widespread under the names such as alternative medicine and phytotherapy.

Oxidative stress, which disrupts the balance of the antioxidant system in the organism; It causes many different diseases such as cardiovascular diseases, neurodegenerative disorders, cell aging, DNA damage, cancer. It is known that consuming natural antioxidants with nutrition can prevent many diseases related to oxidative stress that may occur or slow the course of the existing disease. For this reason, scientific studies on the determination of the antioxidant capacities of the plants that make up our rich flora, which is a gain of our geographical feature, have increased especially in recent years (Deveci *et. al.*, 2016).

Fruits and vegetables are considered to be the most important plant sources of antioxidants (Apak *et. al.*, 2007). The stems, peels and seeds of fruits produced and consumed all over the world create large amounts of waste (Djilas *et. al.*, 2009). Investigation of these wastes in terms of antioxidant content is very important in order to contribute to sustainability in agriculture as well as to benefit from health.

Citrus plant community, which includes fruit tree species with high economic value, such as citrus, orange, grapefruit, tangerine, lemon, is defined as citrus. It is the most produced fruit group in the world with a production capacity of 115 million tons. Citrus fruits have high economic value in international fruit trade. Our country, on the other hand, ranks fifth in the world in tangerine production with an annual average of 1 million tons of tangerine production (Africa *et. al.*, 2022).

Rize Satsuma tangerine, which meets the majority of tangerine production in our country, stands out because of its seedless structure, early harvest and being the most exported tangerine species in our country. Satsuma tangerine has the potential to withstand temperatures down to -80°C and is one of the most cold-resistant citrus fruits. It has been reported that the antioxidant properties of citrus fruits are due to their ascorbic acid and phenolic acid contents (Zhang *et. al.*, 2011). In the light of available information, in this study, it was aimed to determine their antioxidant capacity and antibacterial

properties by obtaining methanolic, ethanolic and ethyl acetate extracts from Rize Satsuma tangerine peels.

MATERIALS AND METHODS

Preparation of Extracts

Tangerine brought from Cakmacilar village Derepazarı Rize was divided peels. It was left in an oven to dry at 37 °C. The dried tangerine peels parts were pulverized in the grinder. 3 grams of the powdered peel were weighed and extraction was carried out in 100 mL methanol, ethanol and ethyl acetate in a shaker incubator for 24 hours filtered and the solvents were evaporated in the evaporator. The extracts were dissolved in 10% DMSO with the aid of an ultrasonic cleaner at a dry gram weight of 10 mg/mL.

Total Phenolic Matter Amounts (TPMA) Analyzing

The total number of phenolic substances in the extracts was determined spectrophotometrically at 700 nm by the formation of colored complexes with Folin reagents in alkaline medium and the purple-violet colored complex formed (Lowry *et. al.*, 1951). Results are given as mg gallic acid equivalent per gram dry weight of extract (mg GAE/g dry).

Total Flavonoid Amounts (TFA) Analyzing

The total flavonoid content of the extracts was determined spectrophotometrically according to the Aluminum Chloride/Potassium Acetate method (Pallab *et. al.*, 2011). Results are given as mg quercetin per g dry extract weight (mg QE/g dry extract).

Copper Ion Reducing Antioxidant Capacity (CUPRAC) Activity

In the CUPRAC (Cupric reducing antioxidant capacity) method, Cu(I)-neocuproin chelate, which is formed in the presence of antioxidant substance, of Cu (II)-Neocuproin complex formed by Cu (II) of 2,9-dimethyl-1,10-phenanthroline, gives a maximum absorbance at 450 nm method was made based on (Zengin *et. al.*, 2015). Results were expressed as gram extract Trolox equivalent (TECA/g dry extract).

Ferric Reducing Antioxidant Power (FRAP) Activity

FRAP (Ferric reducing ability of plasma) determination was made concerning the method used by Benzie and Strain (Benzie and Strain, 1999). In the method, the Fe(III) -TPTZ (2,4,6-tris(2-pyridyl)-S-triazine) compound is reduced to the blue Fe(II)-TPTZ compound in the presence of antioxidants, and the absorbance of this compound is measured at 595 nm. Results were expressed as gram extract trolox equivalents (mg TEFA/g dry extract).

Free Radical Scavenging Activity (DPPH)

The DPPH radical (2,2-diphenyl-1-picrylhydrazil) is commercially purchased radical, and in this study, 100 µM methanolic solution of this radical was prepared daily in extracts, freshly and using the modified Coudent method (Barut *et. al.*, 2017).

Antibacterial Properties Analyzing

Nine standard strains of microorganisms were used in this study. The strains used were obtained from the Recep Tayyip Erdogan University Medical Microbiology Research Laboratory. American Type Culture Collection (ATCC) strains were used (Table 1). Mueller Hinton agar was used as the medium for bacterial cultures. Sterile media were poured into sterile petri dishes with a diameter of 90 mm and a thickness of 4 mm, and incubated for 18 hours in a 37°C oven for bacteria. The next day, the microorganism densities were adjusted to 0.5 McFarland in physiological saline (SF). Prepared microorganisms were planted in MHA and wells were opened in front of the flame. Then, 40 microliters of extracts prepared with 30 mg/mL concentrations of EtoH, EA, Met were added to the wells. 10% DMSO was used as negative control. Ampicillin and meropenem antibiotic discs were used as positive controls. All processes were completed in a total of half an hour, with each step being 10 minutes. Finally, the samples were incubated for 24 hours at 37ºC. The antibacterial activity of the extracts was examined by the agar well method repeated three times for three times. The diameters of the zones formed after incubation were measured with the help of a millimetric ruler (Malik *et. al.*, 2021).

Table 1. American Type Culture Collection (ATCC) strains.

Bacteria	**Bacteria code**
Escherichia coli	ATCC 25922
Klebsiella pneumoniae	ATCC 13883
Staphylococcus aureus	ATCC 25923
Pseudomonas aureginosa	ATCC 27853
Enterococcus faecalis	ATCC 29212
Bacillus subtilis	ATCC 6633
Enterobacter aerogenes	ATCC 13048
Acinetobacter haemolyticus	ATCC 19002
Salmonella typhimurium	ATCC 14028

Statistical Analysis

The conformity of the data obtained from the results of the biochemical analyzes to the normal distribution was made with the Kolmogorov-Smirnov test. Parametric ones are given as arithmetic mean ($\bar{x}$) and standard deviation (SD). Nonparametric ones were expressed as median and interquartile range. The analysis of variance between groups of normally distributed data was determined by ANOVA test and nonparametric ones were determined by Kruskal Wallis tests (Pairwise comparison Mann-Whitney U analysis). A value of $p<0.05$ was considered statistically significant.

RESULTS

As a result of the studies, it was determined that while no antibacterial activity was found in any methanol, ethanol and ethyl acetate extract of Rize tangerine peel, the antioxidant properties changed depending on the solvent difference.

TPMA, TFA, CUPRAC, FRAP, DPPH Capacity

The antioxidant capacity results of tangerine peel extracts are given in Table 2.

Table 2. Antioxidant capacity results tangerine peel extract.

Extracts With The Different Solvents	Methanol	Ethanol	Ethyl acetate
TPMA (mg GAE/ g dw)	0.74 ± 0.12	0.84 ± 0.08	0.73 ± 0.05a*
TFA (mg QE/ g dw)	0.23 (0.02)b**	0.23 (0.01)	0.35 (0.06)a**
CUPRAC (mg TE/ g dw)	2.45± 0.28b*	2.51 ± 0.22	2.17 ± 0.13a*
FRAP (mg TE/ g dw)	0.47 ± 0.01b**	0.51 ± 0.02c*	0.36 ± 0.06a**
DPPH (SC50, mg/mL)	0.66 ± 0.07b**	0.57 ± 0.06c*	0.52 ± 0.05

* = p<0,05, ** = p<0001
a: Statistically significant difference from the ethanolic extract.
b: Statistically significant difference from the ethyl acetate extract.
c: Statistically significant difference from the methanol extract.

DISCUSSION

Although the extraction method in Özkaynak and Saral's study with tangerine peel extracts is different from the method in our study, our CUPRAC and FRAP results are similar for the extract obtained with each solvent (Özkaynak Kanmaz & Saral, 2017).

Balaky *et. al.* (Balaky *et. al.*, 2020) used microwave extraction method and water and ethanol as solvents in their study with tangerine peels. The total amount of phenolic substances in our study (0.84

mg GAE / g dry weight) was determined lower than Balaky *et. al.* (1.87 mg GAE / g dry weight). The total amount of flavonoids was found to be higher in our study (0.23 mg QE/ g dry weight) than in the study of Balaky *et. al.* (0.19 mg QE/ g dry weight).

Again, Balaky *et. al.* examined antimicrobial activity in 6 different bacterial species and found activity only in *Staphylococcus aureus* ATCC29213. In our study, no actimicrobial activity was observed in any of the 9 different bacterial species. It is thought that this may be due to the difference in both the extraction method and the type of tangerine investigated (Balaky *et. al.*, 2020).

CONCLUSIONS

The results obtained reveal that the peels of Rize tangerines, which have a high market volume and value, have the potential to be evaluated as an antioxidant. Thus, it is foreseen that it can contribute to both alternative treatment methods and sustainability in agriculture.

ACKNOWLEDGEMENTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Africa S, Orange F & Higher EC (2022). *South Africa Fresh Orange Production and Exports Climb Higher*. *July*, 1–13. https://apps.fas.usda.gov/psdonline/circulars/citrus.pdf

Apak R, Güçlü K, Demirata B, Özyürek M, Çelik SE, Bektaşoğlu B, Berker KI & Özyurt D (2007). Comparative evaluation of various total antioxidant capacity assays applied to phenolic compounds with the CUPRAC assay. *Molecules*, *12*(7): 1496–1547. https://doi.org/10.3390/12071496

Balaky HH, Galali Y., Osman AA, Karaoğul E, Altuntas E, Uğuz MT, Galalaey AMK & Alma MH (2020). Evaluation of antioxidant and antimicrobial activities of mandarin peel (*Citrus reticulata blanco*) with microwave assisted extract using two different solvents. *Asian Journal of Plant Sciences*, *19*(3): 223–229. https://doi.org/10.3923/ajps.2020.223.229

Barut EN, Barut B, Engin, S, Yıldırım S, Yaşar A, Türkiş S, Özel A & Sezen FS (2017). Antioxidant capacity, anti-acetylcholinesterase activity and inhibitory effect on lipid peroxidation in mice brain homogenate of *Achillea millefolium*. *Turkish Journal of Biochemistry*, *42*(4): 493–502. https://doi.org/10.1515/tjb-2017-0084

Benzie IFF & Strain JJ (1999). Ferric reducing/antioxidant power assay: Direct measure of total antioxidant activity of biological fluids and modified version for simultaneous measurement of

total antioxidant power and ascorbic acid concentration. *Methods in Enzymology*, *299*(1995): 15–27. https://doi.org/10.1016/S0076-6879(99)99005-5

Deveci HA, Nur G, Kirpik MA, Harmankaya A & Yildiz Y (2016). Fenolik Bileşik İçeren Bitkisel Antioksidanlar. *Kafkas Üniversitesi Fen Bil. Enst. Derg*, *9*(1): 26–32.

Djilas S, Čanadanović-Brunet J & Ćetković G (2009). By-products of fruits processing as a source of phytochemicals. *Chemical Industry and Chemical Engineering Quarterly*, *15*(4): 191–202. https://doi.org/10.2298/CICEQ0904191D

Kendir G & Güvenç A (2010). Etnobotanik ve Türkiye ' de Yapılmış Etnobotanik Çalışmalara Genel Bir Bakış. *Hacettepe Üniversitesi Eczacılık Fakültesi Dergisi*, *30*(1): 49–80.

Lowry OH, Rosebrough NJ, Farr AL & Randall RJ (1951). Protein measurement with the Folin phenol reagent. *The Journal of Biological Chemistry*, *193*(1): 265–275. https://doi.org/10.1016/s0021-9258(19)52451-6

Malik A, Najda A, Bains A, Nurzyńska-Wierdak R & Chawla P (2021). Characterization of *Citrus nobilis* peel methanolic extract for antioxidant, antimicrobial, and anti-inflammatory activity. *Molecules*, *26*(14). https://doi.org/10.3390/molecules26144310

Özkaynak Kanmaz E & Saral Ö (2017). the Effect of Extraction Parameters on Antioxidant Activity of Subcritical Water Extracts Obtained From Mandarin Peel. *Gida / the Journal of Food*, *42*(4): 405–412. https://doi.org/10.15237/gida.gd16073

Pallab K, Tapan KB, Tapas KP & Ramen K (2011). Research Article Estimation of Total Flavonoids Content (Tfc) and Anti Oxidant Activities of Methanolic Whole Plant Extract of Biophytum Sensitivum Linn. *Journal of Drug Delivery and Therapeutics*, 10(1): 33–37.

Zengin G, Uysal S, Ceylan R & Aktumsek A (2015). Phenolic constituent, antioxidative and tyrosinase inhibitory activity of *Ornithogalum narbonense* L. from Turkey: A phytochemical study. *Industrial Crops and Products*, 70: 1–6. https://doi.org/10.1016/j.indcrop.2015.03.012

Zhang F, Hu L, Xu G & Chen Q (2011). Changes of some chemical substances and antioxidant capacity of mandarin orange segments during can processing. *Procedia Environmental Sciences*, 11(PART C): 1260–1266. https://doi.org/10.1016/j.proenv.2011.12.189

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-55
Friday
Hall-2 Ender Yurdakulol Session
Full Text

Effect of Different Auxin Types on Adventitious Root Induction from Leaf Explants of *Echinacea pallida*

Münüre Tanur Erkoyuncu[1*], Havva Çağlar[1], Mustafa Yorgancılar[1]

[1]Selcuk University, Faculty of Agriculture, Department of Field Crops, Konya, Türkiye

*Corresponding author e-mail: mtanur@selcuk.edu.tr

Abstract

Adventitious root cultures of medicinal plants are considered as a source of raw material for pharmaceutical industries. In this study, it was aimed to examine the effects of different auxin types of *Echinacea pallida*, which has medical and economic importance, on adventitious root induction and root growth from leaf explant. For this purpose, leaf explants were taken into MS medium containing NAA, IAA and IBA at 0.5, 1.0 and 2.0 mg/L concentrations. At the end of the culture period, adventitious root induction occurred successfully in media containing IAA and IBA, while root induction did not occur in media containing NAA. As a result of the research, based on the root induction rate (%) and root fresh weight (mg), it was determined that the most effective growth regulator in adventitious root induction from the leaf explant was IBA, and the most appropriate concentration was 0.5 mg/L.

Keywords: Adventitous root, auxin, Echinacea, leaf.

INTRODUCTION

Echinacea Moench is a perennial herbaceous plant with the high ornamental and medicinal value belonging to the Asteraceae family (Viles and Reese 1996). Echinacea genus contains nine species including the *Echinacea pallida* (Nutt.) Nutt., *Echinacea purpurea* (L.) Moench, and *Echinacea angustifolia* D.C., which are the most important species used in the drug production. They have also been widely explored because of their increasing economic value and valuable medicinal functions (Cui *et. al.* 2013). The chemical composition of Echinacea species basically consists of four groups of bioactive components: phenolic compounds (caffeic acid derivatives), alkamides (alkylamides), glucoproteins and polysaccharides (Bruni *et. al.* 2018). Caffeic acid derivatives (cichoric acid, echinacoside, chlorogenic acid, caftaric acid, caffeic acid and cynarin,) are characteristic phenolic compounds of Echinacea species (Barnes *et. al.* 2005). Compared with other commercially utilized species, *E. pallida* is phytochemically unique with regard to accumulation of phenolic compounds and alkylamides; this characteristic contributes to its biological activities (Bauer and Wagner 1991). *E.*

pallida specifically has been recognized for its anti-inflammatory and cicatrizing activity (Speroni *et. al.* 2002), antimicrobial activities (Jamshidi *et. al.* 2014) and antioxidant activities (Mishima *et. al.* 2004).

Plant cell, tissue, and organ cultures with the production of secondary metabolites are promising potential alternative sources for the production of pharmaceutical agents of industrial importance. Among these cultures, in vitro-induced adventitious roots (ARs) are considered good biological materials due to their rapid growth rate and stable commercial production of secondary metabolites (Wu *et. al.* 2018). Thus, high product concentrations and efficiency can be achieved by optimizing the *in vitro* AR culture conditions. In many plant species, AR cultures have been widely used to produce bioactive compounds such as ginsenosides (Hahn *et. al.* 2003) glycyrrhetinic acid (Yin *et. al.* 2014), phenolics (Jiang *et. al.* 2015) and caffeic acid derivatives (An *et. al.* 2021). To date, Echinacea AR culture has been systematically studied in two Echinacea species, namely, *E. purpurea* and *E. angustifolia*, however, only few studies have addressed the species of *E. pallida*. The detail studies of *E. pallida* AR culture for efficient production of metabolites should therefore be investigated (Wu *et. al.* 2006; Jeong *et. al.* 2009; Wu *et. al.* 2013; Wu *et. al.* 2018). Here, we examined the effect of different auxin types on adventitious roots are formed by direct organogenesis from leaf explants of *Echinacea pallida*.

MATERIALS AND METHODS

Plant material and induction of adventitious root

In vitro grown green leaves of *E. pallida* were used as explants for the induction of adventitious roots. Leaves from 8-week old sterile seedlings maintained in solid basal Murashige and Skoog (MS, 1962) media were used for the study. Leaf pieces of 10x10 mm size were placed on solid MS media with 3 % sucrose and 0.2 % gelrite (Wu *et. al.* 2006) supplemented with varying concentration (0.5–1.0-2.0 mg/L) and combinations of IAA, IBA and NAA in petri dishes for adventitious root induction. The media were adjusted to pH 5.8 with 1 M NaOH prior to autoclaving at 121°C for 20 min. All the cultures were kept in the growth cabinet (Sanyo: MLR-351H) at 24±2°C, 65% humidity, under darkness. All experiments were performed in triplicate with 30 explants per each treatment. Frequency of root induction was determined as mean percentage of the explants producing roots after 5 weeks of incubation. The adventitious root that developed from each explant was weighed on a precision scale, and the fresh weight was recorded as mg.

Statistical analysis

Analysis of variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) was performed on SPSS Statistics 17 (SPSS Inc., Chicago, IL, USA) to determine statistical differences ($P < 0.01$) between means of groups.

RESULTS

Initiation of adventitious roots

Root formation and root fresh weight were analyzed separately, and mean values are given in Table 1. The effects of different types and concentrations of auxins on root formation percent (%) and root fresh weight (mg) were found to be statistically significant ($P < 0.01$).

Adventitious roots were initiated on leaf explants in media with different combinations of plant growth regulators (PGR) after period of 10–15 days. The time for root induction varied with concentrations and combinations of PGRs present. Root induction was observed in all media supplemented with combinations of IAA with IBA (Fig. 1). Especially, low concentrations (0.5 mg/L) of IBA and IAA have been found to give the best results in adventitious root induction from leaf explant in *E. pallida*. Media with high IAA and IBA concentration was found to induce a greater number of small fluffy roots. All NAA concentration did not induce roots. Compared to other auxin types of NAA concentrations, callus induction rather than root induction was observed. In terms of root formation percentage, low concentrations of IBA and IAA were determined as the best medium, fresh root weight remained low at all IAA concentrations compared to IBA. Thicker roots were obtained in media containing 0.5 mg/L IBA and 1.0 mg/L IBA. 0.5 mg/L IBA was determined as the best auxin type and concentration in terms of both root formation percentage and fresh root weight.

Table 1. Adventitious root induction on leaf explants of *E. pallida* in different concentrations and combination of IBA, IAA and NAA.

Growth Regulators (mg/L)		**Root Formation Percent (%)**	**Root Fresh Weight (mg)**
IBA	0.5	25a	11.63a
	1.0	12b	12.88a
	2.0	7bc	4.71b
NAA	0.5	0c	0c
	1.0	0c	0c
	2.0	0c	0c
IAA	0.5	23a	4.53b
	1.0	7bc	4.00b
	2.0	13b	0.63c
* According to Duncan multiple comparison test, there is a 5% difference between the means expressed with different letters in the same column.			

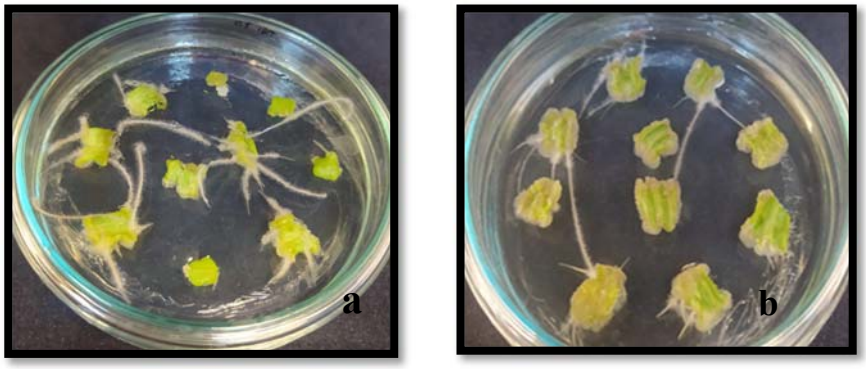

Figure 1. Adventitious root induction at 0.5 mg/L IBA (a), at 0.5 mg/L IAA (b)

DISCUSSION

The formation of adventitious roots mainly depends on anatomical status. Induction and differentiation pathways in the rooting process can be stimulated by artificially providing certain auxin hormones (Praveen *et. al.* 2009). In addition, physiological stages of rooting can be affected by changes in endogenous auxin concentrations.

IBA is the most suitable auxin for induction and development of adventitious root culture of medicinal plants (Rahmat and Kang, 2019). This had been reported in many plant species such as *E. angustifolia* (Wu *et. al.* 2006), *Panax ginseng* (Kim *et. al.* 2003), *Podophyllum hexandrum* (Rajesh *et. al.* 2012) *Silyabum marianum* (Riasat *et. al.* 2015). However, the response of adventitious roots to different auxins depends on the plant species. For example, treatment with IAA is more effective than NAA in promoting biomass production from root cultures of *Orthosiphon stamineus* (Ling *et. al.* 2009). In contrast, in the adventitious root culture study of the medicinal plant *Andrographis paniculata*, higher biomass accumulation (fresh and dry weight) was obtained in NAA compared to IAA and IBA (Praveen *et. al.* 2009) In other hand, according to Zolman et al., (2000), superior activity in rooting response also might be due to the differences in transport, uptake, degradation or metabolism of the plant used. Besides, more energy are used up to converting synthetic auxins, NAA to natural form IAA before have been used by explants lead to insufficient energy for cell growth and development during root formation (Krisantini *et. al.* 2006). Finally, naturally occurring auxins (IAA or IBA) show different effects on the induction and elongation of roots compared with synthetic auxins e.g., NAA (Biondi *et. al.* 1997).

CONCLUSIONS

The rapid advancement in biotechnology has rendered adventitious root cultures as one of the main choices for secondary metabolite production from medicinal plants. Many studies have been

conducted to produce active compounds from medicinal plants using adventitious root culture techniques. Different improvements and process optimizations have been examined to enhance the secondary metabolites production in adventitious root cultures. However, both physical and chemical optimization is essential to produce abundant and high-quality yields. These optimization processes include proper culture conditions, the suitability of the type of media used, elicitation, and other influential parameters. In addition, scale-up production using bioreactors is also important to meet the market demands for natural drugs to cure various diseases. However, the scale-up process still needs to be optimized before it is applied for industrial production.

ACKNOWLEDGEMENTS

This study was produced from the Havva Çağlar's master's thesis. The authors acknowledge the financial support of this study by the Scientific Research Project Center, Selcuk University (Project ID: 21201032/BAP).

REFERENCES

An D, Wu CH, Wang M, Wang M, Chang GN, Chang XJ & Lian ML (2022). Methyl jasmonate elicits enhacement of bioactive compound synthesis in adventitious root co-culture of *Echinacea purpurea* and *Echinacea pallida. In Vitro Cellular & Developmental Biology-Plant* 58(1): 181-187.

Barnes J, Anderson LA, Gibbons S & Phillipson JD (2005). *Echinacea* species (*Echinacea angustifolia* (DC.) Hell., *Echinacea pallida* (Nutt.) Nutt., *Echinacea purpurea* (L.) Moench): a review of their chemistry, pharmacology and clinical properties. *Journal of Pharmacy and Pharmacology* 57 (8): 929-954.

Bauer R & Wagner H (1991). *Echinacea* species as potential immunostimulatory drugs. In: Farnsworth NR, Wagner H (eds) Phytomedicines of Europe: chemistry and biological activity. Academic, New York, pp 253–317.

Biondi S, Lenzi C, Baraldi R & Bagni N (1997). Hormonal effects on growth and morphology of normal and hairy roots of *Hyoscyamus mutics. J Plant Growth Regul* 16:159-167.

Bruni R, Brighenti V, Caesar LK, Bertelli D, Cech NB & Pellati F (2018). Analytical methods for the study of bioactive compounds from medicinally used *Echinacea* species. *J Pharm Biomed Anal* 160: 443-477.

Cui HY, Baque MA, Lee EJ & Paek KY (2013). Scale-up of adventitious root cultures of *Echinacea angustifolia* in a pilot-scale bioreactor for the production of biomass and caffeic acid derivatives. *Plant Biotechnol. Rep*. 7: 297–308.

Hahn EJ, Kim YS, Yu KW, Jeong CS & Paek KY (2003). Adventitious root cultures of *Panax ginseng* C.A. Meyer and ginsenoside production through large-scale bioreactor system. *J Plant Biotech* 5: 1-6.

Jamshidi M, Barzegar M & Sahari MA (2014). Effect of gamma and microwave irradiation on antioxidant and antimicrobial activities of *Cinnamomum zeylanicum* and *Echinacea purpurea. Int Food Res J* 21: 1289–1296.

Jeong JA, Wu CH, Murthy HN, Hahn EJ & Paek KY (2009). Application of an airlift bioreactor system for the production of adventitious root biomass and caffeic acid derivatives of *Echinacea purpurea. Biotechnol Bioprocess Eng* 14: 91–98.

Jiang YJ, Piao XC, Liu JS, Jiang J, Lian ZX, Kim MJ & Lian ML (2015). Bioactive compound production by adventitious root culture of *Oplopanax elatus* in balloon-type airlift bioreactor systems and bioactivity property. *Plant Cell Tissue Organ Cult* 123: 413–425.

Kim YS, Hahn EJ, Yeung EC & Paek KY (2003). Lateral root development and saponin accumulation as affected by IBA or NAA in adventitious root cultures of *Panax ginseng* CA Meyer. *In Vitro Cell Dev Biol Plant* 39: 245-249.

Krisantini S, Johnston M, Williams RR & Beveridge C (2006). Adventitious root formation in *Grevillea (*Proteaceae*),* an Australian native species. *Scientia Horticulturae* 107(2): 171-175.

Ling APK, Chin MF & Hussein S (2009). Adventitious Root Production of *Centella asiatica* in response to plant growth regulators and sucrose concentration. *Medicinal Aromatic Plant Sci Biotechnol* 3(1): 36-41.

Mishima S, Saito K, Maruyama H, Inoue M, Yamashita T, Ishida T & Gu Y (2004). Antioxidant and immuno-enhancing effects of *Echinacea purpurea*. *Biol Pharm Bull* 27: 1004–1009.

Murashige T & Skoog F (1962). A revised medium for rapid growth and bio assays with tobacco tissue cultures, *Physiologia Plantarum* 15 (3): 473-497.

Praveen N, Manohar SH, Naik PM, Nayeem A, Jeong JH & Murthy HN (2009). Production of androghrapholide from adventitious root cultures of *Andrographis paniculata*. *Curr Sci* 96: 5-10.

Rahmat E & Kang Y (2019). Adventitious root culture for secondary metabolite production in medicinal plants: a review. *J Plant Biotechnol* 46: 143–157.

Rajesh M, Jeyaraj M, Sivanandhan G, Subramanyam K, Dev GK & Ganapathi A (2012). Adventitious root culture in *Podophyllum hexandrum* Royle (syn. *P. emodi* Wall. ex Hook.f. & Thomas) - An important medicinal plant. *J Biotechnol Biomater* 2: 6.

Riasat R, Riasat Z, Abbasi BH, Liu C & Khan MA (2015). *Silybum marianum:* adventitious roots induction along with free radical scavenging activity. *J Plant Biol Res* 4(1):12-21.

Saiman MZ, Mustafa NR, Schulte AE, Verpoorte R & Choi YH (2012). Induction, characterization, and NMR-based metabolic profiling of adventitious root cultures from leaf explants of *Gynura procumbens*. *Plant Cell Tissue Organ Cult* 109: 465–475.

Speroni E, Govoni P, Guizzardi S, Renzulli C & Guerra MC (2002). Antiinflammatory and cicatrizing activity of *Echinacea pallida* Nutt. root extract. *J Ethnopharmacol* 79: 265–272.

Viles AL & Reese RN (1996). Allelopathic potential of *Echinacea angustifolia* DC. *Environmental and Experimental Botany* 36: 39–43.

Yin S, Zhang Y, Gao W, Wang J, Man S & Liu H (2014). Effects of nitrogen source and phosphate concentration on biomass and metabolites accumulation in adventitious root culture of *Glycyrrhiza uralensis* Fisch. *Acta Physiologiae Plantarum* 36(4): 915-921.

Zolman BK, Yoder A & Bartel B (2000). Genetic analysis of indole-3-butyric acid responses in *Arabidopsis thaliana* reveals four mutant classes. *Genetics* 156(3): 1323-1337.

Wu CH, Dewir YH, Hahn EJ & Paek KY (2006). Optimization of culturing conditions for the production of biomass and phenolics from adventitious roots of *Echinacea angustifolia. Journal of Plant Biology* 49 (3): 193.

Wu CH, Wang M, Song H & Cui X (2013). Medium salt strength and sucrose concentration affect root growth and secondary metabolite contents in adventitious root cultures of *Echinacea pallida. Nat Prod Res Dev* 25: 1167–117.

Wu CH, Tang J, Jin ZX, Wang M, Liu ZQ, Huang T & Lian ML (2018). Optimizing co-culture conditions of adventitious roots of *Echinacea pallida* and *Echinacea purpurea* in air-lift bioreactor systems. *Biochem Eng J* 132: 206–216.

Oral Presentation OP-56
Friday
Hall-2 Ender Yurdakulol Session
Full Text

The Effects of Some Antimitotic Chemicals on the Induction of Polyploidy in Red Globe Grape Cultivar

Heydem Ekinci[1*], Kevser Yazar[2]

[1]Harran University, Faculty of Agriculture, Department of Horticulture, Şanlıurfa, Türkiye.

[2]Selcuk University, Faculty of Agriculture, Department of Horticulture, Konya, Türkiye.

*Corresponding author e-mail: heydemekinci@harran.edu.tr

Abstract

Grapes are evaluated worldwide in three main ways as table grapes, wine grapes, and raisins. It is important to improve the characteristics of existing grape cultivars and to breed new cultivars suitable for changing market conditions. Polyploidization is an important tool for the generation of new gene sources in plant breeding. Plants with increased ploidy can gain better qualities than their original diploids in some features such as grain size, leaf size, and resistance to phylloxera. Ploidy can be induced by using many antimitotic agents (colchicine, oryzalin, etc.). In his study applied 5 g L^{-1}, 6 g L^{-1}, 7 g L^{-1} colchicine, and 10, 20, and 30 µM oryzalin doses to the Red Globe cultivar. The cuttings were placed in a polyethylene container with the shoot tips touching the solution and shaken for 6 hours in a shaker at 120 rpm. The effects of the application were evaluated by examining stomatal width and length, chloroplast counts, and flow cytometry (FC) analysis. It has been determined that colchicine and oryzalin applications cause morphological changes. Statistical differences were determined between the treatments and the control group in stoma length, stoma width, and stoma area values. As a result of FC analysis, it was determined that there were no cytological changes in genotypes determined to be morphologically different. In FC analyzes, it was determined that the ploidy level of the genotypes did not change (2n=2x).

Keywords: Grapevine, flow cytometry, antimitotic agent, polyploidy.

INTRODUCTION

Grapevine (*Vitis vinifera* L.) is accepted one of the most important for me in terms of the area grown and its economic value. Grapes are used in the production of table, raisin, wine and fruit juice. Table grape market is in an increasing trend. Global climate change creates a high demand for adaptation to environmental conditions and new grape varieties are needed to meet market demands

(Bouquet *et. al.* 2006; Kara and Yazar, 2021). One of the ways to develop new varieties is polyploidy applications.

Polyploidy is the state of having more than two sets of chromosomes and also serves as an important mechanism for plant evolution (Tavan *et. al.* 2015). Polyploids often produce variants that may contain beneficial properties. Larger and stronger structures of leaves, roots, seeds and flowers are formed in polyploids obtained in different ways than diploids (Motosugi *et. al.* 2002). Recovery of fertility and equalization of chromosome numbers by mitotic polyploidization can be achieved by using mitotic inhibitors. Both colchicine and oryzalin are antimitotic agents and are widely used in polyploidization (Thao *et. al.* 2003). Although oryzalin has been proven to be an effective alternative, colchicine has been used for many years (Kermani *et. al.* 2003; Dunn and Lindstrom, 2007). Both act as spindle inhibitors by disrupting spindle microtubules in mitosis; however, colchicine has been shown to cause mutagenic effects. The success rate of using these chemicals in chromosome doubling varies depending on the plant species, concentration levels and application time.

In this study, the development of new genotypes from the 'Red Globe' grape variety, which attracts attention with its superiority of fruit quality characteristics as well as the suitability of mid-late season adaptation, chromosome doubling was tried with chemical mutagen applications in order to add plant material to the gene pool and to improve their phenolic contents in a positive way. For this purpose, different doses of colchicine and oryzalin were applied to the growing shoots by rooting the single bud cuttings in the greenhouse, and their effects on ploidy development were investigated by following the morphological and cytological changes.

MATERIALS AND METHODS

Plant Material

In the study, 'Red Globe' grape variety (Hurisa x Emperor) x Nacera obtained in California and registered in 1980 was used. In terms of grain characteristics, its color is pinkish red, its shape is round, slightly elliptical, its size is large (12-14 g), its taste is neutral. Cluster features are conical in shape, average weight is 1000 g and plump. 'Red Globe' is an important grape variety with seeds, mid-late season, maturing in August-September, with clusters of 1.0-1.5 kg, sweet, juicy, fleshy, crispy textured and sought after for export (Çelik, 2002; Dilbaz *et. al.* 2002).

Chemical Mutagen Colchicine and Oryzalin Applications

In this study, 0, 5 g L^{-1}, 6 g L^{-1}, 7 g L^{-1} colchicine and 10, 20, 30 µM oryzaline doses were applied to Red Globe grape variety. The cuttings were placed in a polyethylene container with the shoot tips touching the solution and shaken for 6 hours in a shaker at 120 rpm. The effects of the

application were evaluated by examining stomatal width and length, chloroplast counts and flow cytometry (FC) analysis. It has been determined that colchicine and oryzalin applications cause morphological changes. Statistical differences were determined between the treatments and the control group in stoma length, stoma width and stoma area values. The experiment was arranged in 3 replications according to the randomized plots experimental design, and 15 cutting were used in each application, with 5 plants in each replication. The numerical values obtained were compared with Student's t-test at the 0.05 significance level in SPSS 17.0 and JMP statistical programs.

Stoma observations

Stoma measurements were made to determine the ploidy level of 'Red Globe' plants and the tetraploid 'Kyoho' grape variety was used to compare the ploidy level. Transparent nail polish was applied in a 1×3 cm area with a special brush on the lower epidermis of the leaf samples taken from the applied cuttings. After the nail polish dried, the mold was removed with adhesive acetate and placed on the slide. The stomatal dimensions of the samples were measured under a microscope with a x40 magnification objective and x10 magnification ocular micrometer (Boso *et. al.* 2016; Kara *et. al.* 2018).

Chloroplast counting

The chloroplast counting was performed to determine the ploidy level of the leaf examples taken from cuttings. The diploid parents and tetraploid 'Kyoho' to comparated. Firstly, fresh leaf was discoloured in Carnoy solution, then immersed in sterile water for 2-5 min, and then stained with 1% I-KI solution for 30 s. Finally, chloroplast number was counted under the light microscope (Olympus BX40, Shinjuku, Tokyo, Japan) at 40× and 100× magnification (Yuan *et. al.*2009).

Flow Cytometry (FC) Analysis

Sections of 0.5 cm^2 were taken from the leaf samples, placed in a petri dish, and 500 µL of isolation buffer (Partec-Nuclei Extraction Buffer) was added and the leaf tissue was cut into small pieces using a razor blade. The samples in the petri dish were shaken for 10-15 seconds and transferred into a tube (Partec-Sample Tubes, 3.5 ml, 55×12 mm) after filtering with a PartecCellTrics 30 µm-green filter. 1600 µL of staining solution [Partec-DAPI (4,6 diamidino-2-phenylindole) Staining Buffer] was added to the tubes and kept in a light-isolated medium for 5 minutes. Afterwards, the samples were analyzed in the FC device (Yazar, 2018). The DNA content of the samples was compared with the Red Globe grape variety with 2x DNA content.

Statistical analyzes

The experiment was conducted in completely randomized design, with 3 repetitions, and with 10 shoot tips per repeat. The effects of the applications dose and duration interaction were compared in the JMP 13.0 Statistical Program with the Tukey test at $p<0.05$ significance level (Yue *et. al.* 2017).

RESULTS AND DISCUSSION

Survival rates of shoot tips (%)

The shoot tip viability rates varied according to the antimitotic chemicals and doses used. Considering the effect of applications on the rate of survival shoot tip; as a result of the toxic effect, the minimum viability rate among colchicine applications was obtained at 6 and 7 g/L^{-1} doses, while the minimum viability rate was determined at O-30 µM in oryzaline applications. In both applications, a decrease in viability was observed with increasing dose amount. When mutagens were compared, it was determined that cuttings responded more sensitively to oryzalin than colchicine (Figure 1). Antimitotic agents, especially applied at high concentrations, generally reduce plant viability (Zakizadeh *et. al.* 2020; Kara and Doğan, 2022).

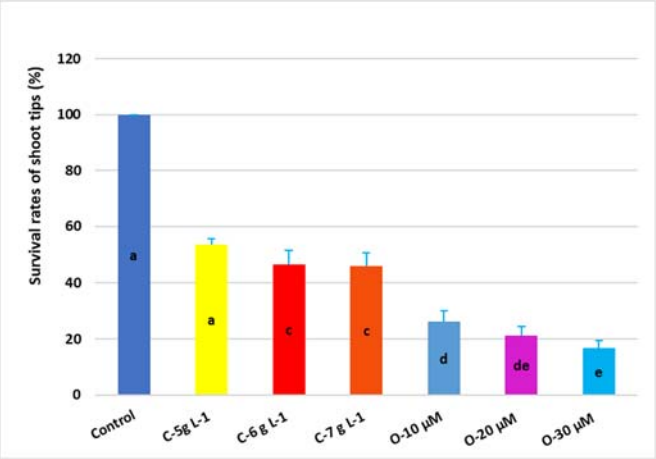

Figure 1. Survival rates of shoot tips (%) (C: Colhicine, O: Oryzaline)

Stoma sizes (µm) and stoma density (mm^{-2})

The effects of the applications differed according to the applications, and increases in stoma sizes were detected. Applications caused an elongation in stomatal length at the application doses of 5 g/L^{-1} colchicine and 10 µM oryzalin compared to the control. An increase in stomatal width occurred in C-5 g/L^{-1} and O-10 µM applications (Figure 2). The stomatal density decreased in the applications of 5 g/L^{-1} colchicine, 10 and 20 µM oryzaline (Figure 2). Examination of stomatal characteristics in ploidy studies is important in terms of eliminating plant materials that do not show any change. In plant

materials with increasing ploidy, stomatal length and width increase, while stomatal density decreases (Kara and Yazar, 2021).

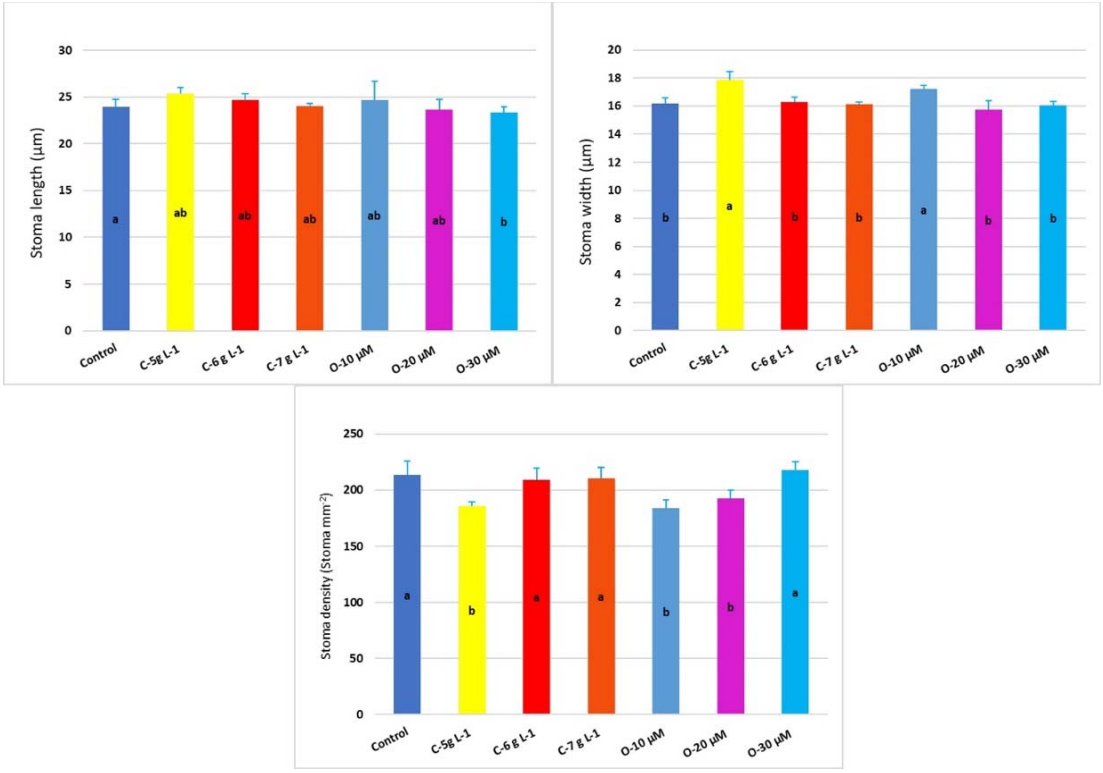

Figure 2. Mutagenic effects on stoma density, length, and width.

Chloroplast counting

Chloroplast numbers of plant materials were determined as half of the chloroplast number of 'Kyoho' grape variety in control, C-6 g/L^{-1}, C-7 g/L^{-1}, O-20 µM and O-30 µM applications. A difference was observed in the C-5 g/L^{-1} application dose. The difference between the number of chloroplasts in the stomatal guard cells of the tetraploid 'Kyoho' grape variety and the chloroplast numbers in colchicine and oryzalin applications was found to be significant. Although it varies according to the applications, it was determined that the number of chloroplasts varied in the range of 20-25, while the chloroplast numbers of the 'Kyoho' grape variety were in the range of 38-40 (Figure 3). The ploidy level of plants can be identified early, quickly and reliably with high accuracy by chloroplast counting (Yuan *et. al.* 2009). To date, an association between ploidy level in some fruit species and chloroplast number in stomatal guard cells has been reported. Chloroplast numbers vary significantly in stomatal guard cells of plants with different ploidy levels (Zhang *et. al.* 2010; Ekinci, 2019).

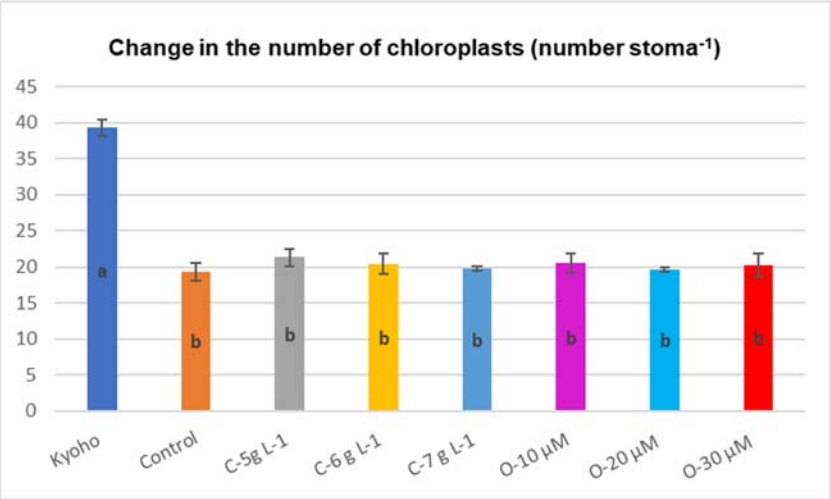

Figure 3. Changes in the number of chloroplasts (number stoma^{-1})

SPAD value

Leaf chlorophyll content is one of the methods used to determine the ploidy level. As a result of oryzalin applications, the highest chlorophyll content was determined at the dose of O-10 µM oryzalin, while it was determined at the dose of C-5 g/L^{-1} in colchicine applications (Figure 4). Many studies support the formation of irregularity in the data obtained in practice (Boger, 1998; Doğan, 2022). Huy *et. al.* (2019) reported that it manifests itself with increased chloroplast number, increased chlorophyll ratio and greener leaves in plants with changing ploidy level. Huy *et. al.* (2019) reported that it manifests itself with increased chloroplast number, increased chlorophyll ratio and greener leaves in plants with changing ploidy level.

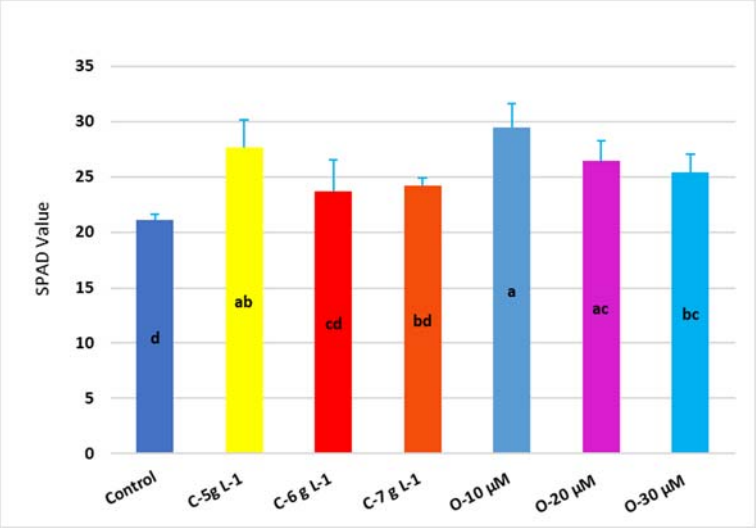

Figure 4. Changes in the *SPAD value*

Flow Cytometry (FC) Analysis

Flow cytometry was used to verify the ploidy level in the treated cuttings. This technique has proven to be more accurate and faster than traditional methods such as chromosome counting or measuring stomatal length (Sgorbati *et. al.* 1986; Ollitrautt-Sammarcelli *et. al.* 1994; Tosca *et. al.* 1995; O'Brien *et. al.* 1996; Pinheiro *et. al.* 2000; Vainola, 2000). Fresh leaf samples (3-4 weeks old) were taken for FC analysis from plants, which were predicted by chloroplast counts with different ploidy levels, which were treated with chemical mutagens. As a result of FC analysis, it was determined that the ploidy levels of the samples examined did not change and they preserved their diploid forms (Figure 5).

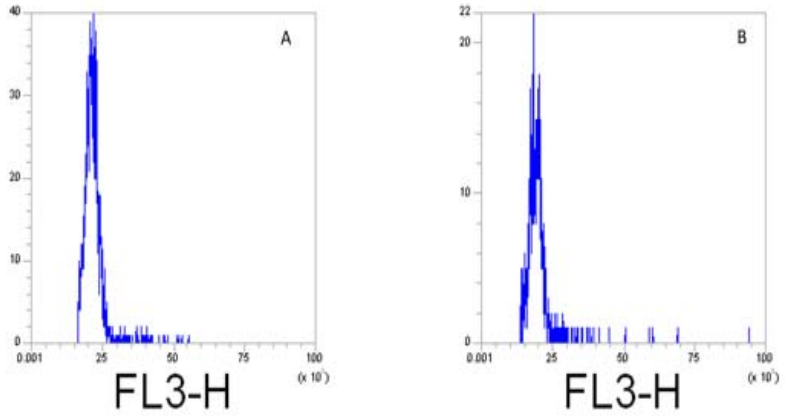

Figure 5. FC analysis result of diploid control plant (a) and mutagen treated and selected 'Red Globe' sample (b).

CONCLUSIONS

Although stomatal characteristics, which is an indirect method in defining polyploidy, did not give definite results, it gave the opportunity to pre-select the plants that were thought to have no change in estimating the ploidy level when working with a large number of plants. Morphological and anatomical observations demonstrating chromosome folding are simple and can often be mistaken. Some of the most used features are stoma-related. Stoma characteristics are affected by environmental factors. For this reason, illusions can often occur. In accordance with the FC analyzes of the materials that differed in the stoma analysis used in the preliminary evaluation, folded plant material could not be detected. Our study will provide resources for future studies. The chemical mutagens used in the study are recommended to be used in different types and doses.

REFERENCES

Boger P (1998). Carotenoid biosynthesis inhibitor herbicides-mode of action and resistance mechanism, *Pesticide Outlook* 9: 29-35.

Boso S, Gago P, Alonso-Villaverde V, Santiago J & Martinez M (2016). Density and size of stomata in the leaves of different hybrids (*Vitis* sp.) and *Vitis vinifera* varieties, *Vitis* 55 (1): 17-22.

Bouquet A, Torregrosa L, Iocco P & Thomas MR (2006). Grapevine (*Vitis vinifera* L.), In: *Agrobacterium Protocols* Volume 2, (ed): Springer, p. 273-285.

Çelik H (2002). Üzüm Çeşit Kataloğu, Sunfidan A.Ş. Mesleki Kitaplar Serisi 2, p. 137.

Dilbaz R, Özdemir AE, Dündar Ö & Ertürk E (2002). Red Globe ve Black Pearl üzüm çeşitlerinde meyve kalitesi ve olgunluk durumlarının saptanması. II. Bahçe Ürünlerinde Muhafaza ve Pazarlama Sempozyumu Çanakkale 254-262.

Doğan O (2022). Azot Protoksit ve Orizalinin '41 B' ile 'Fercal' asma anaçlarında mutajenik etkileri. Doktora, T.C. Selçuk Üniversitesi Fen Bilimleri Enstitüsü 130.

Dunn BL & Lindstrom JT (2007). Oryzalin-induced chromosome doubling in Buddleja to facilitate interspecific hybridization, *HortScience* 42 (6): 1326-1328.

Ekinci H (2019). 'Ekşi Kara' (*Vitis vinifera* L.) üzüm çeşidinde anter kültürü. Yüksek Lisans, T.C. Selçuk Üniversitesi Fen Bilimleri Enstitüsü 50.

Huy NP, Luan VQ, Tung HT, Hien VT, Ngan HTM, Duy PN & Nhut DT (2019). *In vitro* polyploid induction of *Paphiopedilum villosum* using colchicine. *Scientia horticulturae* 252: 283-290.

Kara Z, Yazar K & Ekinci H (2018). Somatic embryogenesis and plant regeneration from anther culture in grape cultivar 'Ekşi Kara' (*Vitis vinifera* L.). XXX International Horticultural Congress IHC2018: International Symposium on Viticulture: Primary Production and Processing 1276, 147-154.

Kara Z & Yazar K (2021). Effects of shoot tip colchicine applications on some grape cultivars, *International Journal of Agriculture Environment and Food Science* 5 (1): 78-84.

Kara Z & Doğan O (2022). Reactions of some grapevine rootstock cuttings to mutagenic applications. *Selcuk Journal of Agriculture and Food Sciences* 36 (2): 238-246.

Kermani M, Sarasan V, Roberts A, Yokoya K, Wentworth J & Sieber V (2003). Oryzalin-induced chromosome doubling in Rosa and its effect on plant morphology and pollen viability. *Theoretical and Applied Genetics* 107 (7): 1195-1200.

Motosugi H, Okudo K, Kataoka D & Naruo T (2002). Comparison of growth characteristics between diploid and colchicine-induced tetraploid grape rootstocks. *Journal of The Japanese Society for Horticultural Science* 71 (3): 335-341.

Ollitrault-Sammarcelli F, Legave J.-M, Michaux-Ferriere N & Hirsch AM (1994). Use of flow cytometry for rapid determination of ploidy level in the genus *Actinidia*, *Sci. Hortic.* 57 (4): 303-313.

O'Brien IE, Smith DR, Gardner RC & Murray BG (1996). Flow cytometric determination of genome size in *Pinus*, *Plant Sci.* 115 (1): 91-99.

Pinheiro AA, Pozzobon MT, Do Valle CB, Penteado MIO & Carneiro VTC. (2000). Duplication of the chromosome number of diploid Brachiaria brizantha plants using colchicine. *Plant Cell Reports* 19(3): 274-278.

Sgorbati S, Levi M, Sparvoli E, Trezzi F & Lucchini G (1986). Cytometry and flow cytometry of 4′, 6-diamidino-2-phenylindole (DAPI)-stained suspensions of nuclei released from fresh and fixed tissues of plants. *Physiol. Plant* 68 (3): 471-476.

Tavan M, Mirjalili MH & Karimzadeh G (2015). *In vitro* polyploidy induction: changes in morphological, anatomical and phytochemical characteristics of *Thymus persicus* (*Lamiaceae*). *Plant Cell, Tissue and Organ Culture (PCTOC)* 122 (3): 573-583.

Thao NTP, Ureshino K, Miyajima I, Ozaki Y & Okubo H (2003). Induction of tetraploids in ornamental *Alocasia* through colchicine and oryzalin treatments. *Plant Cell, Tissue and Organ Culture* 72 (1): 19-25.

Tosca A, Pandolfi R, Citterio SA, Fasoli A & Sgorbati S (1995). Determination by flow cytometry of the chromosome doubling capacity of colchicine and oryzalin in gynogenetic haploids of Gerbera, *Plant Cell Rep.* 14 (7): 455-458.

Vainola A (2000). Polyploidization and early screening of Rhododendron hybrids. *Euphytica* 112 (3): 239-244.

Yazar K (2018). Kolhisin uygulamalarının 'Trakya İlkeren', 'Ekşi Kara' ve 'Gök Üzüm' (*Vitis vinifera* L.) çeşitlerinde morfolojik ve sitolojik etkileri Doktora, T.C. Selçuk Üniversitesi Fen Bilimleri Enstitüsü 80.

Yuan S-X, Liu Y-M, Fang Z-Y, Yang L-M, Zhuang M, Zhang Y-Y & Sun P-T, (2009). Study on the relationship between the ploidy level of microspore-derived plants and the number of chloroplast in stomatal guard cells in *Brassica oleracea. Agricultural Sciences in China* 8 (8): 939-946.

Yue Y, Zhu Y, Fan X, Hou X, Zhao C, Zhang S & Wu J (2017). Generation of octoploid switchgrass in three cultivars by colchicine treatment. *Industrial Crops and Products* 107: 20-21.

Zakizadeh S, Kaviani B & Hashemabadi D (2020). *In vivo*-induced polyploidy in Dendrobium ‘Sonia’in a bubble bioreactor system using colchicine and oryzalin. *Brazilian Journal of Botany* 43 (4): 921-932.

Zhang Q, Luo F, Liu L & Guo F (2010). *In vitro* induction of tetraploids in crape myrtle (*Lagerstroemia indica* L.). *Plant Cell, Tissue and Organ Culture (PCTOC)* 101 (1): 41-47.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-60
Friday
Hall-2 Adil Güner Session
Full Text

Effects of Some Chemical Applications on Seed Germination and Vegetative Development of Ekşi Kara Cultivar and 41 B Rootstock Seeds

Kevser YAZAR[1*]

[1]Selcuk University, Faculty of Agriculture, Department of Horticulture, Konya, Türkiye.

*Corresponding author e-mail: kyazar@selcuk.edu.tr

Abstract

Production of grape cultivars that show superior characteristics in terms of yield and quality and are appreciated by consumers is important for the world grape market. For this reason, grape breeding studies, it is aimed to obtain grape cultivars that are well adapted to different climatic and soil conditions, have high resistance to diseases and pests, and have superior characteristics. Germination rates of seeds obtained after breeding studies are important for the success of the study. To ensure successful germination in grape seeds, it is necessary to reduce the effects of germination inhibitory substances in the seed. For this purpose, the seeds are treated with chemicals that promote germination. In this study, the effects of sodium nitroprusside [SNP as nitric oxide (NO) donor] and gibberellic acid (GA_3) applications on seed germination and vegetative growths of Ekşi Kara grape cultivar and 41 B rootstock seeds were tested. Nitric oxide is a bioactive molecule, and it shows both pro-oxidant and antioxidant characteristics in plants. However, there are few studies on the effects of NO on grape seed viability and seed germination. GA_3 is frequently used in studies to increase seed germination. In the present study, the seeds were stratified for 90 days at +4 °C to promote germination. SNP (1mM-24h, 2mM-24h) and GA_3 (1 gL^{-1} -24h) were applied to seeds after stratification. Results showed that all the SNP and the GA_3 treatments enhanced the germination rates of the Ekşi Kara cultivar seeds. It was observed that the germination rates of 41 B rootstock seeds were lower than the Ekşi Kara cultivar. It was determined that GA_3 application had positive results on the germination of 41 B rootstock seeds.

Keywords: Grapevine, Nitric oxide, Seed germination, Seedling growth

INTRODUCTION

Grapevine (*Vitis* spp.) is one of the most socioeconomically important fruit crops worldwide. Production of grape cultivars that show superior characteristics in terms of yield and quality and are appreciated by consumers is important for the world grape market. For this reason, grape breeding studies aim to obtain grape cultivars that are well adapted to different climatic and soil conditions, have high resistance to diseases and pests, and have superior characteristics.

Seed germination plays a critical role affecting for increasing breeding efficiency of higher plants (Holdsworth *et. al.* 2008). Previous studies carried out on seed germination in grapes point out that grape seeds are among the plants that are difficult to germinate compared to many other plants (Ağaoğlu 2002). For this reason, studies in which applications are tested to increase the germination power of grape seeds and the rate of transformation into plants after germination are important. For grape seeds to germinate healthily, first of all, physiological rest in the seeds must be eliminated. Cold applications (Eris 1976; Ağaoğlu 2002) have a significant effect on eliminating the pressure of the germination-inhibiting chemicals in the core. Extracted grape seeds from berries are dormant and breaking dormancy should apply several physical and chemical treatments (Spiegel-Roy *et. al.* 1987; Borges do Val *et. al.* 2010). Several reports (Ellis *et. al.* 1983; Burrows 1994; Jacobsen *et. al.* 2002; Borges do Val *et. al.* 2010) describe increased germination rates after treating the seeds with gibberellic acid (GA_3). However, GA_3 treatments induce increased elongation of hypocotyls after germination (Burrows 1994), which might be unfavorable for seedling growth (Reynolds 2015).

Nitric oxide (NO) acts as a signaling molecule that is involved in the control and regulation of various plant responses to environmental stresses in almost all stages of development (Beligni *et. al.* 2002; Zhao *et. al.* 2007) including seed germination. Notably, NO often exerts its regulatory activity in tight coordination with other molecules, such as ROS (Wang *et. al.* 2009). Dormancy-breaking compounds produced by the NO that is the donor of Sodium Nitroprusside (SNP) (Bethke *et. al.* 2006) stimulate ethylene production under various conditions such as ozone stress and ion deficiency (Ahlfors *et. al.* 2009), thereby stimulating germination (Liu *et. al.* 2010). Kara *et. al.* (2020) showed that NO promotes grape seed vitality and seed germination. However, there is a shortage of information on the effect of NO on grape seed vitality and seed germination. In the present study, the potential promoting effects of SNP (dormancy-breaking compounds) on viability and germination capability in grape seeds were investigated, compared to GA_3, and characterized the response on seed germination and seedling development of Ekşi Kara cultivar and 41 rootstock's seeds.

MATERIALS AND METHODS

Plant Materials

Ekşi Kara (*Vitis vinifera* L.) is an ancient and autochthonous grapevine cultivar intensively grown in Konya due to its well-adaptation to the ecology (Kara and Yazar 2021). 41 B rootstock is preferred for vineyards with its adaptation to calcareous soils (Kara and Doğan 2022).

Application of Germination Promoting Chemicals to Seeds

Grape seeds were cold-stratified at +4°C for 90 days for promoting germination. SNP (1mM-24h, 2mM-24h) and GA_3 (1 gL^{-1}-24h) were applied to seeds after stratification. Then, the seeds were cleaned with tap water and sowed in the mixture (peat: perlite 1:1 v:v) in the greenhouse.

Determination of Seed Germination Rates

Seeds were determined to have germinated when the radicle protruded through the seed coat. The petri dishes for each treatment were scored for radicle emergence 4 days after the start of imbibition, and both factors were calculated as a percent of the control (deionized water) treatment. Seeds were germinated at 23± 2°C under a 16/8h light/dark cycle and a light intensity of approximately 220mmolm^{-2} s^{-1} (Lin *et. al.* 2013).

Measurement of Seedling Development

Germinated seeds were transferred in viols with equal perlite and peat mixture, and grown in a greenhouse for 70 days, and shoot length (cm), the diameter of internodes (cm), leaf area, and SPADs values were measured in all seedlings. All assays were replicated at least three times and were carried out on all seedlings' growth measurements (Kara *et. al.* 2020).

Statistical Analysis

The experiment was conducted in a completely randomized design, with 3 repetitions, and with 96 seeds per repeat. The data obtained from the seeds and plants were compared with the Duncan multiple comparison test in the SPSS 22.0 statistical program (SPSS Inc, Chicago, IL, USA) at a $p<0.05$ significance level.

RESULTS

Seed Germination Rates (%)

The seed germination rates (%) were significantly ($p<0.05$) affected by applications. Results showed that all the SNP and the GA_3 treatments enhanced the germination rates of the Ekşi Kara cultivar seeds. It was observed that the germination rates of 41 B rootstock seeds were lower than the Ekşi Kara cultivar. It was determined that GA_3 application had positive results on the germination of 41 B rootstock seeds (Table 1).

Table 1. Effects of Applications on Seed Germination Rates[z]

	Ekşi Kara	41 B
Control	10.59±0.38d	1.20±0.24d
GA_3 (1 gL^{-1}-24h)	26.14±0.47c	9.11±0.38a
SNP (1mM-24h)	34.52±0.50a	2.09±0.10b
SNP (2 mM-24h)	28.41±0.52b	1.58±0.45c

[z]*Mean separation within columns by Duncan multiple tests at, 0.05 level*

Shoot Length (cm)

The shoot length of seedlings was significantly affected ($p< 0.05$) by the GA and the SNP applications in both grape seeds. It was observed that 1mM-24 h SNP application had a positive effect on shoot length in the Ekşi Kara cultivar (21.80 cm). It was determined that GA_3 application had positive results on the Shoot length of 41 B rootstocks seedlings. It was noted that there was a decrease in the shoot length value depending on the increase in the SNP dose (Table 2).

Table 2. Effects of Applications on Shoot Length[z]

	Ekşi Kara	41 B
Control	20.02±0.76b	19.21±0.86b
GA_3 (1 gL^{-1}-24h)	21.65±0.79ab	21.39±0.73a
SNP (1mM-24h)	21.80±1.03a	21.04±0.50a
SNP (2 mM-24h)	17.82±0.96c	18.23±0.38b

[z]*Mean separation within columns by Duncan multiple tests at, 0.05 level*

Diameter of Internodes(mm)

The diameter of internodes seedlings was significantly affected ($p< 0.05$) by the GA and the SNP applications in both grape seeds. It was observed that 1mM-24 h SNP application had a positive effect on the diameter of internodes value in the Ekşi Kara cultivar (1.14 mm). It was noted that the internode diameter values of the 41 B rootstock seedlings gave close results to each other (Table 3).

Table 3. Effects of Applications on Diameter of Internodes[z]

	Ekşi Kara	41 B
Control	0.95±0.06b	0.96±0.05b
GA_3 (1 gL^{-1}-24h)	1.00±0.04b	1.18±0.03a
SNP (1mM-24h)	1.14±0.03a	1.17±0.04a
SNP (2 mM-24h)	0.92±0.03b	1.18±0.09a

[z]*Mean separation within columns by Duncan multiple tests at, 0.05 level*

Leaf area (cm^2)

Leaf area value was significantly affected ($p< 0.05$) by the GA and the SNP applications Ekşi Kara seedlings. It was observed that 2mM-24 h SNP application had a positive effect on leaf area values in the Ekşi Kara cultivar (11.75 cm^2). It was noted that the leaf area values of the 41 B rootstock seedlings gave close results to each other (Table 4).

Table 4. Effects of Applications on Leaf Area[z]

	Ekşi Kara	41 B
Control	8.09±0.45c	10.53±0.83a
GA_3 (1 gL^{-1}-24h)	10.09±0.71b	11.71±0.67a
SNP (1mM-24h)	10.17±0.14b	10.73±0.46a
SNP (2 mM-24h)	11.75±0.67a	10.53±0.83a

[z]*Mean separation within columns by Duncan multiple tests at, 0.05 level*

SPAD Value

In Ekşi Kara seedlings, the highest leaf chlorophyll content value was recorded in the 2 mM SNP (27.94) application, while the lowest leaf chlorophyll content value (24.14) was determined in the control group. In 41 B rootstock seedlings, the highest leaf chlorophyll content value was recorded in the 1 mM SNP (28.75) application, while the lowest leaf chlorophyll content value (23.80) was determined in the control group (Table 5).

Table 5. Effects of Applications on SPAD Value[z]

	Ekşi Kara	41 B
Control	24.14±0.14d	23.80±0.08d
GA_3 (1 gL^{-1}-24h)	26.47±0.46b	28.56±0.10b
SNP (1mM-24h)	25.72±0.18c	28.75±0.06a
SNP (2 mM-24h)	27.94±0.27a	26.12±0.04c

[z]*Mean separation within columns by Duncan multiple tests at, 0.05 level*

DISCUSSION

Nitric oxide (NO) is an important signaling molecule in eukaryotes including plants (Lamotte *et. al.* 2005), and research with seeds of several species suggests that NO is a component of the signaling network that controls seed dormancy. Other studies on seed germination stated that the GA_3 ratio increased during the germination phase and the abscisic acid ratio decreased and was suppressed. It has been noted that GA_3 applications to promote germination increase the germination rate (Lorrai *et. al.* 2018; Shu *et. al.* 2018). The values obtained as a result of the GA_3 application are similar to the literature. The results of this study indicate that SNP and GA_3 treatments enhanced seed germination and seedling growth rates. Kara *et. al.* (2020), it was reported that the expected shoot elongation did not occur with the increase in SNP application time. It was predicted that the measurements made during the early development period would not yield clear results for shoot growth values. Our results are similar to the literature. Many studies have shown that SNP can protect plants under oxidative stresses and maintain chlorophyll (Lightenthaler 1987). SNP could improve the effects of salinity and increase chlorophyll in cotton (Shallan *et. al.* 2012). Such an explanation of NO action may also be possible in this study.

CONCLUSIONS

The results of the current study showed that GA_3 and SNP both promoted seed germination and some seedling growth parameters. It is thought that the results may be useful for success in grapevine breeding studies. In order to determine seed germination and shoot growth rates more clearly, SNP and GA_3 applications should be tried at different doses and times in future studies.

REFERENCES

Ağaoğlu YS (2002). *Bilimsel ve uygulamalı bağcılık (Asma Fizyolojisi I).* Kavaklıdere Eğitim Yayınları p. 445.

Ahlfors R, Brosché M & Kangasjär J (2009). Ozone and nitric oxide interaction in *Arabidopsis thaliana*, a role for ethylene? A role for ethylene?. *Plant signaling & behavior* 4 (9): 878-879.

Beligni MV, Fath A, Bethke PC, Lamattina L & Jones RL (2002). Nitric oxide acts as an antioxidant and delays programmed cell death in barley aleurone layers. *Plant physiology* 129 (4): 1642-1650.

Bethke PC, Libourel IG, Reinöhl V & Jones RL (2006). Sodium nitroprusside, cyanide, nitrite, and nitrate break *Arabidopsis* seed dormancy in a nitric oxide-dependent manner. *Planta* 223 (4): 805-812.

Borges do Val AD, Motoike SY, Alvarenga EM & Cecon PR (2010). Breaking the dormancy of Niagara Rosada seeds without stratification. *Revista Ceres* 57: 234-238.

Burrows G (1994). Seed propagation of grapevines-a comparison of GA_3 and K-GA_3 [gibberellic acid]. *Australian Grapegrower and Winemaker* (370): 16-17.

Ellis R, Hong T & Roberts E (1983). A note on the development of a practical procedure for promoting the germination of dormant seed of grape (*Vitis* spp.). *Vitis* 22 (3): 211-219.

Eris A (1976). On the influence of growth regulators and stratification on germination of seeds of the vine cv. Muscat Hamburg. *Mitteil. Rebe Wein Obstbau Fruchte*, 26: 85-90.

Holdsworth MJ, Bentsink L & Soppe WJ (2008). Molecular networks regulating *Arabidopsis* seed maturation, after-ripening, dormancy and germination. *New Phytologist* 179 (1): 33-54.

Jacobsen JV, Pearce DW, Poole AT, Pharis RP & Mander LN (2002). Abscisic acid, phaseic acid and gibberellin contents are associated with dormancy and germination in barley. *Physiologia Plantarum* 115 (3): 428-441.

Kara Z & Yazar K (2021). Effects of shoot tip colchicine applications on some grape cultivars. *International Journal of Agriculture Environment and Food Sciences* 5 (1): 78-84.

Kara Z & Doğan O (2022). Reactions of some grapevine rootstock cuttings to mutagenic applications. *Selcuk Journal of Agriculture and Food Sciences* 36 (2): 238-246.

Kara Z, Yazar K, Doğan O & Vergili E (2020). Sodium nitroprusside and gibberellin effects on seed germination and seedling development of grapevine (*Vitis vinifera* L.) cvs. Ekşi Kara and Gök Üzüm. *Erwerbs-Obstbau* 62 (1): 61-68.

Lamotte O, Courtois C, Barnavon L, Pugin A & Wendehenne D (2005). Nitric oxide in plants: the biosynthesis and cell signaling properties of a fascinating molecule. *Planta* 221 (1): 1-4.

Lightenthaler H (1987). Chlorophylls and carotenoids: pigments of photosynthetic biomembranes. *Methods in Enzymology* 148: 350-382.

Lin Y, Chen D, Paul M, Zu Y & Tang Z (2013). Loss-of-function mutation of EIN2 in *Arabidopsis* exaggerates oxidative stress induced by salinity. *Acta Physiologiae Plantarum* 35 (4): 1319-1328.

Liu Y, Ye N, Liu R, Chen M & Zhang J (2010). H_2O_2 mediates the regulation of ABA catabolism and GA biosynthesis in *Arabidopsis* seed dormancy and germination. *Journal of Experimental Botany* 61 (11): 2979-2990.

Lorrai R, Boccaccini A, Ruta V, Possenti M, Costantino P & Vittorioso P (2018). Abscisic acid inhibits hypocotyl elongation acting on gibberellins, DELLA proteins and auxin. *AoB Plants* 10 (5): ply061.

Reynolds AG (2015). Grapevine breeding programs for the wine industry. *Elsevier*, p. 475.

Shallan MA, Hassan HM, Namich AA & Ibrahim AA (2012). Effect of sodium nitroprusside, putrescine and glycine betaine on alleviation of drought stress in cotton plant. Am *Eurasian J Agric Environ Sci* 12 (9): 1252-1265.

Shu K, Zhou W, Chen F, Luo X & Yang W (2018). Abscisic acid and gibberellins antagonistically mediate plant development and abiotic stress responses. *Frontiers in Plant Science* 9: 416.

Spiegel-Roy P, Shulman Y, Baron I & Ashbel E (1987). Effect of cyanamide in overcoming grape seed dormancy. *HortScience* 22 (2): 208-210.

Wang H, Liang X, Wan Q, Wang X & Bi Y (2009). Ethylene and nitric oxide are involved in maintaining ion homeostasis in Arabidopsis callus under salt stress. *Planta* 230 (2): 293-307.

Zhao M-G, Tian Q-Y & Zhang W-H (2007). Nitric oxide synthase-dependent nitric oxide production is associated with salt tolerance in Arabidopsis. *Plant Physiology* 144 (1): 206-217.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-28
Friday

Fulltext

Orchids in Tunisia

Ines Harzli[1*], Yasemin Özdener Kömpe[2]

[1]Ondokuz Mayıs University, Faculty of Arts and Sciences, Department of Biology, Samsun, Türkiye.

*Corresponding author's e-mail: inesharzli9@gmail.com

Abstract

The *Orchidaceae* is among the biggest flowering plant families with a variety of life strategies such as epiphytic, saprophytic, and terrestrial. It is also well-known across the world for their awesome flowers in the wild and has grown increasingly popular in recent decades. An approximately number of existing orchid species in the world is between 25,000 and 30,000 (about 10% of flowering plants) and this number still increasing over the last 30 years. The Mediterranean region is a very rich region in this regard. Since Tunisia is an important country in terms of biological diversity in the Mediterranean region, different orchid species have been discovered there during the last decades. The aim of this study was to document the findings and preliminary description of the orchid species discovered in Tunisia during the last decades. General knowledge of the discovered orchid species and especially the endemic ones and their distribution were presented. A comparison between endemic orchid species in Turkey and in Tunisia was also presented. It was determined that several regions in Tunisia are rich with various orchid species (Nabeul, Zaghouan, and Tunis province). This study showed also that investigation be continued, and new orchid species would be added to the Flora of Tunisia.

Keywords: Orchids, Tunisia, Turkey, endemic species, North Africa.

INTRODUCTION

The *Orchidaceae* family is considered as one of the biggest flowering plant families of angiosperms, with over 28.000 species divided into 880 genera (Fochi *et. al.*, 2017, Xing *et. al.*, 2017). Orchids can be found all over the world, in both tropical and subtropical climates, and in a variety of environments (Tsulsiyah *et. al.*, 2021).

The most orchid species-rich area in Europe is Southern Europe, especially the Mediterranean area (Del Prete and Mazzola 1995; Hágsater and Dumont 1996). Tunisia, the Africa's northernmost country is an important country in the Mediterranean Region in terms of its biological diversity and especially in terms of orchid diversity with more than 50 species located mostly in the northern region of the country.

Tunisia is a country located in northern Africa along the Mediterranean Sea (Figure 1). It is a relatively small country (it covers just 63,170 square miles) and bordered by Algeria and Libya. As it is located along the Mediterranean coast, it has an average January low temperature of 43˚F (6˚C) and an average August high temperature of 91˚F (33˚C).

Figure 1. Map of Tunisia

THE REGIONS WHERE TUNISIAN ORCHIDS WERE DISCOVERED

In Tunisia, the discovery of different species of orchids was carried out in three major regions; Northwest, Cap Bon (Northeast) and Zaghouan region.

1. The **Northwestern region** (Figure 2) is represented by 17 orchid species, (Figure 2, Table 1) (Martin *et. al.*, 2015)

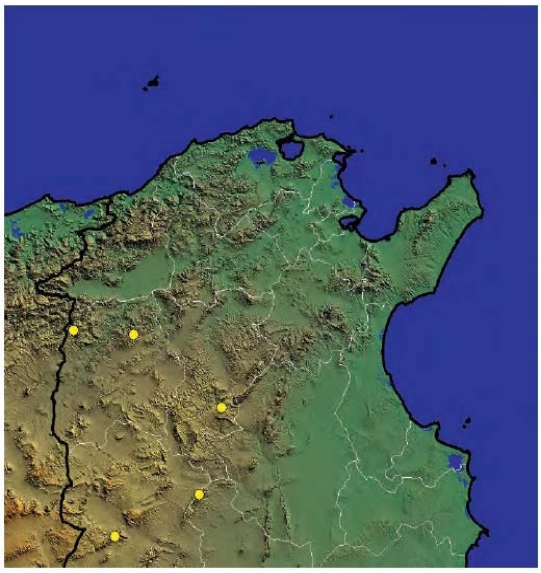

Figure 2. Distribution map of orchid species in Northwestern region of Tunisia

Table 1. Orchid species discovered in Northwestern region (Martin *et. al.*, 2015)

Northwestern's Species
Anacamptis palustris subsp. *robusta* (T.Stephenson) R.M.Bateman, Pridgeon & M.W.Chase (Figure 3)
Anacamptis pyramidalis (L.) Rich., De Orchid. Eur.: 33 (1817) subsp. *pyramidalis*
Cephalanthera longifolia (L.) Fritsch (Figure 4)
Dactylorhiza munbyana (Boiss. & Reut.) Holub
Himantoglossum hircinum (L.) Spreng. (Figure 5)
Neottia nidus-avis (L.) Rich.
Ophrys atlantica Munby
Ophrys omegaifera subsp. *hayekii* (H.Fleischm. & Soó) Kreutz
Orchis lactea Poir.
Orchis patens Desf.
Orchis simia Lam.
Platanthera bifolia subsp. *kuenkelei* (H.Baumann) Kreutz
Serapias cordigera L.
Serapias lingua L.
Serapias lingua subsp. *stenopetala* (Maire & T.Stephenson) Maire & Weiller
Serapias nurrica Corrias
Spiranthes aestivalis (Poir.) L.C.M. Rich.

Figure 3. *A. palustris* subsp. *robusta*

Figure 4. *C. longifolia*

Figure 5. *H. hircinium* subsp. *hircinum*

2. **<u>Cap Bon (Northeast)</u>** region is represented by 25 orchid species (Figure 6, Table 2) (Martin *et. al.*, 2013)

Figure 6. Map of the Cap Bon region in Tunisia

Table 2. Orchid species discovered in Cap Bon region (Martin *et. al.*, 2013)

Northeast's species
Anacamptis coriophora subsp. *fragrans* (Pollini) R.M. Bateman, Pridgeon & Chase
Anacamptis morio subsp. *longicornu* (Poir.) H. Kretzschmar, Eccarius & H. Dietr.
Anacamptis papilionacea (L.) R.M. Bateman, Pridgeon & Chase
Gennaria diphylla (Link) Parl.(Figure 8)
Limodorum abortivum (L.) Sw.
Ophrys apifera Huds.
Ophrys aspea Devillers-Tersch. & Devillers (Figure 9)
Ophrys battandieri E.G.Camus
Ophrys bombyliflora Link
Ophrys flammeola P. Delforge
Ophrys iricolor subsp. *mesaritica* (Paulus, C. Alibertis & A. Alibertis) Kreutz
Ophrys iricolor Desf. subsp. *iricolor*
Ophrys iricolor subsp. *vallesiana* (Devillers-Tersch. & Devillers) Paulus & Gack
Ophrys lutea (Gouan) Cav.
Ophrys marmorata subsp. *caesiella* (P. Delforge) Véla et R. Martin
Ophrys migoutiana H. Gay
Ophrys scolopax subsp. *apiformis* (Desf.) Maire & Weiller
Ophrys scolopax Cav. subsp. *scolopax*
Ophrys speculum Link
Ophrys tenthredinifera Willd. subsp. *tenthredinifera*
Orchis anthropophora L.
Orchis intacta Link (Figure 7)
Orchis italica Poir.
Serapias parviflora Parl.
Serapias strictiflora Welwitsch ex Veiga
Spiranthes spiralis (L.) Chevall.

Figure 7. *O. intacta*

Figure 8. *G. diphylla*

Figure 9. *O. aspea*

3. **Zaghouan** region is represented by 20 orchid species (Figure 10, Table 3) (Martin and Ouni, 2016)

Figure 10. Map of the Zaghouan region in Tunisia

Table 3. Orchid species discovered in Zaghouan region (Martin and Ouni, 2016)

Zaghouan's Species
Anacamptis papilionacea (L.) Bateman, Pridgeon & Chase
Ophrys aspea J. Devillers-Treshuren & P. Devillers
Ophrys battandieri E.G. Camus, P. Bergon & A. Camus (Figure 11)
Ophrys funerea Viv. (Figure 13)
Ophrys iricolor Desf. subsp. *iricolor*
Ophrys iricolor subsp. *mesaritica* (H.F. Paulus, C. Alibertis & A. Alibertis) Kreutz, Komp.
Ophrys iricolor subsp. *valesiana* (Devillers-Tersch. & Devillers) Paulus & Gack
Ophrys lutea Cav. subsp. *lutea*
Ophrys marmorata subsp. *caesiella* (P. Delforge) Véla & R. Martin
Ophrys numida Devillers-Tersch. & Devillers
Ophrys pseudomigoutiana R.Martin, Véla & Ouni, sp. nov. (Figure 12)
Ophrys scolopax Cav. subsp. *apiformis* (Desf.) Maire & Weiller
Ophrys scolopax Cav. subsp. *scolopax*
Ophrys speculum Link
Ophrys tenthredinifera Willd. subsp. *ficalhoana* (Guimarès) Lowe & Tyteca
Ophrys tenthredinifera Willd. subsp. *tenthredinifera*
Orchis anthropophora (L.) All.
Orchis intacta Link
Orchis pauciflora Ten. subsp. *laeta* (Steinh.) Kreutz
Serapias parviflora Parl.
Spiranthes spiralis (L.) Chevall.

Figure 11. *O. battandieri*

Figure 12. *O. pseudomigoutiana*

Figure 13. *O. funerea*

ENDEMIC ORCHID SPECIES IN TUNISIA AND TÜRKİYE

1) *Endemic orchid species in Tunisia*

Tunisia presents a wealth of orchid family (12 genera and 70 species in total)

The study of orchids in Tunisia has mainly focused on the discovery of the different genus and species of the family, but pollination methods, orchid-fungi relations (germination) and protection have not been sufficiently developed. Endemic Orchid species in Tunisia are given in Table 4.

Table 4. Endemic Orchid species in Tunisia

Genus	Species
Dactylorhiza	*D. munbyana*
Himantoglossum	*H. robertinum, H. hircinium*
Ophrys	*O. atlantica, O omegaifera* subsp. *hayekii O. pseudomigoutiana,* *O irricolor* subsp. *iricolor, O. iricolor* subsp. *mesaritica,* *O. scolopax* subsp. *scolopax, O. aspea, O. battandieri* *Ophrys bombyliflora, O. migoutiana, O. flammeola*
Orchis	*O. lacteal, O. intacta, O. pauciflora* subsp. *laeta*
Serapias	*S. lingua, S. lingua* subsp. *stenopetala* *S. nurrica, S. parviflora*
Spiranthes	*S. aestivalis*

2) *Endemic orchid species in Türkiye*

It has been reported that more than of 204 orchid species, belonging to more than 23 genera, are found in Türkiye.

However, there is not studies that have been at a level to ensure the conservation and sustainable use of Turkish orchids.

Studies in Türkiye have generally been limited to the detection of orchid species in the regions where salep is grown and the cultivation of some species (Sezik, 2002). Endemic Orchid Species in Türkiye are give in Table 5 (Kreutz, 2009).

Table 5 : Endemic Orchid Species in Türkiye (Kreutz, 2009)

Genus	Species
Dactylorhiza	*D. nieschalkiorum, D. osmanica* var. *osmanica, D. umbrosa* var. *chuhensis, D. ilgazica, D. osmanica* var. *anatolica, D. saccifera* subsp. *taurica*
Epipactis	*E. bithynica, E. turcica*
Himatoglossum	*H. caprinum* subsp. *robustissimum*
Ophrys	*O. fusca* subsp. *thracica, O. fusca* subsp. *phaseliana, O. bornmuelleri* subsp. *carduchorum, O. holoserica* subsp. *aramaeorum, O. cardica* subsp. *lyciensis, O. oestrifera* subsp. *karadenizensis, O. oestrifera* subsp. *hygrophila, O. oestrifera* subsp. *akcakarae, O. kreutzii, O. isaura, O. umbilicata* subsp. *khuzestanica, O. umbilicata* subsp. *calycadniensis, O. amanensis* subsp. *amanensis, O. amanensis* subsp. *antalyensis, O. amanensis* subsp. *iceliensis, O. transhyrcana* subsp. *paphlagonica, O. argolica* subsp. *madalyana, O. climacis*
Serapias	*S. parviflora, S. vomeracea* var. *artemisiae*

DISCUSSION

Orchid research in Tunisia has started in recent years. Researchers tried to discover, several regions, and several species were added to the Flora of Tunisia, and others were withdrawn. In this research, we mentioned that Tunisia with the 3 main regions (Northwest, CapBon, and Zaghouan) where different orchid species were discovered is a highly diversified country with more than 25 endemic orchid species. Despite the richness of the species in the country's geography, studies on orchid species in Tunisia are limited as the majority of studies are generally limited to the discover of new orchid species in different regions.

REFERENCES

Del Prete C, Mazzola P (1995) Endemism and speciation in the orchids of Mediterranean islands. *Flora Mediterranea 2*1: pp.119– 134.

Fochi V., Falla N., Girlanda M., Perotto S., Balestrini R. 2017. Cell-specific expression of plant nutrient transporter genes in orchid mycorrhizae. *Plant Science, 263*, pp.39-45.

Hagsater E, Dumont V (1996) *Orchids: status, survey and conservation action plan* (Vol.28). IUCN, Gland, Switzerland.

Kreutz CAJ (2009) Türkiye Orkideleri Botanik Özellikler, Ekolojik İstekleri, Doğal Yayılış Alanları, Yaşam Tehditleri, Koruma Önlemleri, Rota Yayınları, İstanbul.

Martin, R. Ouni, R. Véla, E. Léger, J-F. (2013). *A la découverte des orchidées du Cap Bon en Tunisie*.

Martin, R., Véla, E., & Ouni, R. (2015). *Orchidées de Tunisie*. Société botanique du Centre-Ouest, 159p.

Martin R, Ouni R. (2016). Les orchidées Du" zaghouan.

Sezik, E. (2002). Turkish orchids and salep. *Acta Pharmaceutica Turcica, 44(3),* 151-157.

Tsulsiyah B, Farida T, Sutra CL, Semiarti E. Important Role of Mycorrhiza for Seed Germination and Growth of *Dendrobium* Orchids. *J Trop Biodiv Biotech. 2021;6(2)*:jtbb60805. doi:10.22146/ jtbb.60805.

Xing X., Ma X., Men,J., Chen Y. and Guo S. 2017. 2017. Phylogenetic constrains on mycorrhizal specificity in eight *Dendrobium* (*Orchidaceae*) species. *Science China Life Sciences, 60(5*), pp.536-544.

ABSTRACTS OF ORAL PRESENTATIONS

Oral Presentation OP-01
Thursday
Hall-1 Tuna Ekim Session

2022 Year Studies on Turkey *Papaver* (Papaveraceae) Genus

Osman Tugay[1*], Ferhat Celep[2], Metin Armağan[3], Deniz Ulukuş[4], Bayram Atasagun[5], Aleyna Özbek[6]

[1]Selcuk University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Konya, Türkiye.

[2]Kırıkkale University, Faculty of Art and Sciences, Department of Biology, Kırıkkale, Türkiye.

[3]Necmettin Erbakan University, Ereğli Faculty of Agriculture, Department of Arable Crops, Konya, Türkiye.

[4]Selcuk University, Faculty of Science, Department of Biotechnology, Konya, Türkiye.

[5]Selcuk University, Vocational Scholl of Health Services, Konya, Türkiye.

[6]Selcuk University, Institute of Science, Department of Biotechnology, Konya, Türkiye.

*Corresponding author's e-mail: otugay@selcuk.edu.tr

Abstract

The genus *Papaver*, whose Turkish name is "Gelincik", is represented by 80 taxa and the most famous species of this genus is *Papaver somniferum*. This plant, known as "Haşhaş" in Turkish, has been used as food, pain reliever and sedative in Anatolia from the Hittites to the present day. *Papaver* genus is represented by 52 taxa in Turkey and 18 of them are endemic. According to Flora of Turkey, leaf, petal, capsule, stigma and seed characters are generally important for the identification of *Papaver* taxa. Taxa with deficiencies in terms of taxonomic characters are: *P. acrochaetum, P. persicum* subsp. *fulvum, P. persicum* subsp. *persicum* (petal, stigma and seed characters are missing); *P. arenarium, P. bracteatum, P. curviscapum, P. fugax* var. *fugax, P. guerlekense, P. lasiothrix, P. lateritium* subsp. *lateritium, P. libanoticum* subsp. *polychaetum, P. macrostomum, P. orientale, P. pilosum* subsp. *glabrisepalum, P. pilosum* subsp. *pilosum, P. pilosum* subsp. *spicatum, P. pilosum* subsp. *strictum, P. postii, P. pseudo-orientale, P. rhoeas, P. rhopalothece, P. somniferum* var. *somniferum, P. spicatum.* var. *luschanii, P. triniifolium, P. yildirimlii* (seed characters are missing); *P. argemone* subsp. *argemone, P. armeniacum, P. clavatum, P. cylindricum, P. dubium* subsp. *dubium, P. glaucum, P. gracile, P. hybridum, P. stylatum, P. syriacum* (stigma and seed characters are missing); *P. argemone* subsp. *davisii, P. argemone* subsp. *nigrotinctum, P. somniferum* var. *pullatum, P. virchowii* (capsule, stigma and seed characters are missing); *P. dubium* subsp. *dubium* var. *albiflorum, P. dubium* subsp. *laevigatum, P. dubium* subsp. *lecokii, P. fugax* var. *platydiscus, P. pilosum* subsp. *sparsipilosum* (petal, capsule, stigma and seed characters are missing); *P. lateritium* subsp. *monanthum* (petal and seed characters are missing); *P. paucifoliatum* (capsule and seed characters are missing). As a result of the field studies carried out in 2022, the above-mentioned morphological deficiencies of taxa *P. persicum* subsp. *fulvum, P. persicum* subsp. *persicum, P. arenarium, P. bracteatum, P.*

macrostomum, P. orientale, P. somniferum var. *somniferum, P. triniifolium, P. argemone* subsp. *argemone* and *P. gracile* were eliminated.

Keywords: *Papaver*, poppy, morphology, Turkey.

Acknowledgement: We thank TÜBİTAK, KBAG (Project no: 121Z794) for financial support with the project title "Revision of the Genus *Papaver* L. (Papaveraceae) in Turkey".

Oral Presentation OP-02
Thursday
Hall-1 Tuna Ekim Session

Stem, Leaf and Fruit Micro Morphological Characteristics of Turkish *Vincetoxicum* Wolf (Apocynaceae-Asclepiadoideae)

Selin Meral Doğan[1], Seher Güven[1*]

[1]Recep Tayyip Erdogan University, Faculty of Sciences and Arts, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: seher.cakmak@erdogan.edu.tr

Abstract

In the present study, stem, leaf and fruit surface properties of 11 *Vincetoxicum* Wolf taxa in Türkiye were studied using scanning electron microscopy (SEM) to contribute to delimitation of the examined taxa. The plant samples were collected from 21 different natural populations between 2012-2019 and stored in the herbarium of the Department of Biology of Recep Tayyip Erdoğan University (RUB). For micro morphological studies, the stored herbarium materials were used and the distinctive micro morphological characters were determined. In all the examined taxa, the epicuticular wax was smooth on the stem and fruit surfaces, striate on the leaf surfaces; the leaf epidermal cells were polygonal or irregularly shaped; the periclinal cell wall was convex or concave, and the anticlinal cell wall was flat. Pubescence is present along one side, two side or the entire surface on stems; along the margins and veins or the entire surface on leaves; along the entire surface or is absent on fruits. Pubescence type varies from canescent-tomentose, velutinous-lanate to crisped hairy on both stem and leaves, while it is crisped hairy or glabrous on fruits. Stem, leaf and fruit micro morphological features of the Turkish *Vincetoxicum* taxa were determined for the first time. It was determined that micro morphological characters such as stem, leaf and fruit pubescence and the presence of stomata on the abaxial and adaxial leaf surfaces were effective in differentiation of the studied taxa.

Keywords: Micro morphology, SEM, Türkiye, *Vincetoxicum*.

Acknowledgement: The authors extend their thanks to TUBITAK (Project number: 2209A/1919B012004568) and RTEUBAP (Project number 2013.102.03.1) for the financial support.

Oral Presentation OP-03
Thursday
Hall-1 Tuna Ekim Session

Preliminary Results from Updated Phylogeny of the Genus *Lamium* (Lamiaceae)

Ferhat Celep[1*], Fatma Özmen[2], Fergan Karaer[3], Hayri Duman[2], Aslı Yılmaz[4], Bryan Drew[5]

[1]Kırıkkale University, Department of Biology, Kırıkkale, Türkiye.

[2]Gazi University, Department of Biology, Ankara, Türkiye

[3]Ondokuz Mayıs University, Department of Mats and Science, Samsun, Türkiye

[4]Ataturk University, Department of Molecular Biology and Genetics, Erzurum, Türkiye

[5]University of Nebraska-Kearney, Department of Biology, Kearney, USA

*Corresponding author's e-mail: ferhat_celep@hotmail.com

Abstract

Lamium L., the type genus of the Lamiaceae, comprises 16–40 species, depending on the circumscription of the genus. Recent morphological and molecular phylogenetic studies shown that taxonomy and phylogeny of the genus needs extensive revision particularly on infrageneric and species delimitations. In this study, all known *Lamium* species were used in the updated phylogenetic study. We used 2 nuclear (*ITS* and *ETS*) and 4 chloroplast regions (*matK*, *rpoA*, *ycf1* ve *psba-trnH*). *ETS* and *ycf1* regions were used for the first time in this study. Bayesian (BI) and Maximum Likelihood (ML) phylogenetic results, which mostly agree with the previous phylogentic studies, mainly shown that *Lamium galeobdolon* is sister to all remaining *Lamium* species, *Wiedemannia* is nested within *Lamium*, *L. amplexicaule* is polyphyletic, some previously synonymized species should be resurrected, i.e. *L. garganicum* complex, and Mennema's infrageneric classification is not supported by molecular data.

Keywords: Phylogeny, Lamiaceae, *Lamium*, taxonomy, infrageneric classification.

Acknowledgement: We thank to the Scientific and Technical Research Council of Turkey (TUBİTAK) (project no: 112T131 and 121Z374, TUBİTAK) for their financial support.

Oral Presentation OP-04
Thursday
Hall-1 Tuna Ekim Session

The Preliminary Results of the Effect of White Mistletoe (*Viscum album* ssp. *abiteis*) on Radial Growth of Cilician Fir (*Abies cilicica* ssp. *cilicica*)

Murat Öztürk[1*], Kadir Alperen Coskuner[1], Bedri Serdar[1], Ertuğrul Bilgili[1]

[1]Karadeniz Technical University, Faculty of Forestry, Trabzon, Türkiye.

*Corresponding author's e-mail: murat_ozturk@ktu.edu.tr

Abstract

White mistletoe (*Viscum album* ssp. abietis, *Santalaceae*) is a hemi-parasitic plant that have various effects on their hosts, including changes in wood formation and growth. This study presents the preliminary results of a 20-year retrospective analysis of the radial growth of Cilician fir (*Abies cilicica* ssp. *cilicica*) in relation to the severity of white mistletoe infection. The study was conducted in white mistletoe infected pure cilician fir forest in Emli Valley within the boundaries of Aladaglar National Park in Nigde, Türkiye. Of the sampled trees, a total of 20 cilician fir trees were selected and analyzed for the preliminary results. Of these trees, 5 were uninfected, 5 lightly infected, 5 moderately infected and 5 highly infected. The 6-class dwarf mistletoe rating system (DMRS) was used to define the infection severity. Increment cores were taken at breast height level (1.30m) of each sampled trees. Increment cores including annual rings of the last 20 years were cut off from the bark to pith with razor blade. Transverse sections were obtained from increment cores with a sliding microtome at 15-20 µm intervals. Then the sections were stained with safranin and were embedded glycerine-gelatine. All sections were examined with Olympus BX50 digital photomicroscope and each annual ring width measured using Bs200ProP image analyze software (BAB Imaging Systems Ltd, Ankara, Türkiye). The preliminary results of the radial growth of white mistletoe infected cilician fir trees showed that average radial growth losses were up to 60% in highly infected trees.

Keywords: Mistletoe, *Viscum album*, *Abies cilicica*, growth loss.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-05
Thursday
Hall-1 Osman Ketenoğlu Session

Taxonomic Problems and Preliminary Result of *Linaria* Mill. (Plantaginaceae) in Turkey

Deniz Ulukuş[1*], Osman Tugay[2] , Ferhat Celep[3], Metin Armağan[4], Bayram Atasagun[5], Dilek Eda Yeniyayla[6]

[1]Selcuk University, Faculty of Science, Department of Biotechnology, Konya, Türkiye.

[2]Selcuk University, Faculty of Farmacy, Pharmaceutical Botany, Konya, Türkiye.

[3]Kırıkkale University, Science and Art Faculty, Department of Biology, Kırıkkale, Türkiye.

[4]Necmettin Erbakan Üniversity, Ereğli Faculty of Agriculture, Department of Field Crop, Konya, Türkiye.

[5]Selçuk University, Vocational School of Health Services, Konya, Türkiye.

[6]Selçuk Üniversity, Institute of Sciences, Biotechnology, Konya, Türkiye.

*Corresponding author's e-mail: dulukus@selcuk.edu.tr

Abstract

The genus *Linaria*, which has 200 taxa in the world, is distributed over the continents of North America, Europe, and Asia. According to the Turkey Plant List, *Linaria* is represented by 31 taxa, and 12 of these taxa are endemic. This study aims to answer the taxonomic problems of the genus *Linaria* and the first observations of the project's ongoing "Systematic Revision of *Linaria* in Turkey." In April and August, field studies were carried out according to distribution of taxa in Turkey. The plants were found in the flowering and fruiting periods, and the data obtained from the literature and herbarium records, and samples, photographs, and notes were taken of the plants. Plant samples were dried according to standard herbarium techniques. According to our field observations and morphological examinations for the first six months, the following taxonomic problems and the preliminary result were determined; It is not clear whether some of the species shown in the flora of Turkey are naturally distributed, whether the stem leaves that emerge after grazing in the perennial yellow-flowered *Linaria* taxa belong to the newly formed flowering stem or whether they are the main stem leaves. It is difficult to distinguish the *L. sintenisii* taxon from the *L. kurdica* group, as the calyx lobes are both margined and non-marginated. In the differentiation of subspecies belonging to the *L. kurdica* taxon, the indumentum of the calyx lobes and the differences in the shape of the middle leaves cause difficulties in separating the taxa. The indumentum of calyx lobes is a problem distinguishing between *L. genistifolia* and *L. kurdica* taxa. According to preliminary results, locality records and photographs of some of the taxa are provided in this study.

Keywords: *Linaria*, Plantaginaceae, Taxonomy.

Acknowledgement: This study was financed by TUBITAK (Project numbers: 121Z792).

Oral Presentation OP-06
Thursday
Hall-1 Osman Ketenoğlu Session

Pollen Studies in Some *Cirsium* Taxa Representing of the Sections *Epitrachys* and *Cirsium*

Funda Erşen Bak[1*], Melahat Özcan[1]

[1]Artvin Coruh University, Faculty of Forestry, Department of Forest Engineering, Artvin, Türkiye.

*Corresponding author's e-mail: fundaersenbak@artvin.edu.tr

Abstract

In this study, the morphological structures of the pollen of ten *Cirsium* Miller taxa were described in detail. They are indicated in two sections; sect. Epitrachys (*C. ligulare* Boiss., *C. kosmelii* (Adams) Fisch. Ex Hohen., *C. osseticum* (Adams) Petr., *C. rigidum* DC., *C. ciliatum* Moench subsp. *szovitsii, C. pugnax* Sommier & Levier) and sect. Cirsium (*C. pubigerum* var. *caniforme* Petr., *C. subinerme* Fisch. & C.A.Mey, *C. rhizocephalum* C.A.Mey. subsp. *rhizocephalum, C. rhizocephalum* subsp. *sinuatum* (Boiss.) P.H.Davis & Parris). Taxa were collected from different localities of NE Anatolia and pollen grains were prepared for light microscopy using the Wodehouse method. At least 30 pollen grains were evaluated per population. The polar axis (P), equatorial axis (E, polar and equatorial view), colpus length (clg) and width (clt), porus length (plg) and width (plt), length of one side of triangular polar area, length (dh) and width (dt) of spine, exine and intine thickness were measured on the pollen grains. Spines per 100 μm^2 were counted on the pollen grains. In addition, P/E ratio and polar area index (PAI) were calculated. Pollen shape and exine ornamentation was determined. Statistical analysis was also performed. Results obtained from this study were compared to the data present in the literature. There are some similarities among taxa but most of the values investigated are found significantly different, according to variance analysis.

Keywords: *Cirsium*, pollen morphology, Türkiye.

Acknowledgement: The research was founded by Artvin Coruh University with the project number: 2018. F10.02.01.

Oral Presentation OP-07
Thursday
Hall-1 Osman Beyazoğlu Session

Invasive Alien Plants in Flora of Turkey

Kamil Coşkunçelebi[1], Salih Terzioğlu[2*]

[1]Karadeniz Technical University, Science Faculty, Department of Biology, Trabzon, Türkiye

[2]Karadeniz Technical University, Faculty of Forestry, Department of Forest Engineering, Trabzon, Türkiye

*Corresponding author's e-mail: sterzi@ktu.edu.tr

Abstract

Many of the invasive alien species, in different taxonomic categories, are recognized as one of the most important global threats, causing serious economic and environmental damage, and adversely affecting the ecosystem, human health and biodiversity. For this reason, these species have started to take attention not only by scientists but also in administrative, social and economic fields throughout the world, in recent years. Currently, 17 thousand of more than 45 thousand alien species in the world have naturalized in their new ecosystems, and 10 thousand have been registered as invasive alien species due to their negative effects on these new ecosystems. Considering the newly published data so far, 3.9% of the 391,000 vascular plant species (13,168 species) have naturalized out of their natural habitats by human mobility. Of the 100 most dangerous invasive species in the world, 32 are plants. According to literature, 450 of the over 12 thousand plant taxa in our country are considered as alien (exotic) species. Human mobility is a well-known leader reasons in transporting exotic species. Exotic plant taxa in Türkiye is known that 71.9% of them intentionally and 28.1% of them unintentionally carried to our country. Of the intentionally carried species, 55.2% were brought for ornamental, 10% for afforestation, and 6.7% for agricultural (fruit, vegetable, medicine, fiber, etc.) purposes. In addition, it has been determined that 17 of the 31 species listed as invasive in the border/neighboring countries of Türkiye have not been recorded from our country yet, 5 of them are amongst the naturalized taxa in our country, and 9 of them used in afforestation and/or landscape design. Moreover, only 107 of the exotic species in Türkiye are listed as invasive plant species. However, considering the articles published so far, the number of records, their prevalence, effects on the Anatolian ecosystem and field observations, 20 of these species was selected as the most dangerous invasive alien plants (black list) for Türkiye. In this study, five species of the black list, *Ailanthus altissima*, *Robinia pseudoacacia*, *Sicyos angulatus*, *Microstegium vimineum* and *Persicaria perfoliata,* are considered as the most aggressive invasive alien plants for our country's ecosystems.

Keywords: Flora, invasive alien species, Türkiye.

Oral Presentation OP-08
Thursday
Hall-1 Osman Beyazoğlu Session

Morpho-Anatomical Study of Rare Endemic *Lilium akkusianum* R. Gamperle

Hüseyin Ümit Ömeroğlu[1], Öznur Ergen Akçin[2*], Bekir Gökçen Mazı[3], Şükran Öztürk[4], Yaşar Akçin[5]

[1]Ordu University, Central Research Laboratory, Ordu, Türkiye

[2]Ordu University, Faculty of Science and Art, Department of Molecular Biology and Genetics, Ordu, Türkiye

[3]Ordu University, Faculty of Agriculture, Department of Food Engineering, Ordu, Türkiye

[4]Ordu University, Ulubey Vocational School, Department of Laboratory and Veterinary Health, Ordu, Türkiye

[5]Nuriye Halit Cebi Vocational Hight School, Ordu, Türkiye

* Corresponding author's e-mail: oakcin@gmail.com

Abstract

Lilium akkusianum R.Gamperle is a perennial bulbous plant with showy flowers. The species is a locally endemic species that spreads around the Akkuş district of Ordu province and the border of Tokat. The aim of this study was to investigate the anatomical and morphological properties of *Lilium akkusianum* species. Root, bulb, stem, leaf, bract, flower and fruit parts of *L. akkusianum* were preserved in 70% ethanol for anatomical investigation. Cross and surface sections were taken from plants to determine anatomical features. The root structure of the species is polyarch. Bulbs are concentric type and dirty white. Leaves are dorsiventral and hypostomatic type. Stoma cells are the 4th type according to stoma neighbor cells. The stoma index for the lower surface was found to be 23.19. The flowers are cream-colored, with dark spots towards the base. There is a nectar structure at the base of the tepals. Nectar is secreted from the epidermis cells and papillary structures at the base of the tepals. There are dark pink- purple colored circular or elliptical spots on the inner and outer tepals. The ovary has axial placentation. The fruit is capsules type. The seed is flat and has thin membranous wings.

Keywords: *Lilium akkusianum*, anatomy, endemic, morphology.

Oral Presentation OP-09
Thursday
Hall-1 Osman Beyazoğlu Session

Crocus pallasii Goldb. Complex in Turkey Revisited: Comparative Leaf Anatomy and Its Taxonomic Implications

Osman Erol[1*], Bilge Saadet Kaleli[2], Levent Şık[3], Almıla Çiftçi[1]

[1]İstanbul University, Faculty of Science, Biology Department, Istanbul, Türkiye.

[2]Istanbul University, Institute of Science, Biology Department, Istanbul, Türkiye.

[3]Manisa Celal Bayar University, Faculty of Arts and Science, Botany Division, Manisa, Türkiye.

*Corresponding author's e-mail: erol@istanbul.edu.tr

Abstract

The *Crocus pallasii* Goldb. species complex in Turkey is very diverse in terms of morphology, chromosome number and karyology. Preliminary work on the morphological variation of *C. pallasii* populations showed that geographically distant populations have significant differences. Since crocus leaf anatomy plays an important role in the systematics of the genus, we aimed to see whether our previous findings are corroborated by the leaf anatomical characteristics of the *C. pallasii* species complex. To this end, we examined the leaf anatomy of 38 populations (a total of 96 individuals) of the *C. pallasii* complex (*C. pallasii*, *C. mathewii*, *C. kofudagensis*, *C. asumaniae* and *C. dispathaceus*). Cross sections were taken from the middle of leaves and stained in Safranin-Alcian Blue to make permanent slides using UV-mounting media. 22 quantitative and 5 qualitative characters were used for the statistical analysis. One-way Analysis of Variance (ANOVA) and Principal Coordinate Analysis (PCoA) were conducted using Graphpad Prism and PAST. The results showed no meaningful differences except between *C. mathewii* and *C. pallasii* populations. The other taxa could not be distinguished from *C. pallasii* on an anatomical level. Some geographically distant populations showed surprising similarities in leaf anatomy.

Keywords: *Crocus pallasii*, leaf anatomy, systematic anatomy.

Acknowledgement: This study is supported by Istanbul University Research Projects Unit through project number FBA-2021-38022.

Oral Presentation OP-10
Thursday
Hall-1 Osman Beyazoğlu Session

Morpho-Anatomical Study of *Centaurea carduiformis* DC. subsp. *carduiformis* var. *carduiformis*

Şükran Öztürk[1*], Öznur Ergen Akçin[2]

[1]Ordu University, Ulubey Vocational School, Department of Laboratory and Veterinary Health, Ordu, Türkiye.

[2]Ordu University, Faculty of Science and Art, Department of Molecular Biology and Genetics, Ordu, Türkiye.

*Corresponding author's e-mail: sukranguney0@hotmail.com

Abstract

Centaurea L. (Asteraceae) genus is represented by approximately 500 species in the world and 158 species in Turkey, 106 of which are endemic. The aim of this study was to investigate the anatomical properties of *Centaurea carduiformis* DC. subsp. *carduiformis* DC. var. *carduiformis* DC. Plant materials are collected from the Alucra (Giresun). Samples for anatomical studies were fixed in 70% alcohol. Cross and surface sections of root, stem and basal and stem leaves were excised by hand. The photographs were taken with Nikon FDX-35 microscope. For Scanning Electron Microscopy, dried leaves, appendage were mounted on stubs using double-sided adhesive tape. Samples were coated with 12.5 to 15 nm of gold. Coated leaves, appendage were examined and photographed with Hıtachi-SU1510 Scanning Electron Microscope. Secretory channels were seen in the root, stem and leaves of the species. Species had isobilateral type of leaves. Stomata were anisocytic and anomocytic. There are stone cells on the vascular bundles in the root. The vascular bundles of stem are surrounded by numerous sclerenchymatic fibers. There are numerous egulandular trichomes in the leaf. Stomata were anomocytic and anisocytic type on the lower and upper surfaces of the basal leaves. There are multicellular glandular and eglandular trichomes on the leaves of plant. Lower leaves have extrafloral nectarium. Appendage has spine and numerous cilia.

Keywords: *Centaurea carduiformis*, anatomy, micromorphology, morphology.

Oral Presentation OP-11
Thursday
Hall-1 Osman Beyazoğlu Session

Mericarp Anatomy of *Tordylium* Tourn. ex L. Species Grown in Turkey

Golshan Zare[1*], Aslı Doğru-Koca[2]

[1]Hacettepe University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Ankara, Türkiye.

[2]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

*Corresponding author's e-mail: g_zare@hacettepe.edu.tr

Abstract

Turkey is host to 18 species of *Tordylium* which 7 are endemic and the Mediterranean region is the main distribution area of the genus. One of the most typical features of this family is schizocarp fruits which are composed of two mericarps. The mericarp features such as wings, shape, trichome and vitta have an important role in inter and intra-generic level discrimination of taxa in the Apiaceae family. In this study, we evaluated the mericarp anatomy and morphology of all 18 species found in Turkey, except *T. officinalis*. In the anatomical analysis, cross-sections were taken by razor blades from the middle part of the mericarp and are stained by astra blue and safranin. Microscopic studies revealed anatomical structures of mericarp provided valuable diagnostic characters in the term of taxonomy, especially in doubtful species circumstances. The fruits of *Tordylium* have 2 dimorphic (*T. lanatum*, *T. aegyptiacum*, *T. elegans*) or monomorphic mericarps that are hemispherical or strongly compressed dorsally. Generally, each mericarp has 4 dorsal and 2 commissural vittae, except *T. apulum* and *T. pestalozzae*. In species with uniform fruit the presence or absence of wings, neck length, hair type, margin, dorsal vittae position and their associated characteristics are used as diagnostic characters for the separation of taxa. In addition, we provided species identification key based on morphological and anatomical mericarp characters for all studied taxa. The mericarp anatomical features are discussed based on the morphological and molecular phylogeny of the taxa.

Keywords: Anatomy, mericarp, *Tordylium*, Türkiye.

Acknowledgement: The authors would like to thank The Scientific and Technical Research Council of Türkiye (TÜBİTAK-1001, Project No, 119Z271) for their financial support.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-12
Thursday
Hall-1 Sabri Özyurt Session

Micromorpho-anatomical Characteristics of the Leaves and Woods of Turkish *Daphne* L. (Tymelaeaeceae) Taxa

Melahat Ozcan[1*], Funda Erşen Bak[1]

[1]Artvin Coruh University, Faculty of Forestry, Department of Forest Engineering, Artvin, Turkiye.

*Corresponding author e-mail: melahat.ozcan@artvin.edu.tr

Abstract

The genus *Daphne* L. (Thymelaeaceae) is represented by 95 species growing in different climatic regions of the world, while 7 species (9 taxa) and 7 doubtfully records in Turkey. In the present investigation, seven native Turkish *Daphne* species were examined on the leaf (from 9 accessions) and wood (from 7 accessions) micro morpho-anatomical characters. Section of leaf sample were prepared by hand, and wood samples sectioned according to standard technique and macerated with Schultze's method. Statistical analyses were used to evaluate these characters. SEM analysis was performed to determine the leaves surface structures and intervessel pits on vessel members of the woods. Epicuticular wax is found densely in the abaxial leaf surfaces of four species. Lamina mesophyll of the investigated six species are dorsiventral, whereas isobilateral type is determined in *D. mucronata*. Two species growing in mesophytic habitats; D. *glomerata* and *D. pontica* have undulate to sinuous epidermal cell walls, while other five taxa with straight ones. Triangular or hemispherical leaf midrib occurs in *D. glomerata*, *D. mezereum*, *D. mucronata* and *D. pontica*, but *D. gnidioides*, *D. oleoides* subsp. *kurdica* and *D. sericea* has not distinct midrib region in abaxial sides. Stomata are anomocytic and only found in abaxial surfaces. The highest stomatal density was counted in *D. mezereum* and the smallest one in *D. gnidioides.* The woods of examined *Daphne* species were separated from each other by anatomical features such as growth rings, vessel grouping, intervessel pits and ray characteristics. Moreover, an identification key based leaf and wood characters was presented. Results obtained from this study were compared the data present in literature.

Keywords: *Daphne*, micromorphology, anatomy, leaf, wood, statistical analyses, Türkiye.

Acknowledgement: The research was supported by the Research Fund of Artvin Coruh University (Project number: 2016. F10.02.14).

Oral Presentation OP-13
Thursday
Hall-1 Sabri Özyurt Session

Taxonomical Contributions to Turkish *Polygonum* (Polygonaceae) Taxa Based on Tepal Morphology

Suzan Kundakçı[1*], Kamil Coşkunçelebi[3], Mutlu Gültepe[2], Serdar Makbul[1]

[1]Recep Tayyip Erdogan University, Faculty of Sciences and Arts, Department of Biology, Rize, Türkiye.

[2]Giresun University, Dereli Vocational School, Department of Forestry, Giresun, Türkiye.

[3]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye.

*Corresponding author's e-mail: suzan_kundakci17@erdogan.edu.tr

Abstract

Tepal morphology of 45 *Polygonum* L. s.l. (Polygonaceae) taxa from Turkey has been investigated in detail and the variations among the studied taxa were observed. All Light and Scanning Electron Microscope examinations were performed on the herbarium materials stored in the Herbarium of Biology Department at Recep Tayyip Erdogan University. Tepals of examined taxa are elliptic, oblong, obovate or ovate; the colour light to dark pink, cream-yellow, greenish, base red-green with white-pink margin lobes; the epidermal cells regular or irregular, surface ornamentation striate, smooth or papillate. This is the first comprehensive study performed on Turkish *Polygonum* taxa based on tepal morphology. These results showed that some characteristics such as tepal shape, colour, surface features and ornamentation can be used to distinguish the examined *Polygonum* taxa at especially sectional level and the results support taxonomical delimitation.

Keywords: Tepal, *Polygonum*, SEM, Türkiye.

Acknowledgement: This study is financially supported by TUBITAK (Project number: 219Z024).

Oral Presentation OP-14
Thursday
Hall-1 Sabri Özyurt Session

An Updated Protocol for Fast and Simple Venation Analysis of Small and Difficult to Image Leaves

Rachel Mollman[1*], Almila Çiftçi[2], Osman Erol[2]

[1]Istanbul University, Faculty of Science, Biology Department, Botany Division, Istanbul, Türkiye.

[2]Istanbul University, Institute of Science, Biology Department, Botany Division, Istanbul, Türkiye.

*Corresponding author's e-mail: zmollman@gmail.com

Abstract

Venation analysis is gaining importance in the fields of plant ecology, physiology and even systematics, as researchers use increasingly sophisticated computer-based methods to analyse plants and their abilities to adapt to drought, heat and other abiotic factors in a changing climate. Advancements in imaging methods and machine learning algorithms have made it possible to perform meaningful venation analyses on increasingly difficult leaves (i.e. small leaves with exceptionally fine venation, occluded by trichomes, or compromised by pathogens or damage). However, some leaves confound even the most advanced analytical methods. For these we must rely on laboratory methods for ease of analysis and standardization of data collection. We present a simple, straightforward method for the preparation, imaging and analysis of very small leaves occluded by dense indumentum and a thick cuticle and epidermis, using *Cerasus microcarpa* Boiss. (Rosaceae), a highly variable drought-tolerant shrub or small tree from southeastern Turkey. Up to now, many venation analyses have investigated large leaves with clearly visable veins which are easily photographed. The leaves of *C. microcarpa* are too small, twisted and occluded for previously used methods to be effective. This necessitates imaging under a microscope with the epidermis and occluding layers removed. The proposed method will help in the wider application of venatian analysis to other small-leaved or otherwise difficult to image plant taxa.

Keywords: Venation analysis, laboratory protocol, microscopy, tissue staining.

Acknowledgement: This work was supported by the Istanbul University Scientific Projects Division under Grant Number FYL-2021-37622.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-15
Thursday
Hall-1 Sabri Özyurt Session

On the Hunt for Characters: Seperating *Crocus balansae* J.Gay ex Maw from Its Close Relatives

Almıla Çiftçi[1*], Rachel Mollman[2], Levent Şık[3], Osman Erol[1]

[1]Istanbul University, Faculty of Science, Biology Department, Istanbul, Türkiye.

[2]Istanbul University, Institute of Science, Biology Department, Istanbul, Türkiye.

[3]Manisa Celal Bayar University, Faculty of Arts and Science, Biology Department, Manisa, Türkiye.

*Corresponding author's e-mail: almila.ciftci@istanbul.edu.tr

Abstract

The morphological separation of *Crocus balansae* J.Gay ex Maw is a tricky subject for those who are not very familiar with crocuses. Crocuses show extensive variation by nature and *C. balansae* is no exception. The tendency toward variation reaches an extreme in the tepal patterns of *C. balansae*. They may have almost completely mahogany individuals to fully striped or feathered to suffused at the base to no markings at all, sometimes in the same population. One may think it is easy to distinguish *C. balansae* from its close relatives (i.e. *C. olivieri* and *C. istanbulensis*) based on their style branching and leaf width; however, we observed that these two characteristics are also highly variable within and among populations. Although this observation does not render such characters useless, it implies a need for subsidiary characters. Geometric morphometric studies are becoming popular in systematic botany due to their holistic and numerical nature, which makes them less prone to errors and speculation. In an attempt to find such subsidiary characters, we wanted to see whether geometric morphometry would prove useful in tepal shapes of crocuses. To this end, we used MASS and PAST computer programs for exploratory morphometric studies on these closely related species. The results indicate that tepal shape cannot be used to separate *C. balansae* from its relatives, but that these methods may prove useful in separation of more distantly related taxa.

Keywords: *Crocus balansae*, morphology, plant systematics, elliptic fourier.

Acknowledgement: This study is supported by Istanbul University Research Projects Unit through project number FAB-2021-37723.

Oral Presentation OP-16
Thursday
Hall-1 Sabri Özyurt Session

The Usefulness of Scanning Electron Microscopy and Micromorphological Characters for Taxonomic Study of Genus *Festuca* L. (Poaceae) in Türkiye

Jelena Erdal[1*], Gencer Yaprak[1], Musa Doğan[1]

[1] Middle East Technical University, Faculty of Arts and Sciences, Department of Biological Sciences, Ankara, Türkiye.

*Corresponding author's e-mail: jelenaerdal@gmail.com

Abstract

This study has been performed as a part of the ongoing research project regarding contemporary systematic revision of the genus *Festuca* L. (Poaceae) in Türkiye. Our aim was to assess the taxonomic value of floral and leaf micromorphological characters and see to which extent they could be useful in taxa delimitation. For that purpose, we have analysed the surface patterns of lemma and leaf-blade tissue samples by using Scanning Electron Microscopy (SEM). Samples belong to 76 populations of known and potentially new fescue taxa, representing all sections and subgenera of the genus *Festuca* in Türkiye. The characters of interest include long cells, silica bodies, short cells, crown cells, prickles, micro hairs and their presence or absence, size, frequency, shape and distribution. In this study for the first time micromorphological characters of the whole *Festuca* genus in Türkiye were examined and observed surface patterns were compared with the currently accepted taxonomic classification. Our conclusion is that micromorphological characters of lemma and leaf-blade can give significant contribution to fescue taxa delimitation. The variation in micromorphological characters observed was compatible with the currently recognized subgenera and sections. Also, we saw that differences in the micromorphological characters could be present between the species, as well.

Keywords: *Festuca*, micromorphology, SEM, taxonomy, Türkiye.

Acknowledgement: The first author is in great debt of gratitude to Mrs. Slavica Dordevic and Mr. Serkan Erdal, for their generous help with field work and financing. SEM analyses were performed by METU Central Laboratory, we thank the personnel for their kind assistance.

Oral Presentation OP-17
Friday
Hall-1 Özcan Seçmen Session

The Seed Coat Morphology of *Aethionema* Genus (Brassicaceae) in Turkey

Kuddisi Ertuğrul[1], Burcu Yılmaz Çıtak[1*], Kağan Çiçek[1], Tuna Uysal[1], Hakkı Demirelma[1], Emrah Şirin[1], Meryem Bozkurt[1]

[1]Selcuk University, Faculty of Science, Department of Biology, Konya, Türkiye.

*Corresponding author's e-mail: burcuyilmaz@selcuk.edu.tr

Abstract

Aethionema is represented by 60-70 species in the world, and the most of these are distributed in Irano-Turanian phytogeography region. *Aethionema* is comprised of 57 taxa in Turkey. It is not only the main gene centre but also the main diversification centre together with Iran. *Aethionema* is one of taxonomically baffling genus in Turkey. Taxonomy of the genus has become even more complicated by recently describing many new taxa for genus. In present study, the micromorphological seed structure of genus *Aethionema* distributed in Turkey were investigated by light microscopy (LM) and scanning electron microscopy (SEM) in order to assess diagnostic value of these characters for taxonomical purposes. Seeds of *Aethionema* genus were determined as ovate, broadly ovate or elliptical in shape and straw, light brown or brown in colour. The seed length ranges from 1.05 to 2.14 mm and the width of seed from 0.51 to 1.41 mm. By this study, we have been determined that five seed coat ornamentation type according to seed surface characters of *Aethionema* genus. The cluster analysis has been used to designate the contribution of seed morphological characters to the taxa relationships. Numerical analysis has revealed that the seed size and ornamentation types were affected the separation of taxa from each other.

Keywords: *Aethionema*, Cruciferae, Kayagülü, seed, stone cresses, systematics.

Acknowledgement: The authors would like to thank a lot the foundation The Scientific and Technological Research Council of Turkey (project number 118Z995) because of its financial support.

Oral Presentation OP-18
Friday
Hall-1 Özcan Seçmen Session

Comparison of Turkish *Epilobium tetragonum* (Onagraceae) taxa based on Macro-Micromorphological Properties

Seda Okur[1*], Serdar Makbul[2], Mutlu Gültepe[3], Kamil Çoşkunçelebi[4]

[1]Recep Tayyip Erdoğan Universty, Pazar Vocational School, Department of Plant and Animal Breeding, Rize, Türkiye

[2]Recep Tayyip Erdoğan University, Department of Biology, Faculty of Sciences and Arts, Rize, Türkiye

[3]Giresun University, Dereli Vocational School, Department of Forestry, Giresun, Türkiye

[4]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye

*Corresponding author's e-mail: seda.okur@erdogan.edu.tr

Abstract

In this study, morphological, palynological, seed and trichome micromorphological features of *Epilobium tetragonum* subsp. *lamyii* (F.W. Schultz) Nyman, *E. tetragonum* subsp. *tetragonum*, and *E. tetragonum* subsp. *tourneforti* (Michal.) H. Lev. taxa were studied comparatively to contribute to the delimitation of the taxa. The study material consists of samples collected from different areas of our country within the scope of the TÜBİTAK project (113Z782) and stored in the Herbarium (RUB) of the Biology Department of Recep Tayyip Erdogan University. All materials used in morphological and micromorphological studies were obtained from herbarium samples. Micromorpological characteristics were determined on photographs taken from scanning electron microscopy. It was determined that the examined taxa differs from each other according to some morphological features such as petiole length, leaf hair, sepal length, stamen length and seed properties. Pollen surface ornamentation of studied taxa are regulate, baculate or baculate-piliate. The seed periclinal wall is granulate-striate, granulate-rugose or granulate-ruminate. This is the first report performed on macro-micromorphological characteristics of *E. tetragonum* taxa. Our results indicated that the macro and micro morphological characters can be useful delimiting the examined taxa at infraspecific level.

Keywords: *Epilobium*, micromorpholgy, pollen, Turkey.

Acknowledgement: The authors extend their thanks to TUBITAK (113Z782) for financial support.

Oral Presentation OP-19
Friday
Hall-1 Özcan Seçmen Session

Palynological Studies on Species of the Section *Linum* of the Genus *Linum* L. (Linaceae) with Clavate–Filiform Stigma

Gülce Bayhun[1*], Nadim Yılmazer[1]

[1]Tekirdağ Namık Kemal University, Faculty of Arts and Sciences, Department of Biology, Tekirdağ, Türkiye.

*Corresponding author's e-mail: gulcebayhun@gmail.com

Abstract

The genus *Linum* was discussed by P. H. Davis in "*Flora of Turkey*". Fifty-six *Linum* taxa grow in our country, being divided into five sections. In this study, pollen morphology of the species *L. bienne* Mill., *L. usitatissimum* L., *L. tmoleum* Boiss., *L. aroanium* Boiss. & Orph., and *L. nervosum* Waldst & Kit. was examined by light and scanning electron microscopy (SEM), and systematic relationships of these species were evaluated by the data obtained. Plant samples were collected between 2018 and 2019, and they were compared with those deposited in ISTE herbarium. Flowers of 10-15 plants of each species were used in palynological studies. Wodehouse technique was applied for palynomorphology. The characteristics and size of the pollen grains were determined and measured, and they were photographed by using a trinocular microscope attached with a digital camera at ×100 magnification. In addition, fresh pollen grains were visualized under SEM. Eight morphological characters (P, E, Clg, Clt, se, ne, in and t) were used in the measurements of pollen grains, and Principal Components Analysis (PCA) test was performed. The relationships between species, even between the long-styled and short-styled plants within the same species, were compared. Flowers of *L. nervosum*, *L. aroanium* and *L. tmoleum* are heterostylous, while those of *L. bienne* and *L. usitatissimum* are homostylous. Pollen grains of *Linum* species studied are trizonocolpate, hexacolpate or polypantocolpate, with oblate–spheriodal or suboblate shape, and medium to large in size. Although palynological studies on the genus *Linum* are limited in our country, our findings are in concordance with those of the previous studies. Our study revealed that *Linum* taxa can be distinguished from each other according to the characteristics of their pollen grains. Furthermore, this study provides the pollen identification keys of the species with clavate-filiform stigma in the section *Linum*.

Keywords: *Linum*, PCA, pollen, SEM, Türkiye.

Oral Presentation OP-20
Friday
Hall-1 Özcan Seçmen Session

Contribution to Taxonomy of Turkish *Epilobium* and *Chamaenerion* Taxa Based on Leaf Micro Morphology

Seher Güven[1]*, Serdar Makbul[1], Seda Okur[2], Züleyha Mercan Özmen[1], Kamil Çoşkunçelebi[3]

[1]Recep Tayyip Erdoğan University, Department of Biology, Faculty of Sciences and Arts, Rize, Türkiye

[2]Recep Tayyip Erdoğan Universtiy, Pazar Vocational School, Department of Plant and Animal Breeding, Rize, Türkiye

[3]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye

*Corresponding author's e-mail: seher.cakmak@erdogan.edu.tr

Abstract

In the present study, leaf surface properties of *Chamaenerion* Séguier and *Epilobium* L. taxa in Türkiye were studied using scanning electron microscopy (SEM) to contribute to the delimination of the examined taxa. The plant materials were collected from natural populations over the period 2012-2017 and deposited at the Herbarium of the Department of Biology of Recep Tayyip Erdoğan University (RUB). Micro morphological investigations were performed on the herbarium materials. In all the examined *Chamaenerion* taxa, both abaxial and adaxial leaf surfaces are characterized with striate epicuticular wax (except for *C. angustifolium* (L.) Scop. including also epicuticular wax crystals); irregularly shaped epidermal cells; flat anticlinal cell walls; simple non-glandular hairs present along the margins and veins or the entire surface. In the examined *Epilobium* taxa, the epicuticular wax is smooth or striate; the epidermal cells are puzzle shaped; the anticlinal cell wall is undulate; non-glandular hairs or both glandular and non-glandular hairs present along the margins and veins or the entire surface on both abaxial and adaxial leaf surfaces. Leaf micromorphological features of Turkish *Epilobium* and *Chamaenerion* taxa were investigated comparatively for the first time. Our results showed that some micro morphological characters such as shape of epidermal cells and anticlinal cell walls, epicuticular wax ornamentation, leaf pubescence and the presence of stomata on the abaxial and adaxial surfaces are taxonomically useful at the generic and specific level.

Keywords: *Chamaenerion*, *Epilobium*, micro morphology, SEM.

Acknowledgement: The authors extend their thanks to the Scientific and Technological Research Council of Turkey (TUBITAK, 113Z782) for the financial support.

Oral Presentation OP-21
Friday
Hall-1 Özcan Seçmen Session

Taxonomic Investigation of *Bellevalia sarmatica* and *Bellevalia glauca* Species

Gizem Kaymaz[1], Yasar Kıran[1], Gülden Doğan[1*]

[1]Firat University, Science Faculty, Biology Department, Elazig, Türkiye.

*Corresponding author's e-mail: gdogan@firat.edu.tr

Abstract

Bellevalia Lapeyr. genus, which belongs to the Asparagaceae family and is one of the important genera of our country, has a wide distribution area, mostly from Morocco and Algeria to the Caucasus and Iran in the east. This genus is generally distributed in the Mediterranean Region. The total number of species belonging to the genus *Bellevalia* in our country has been determined as 24 according to the List of Plants of Turkey. As a result of recent studies, the number of species of the genus *Bellevalia* in Turkey has increased to 35. 23 species of this genus are endemic and the endemism rate of this genus is 67.6% in Turkey. In this study, the morphological, anatomical and palynological aspects of *Bellevalia sarmatica* (Pallas ex Georgi) Woronow and *Bellevalia glauca* (Lindl.) Kunth species belonging to the genus *Bellevalia* were investigated. Purpose of this; contributing to the Flora of Turkey, to assist taxonomic studies on the species belonging to this genus. *Bellevalia* species collected for morphological examinations were pressed and made into herbarium material. The collected specimens were preserved in 70% alcohol for anatomical examinations. The preparations were prepared by taking sections from the leaves, scapus and root parts of the species kept in alcohol. The pollen obtained from the samples turned into herbarium material was examined using light and electron microscopy. The Wodehouse (1935) method was used in the examinations made under the light microscope. In addition, a more detailed examination of pollen was made using Scanning Electron Microscopy (SEM). As a result of the examinations, similarities and differences between the species were determined.

Keywords: Anatomy, Asparagaceae, *Bellevalia,* morphology, pollen.

Oral Presentation OP-22
Friday
Hall-1 Tekin Babaç Session

Ocrea Morphology of Turkish *Polygonum* (Polygonaceae) Taxa and Its Taxonomic Significance

Suzan Kundakçı[1*], Serdar Makbul[1], Mutlu Gültepe[2], Kamil Coşkunçelebi[3]

[1]Recep Tayyip Erdogan University, Department of Biology, Faculty of Sciences and Art, Rize, Türkiye.

[2]Giresun University, Department of Forestry, Dereli Vocational School, Giresun, Türkiye.

[3]Karadeniz Technical University, Department of Biology, Faculty of Sciences, Trabzon, Türkiye.

*Corresponding author's e-mail: suzan_kundakci17@erdogan.edu.tr

Abstract

Present study aims to examine the ocrea morphology of Turkish *Polygonum* L. (Polygonaceae) s.l. taxa to elucidate the taxonomic value for the genus. Plant materials belong to 45 *Polygonum* taxa were collected from Turkey. All the Stereo Microscope (SM) examinations were performed on the herbarium materials stored in the Herbarium of Biology Department at Recep Tayyip Erdogan University. Ocreas are brown, greenish or with brown base and hyaline upper part or fully hyaline; the apex truncate, aristate, acute-dentate, or oblique in shape and the surface glabrous or pubescent and number of nerves vary between 3-50. This study is the first report on ocrea morphology of Turkish *Polygonum* taxa. These results showed that some characteristics such as ocrea length, colour, shape, surface features and apex shape can be used to distinguish the examined *Polygonum* taxa at especially sectional level and in some case interspecific level.

Keywords: Ocrea, *Polygonum*, SEM, Türkiye.

Acknowledgement: This study is financially supported by TUBITAK (Project number: 219Z024).

Oral Presentation OP-23
Friday
Hall-1 Tekin Babaç Session

The Pollinator Groups of Plant Families in Ergan Mount, Erzincan, Turkey

Ali Kandemir[1*], Mert Elverici[1], Engin Kılıç[2], Halil İbrahim Türkoğlu[1], Faruk Yıldız[3], Etem Osma[1], Tuğçe Varol[1], Aysel Akverdi[1], Kader Kuş[1], Abdullah Hasbenli[4]

[1]Erzincan Binali Yıldırım University, Faculty of Art and Science Faculty, Department of Biology, Erzincan, Türkiye.

[2]Erzincan Binali Yıldırım University, Faculty of Pharmacy, Department of Basic Pharmacy Sciences, Erzincan, Türkiye.

[3]National Education Directorate, Science and Art Center, Erzincan, Türkiye.

[4]Gazi University, Faculty of Science, Department of Biology, Ankara, Türkiye.

*Corresponding author's e-mail: akandemir@erzincan.edu.tr

Abstract

The study was carried out to determine the pollinators of plant species at 4 different altitudes in Ergan Mountain (Erzincan-Turkey) in 2021 and 2022. The research problems were; "how pollinator diversity in plant communities changes depending on altitudes" and "which plant characteristic is related to pollinator groups". In the mentioned research, pollinators visiting plant families were also recorded. A total of 35 different plant families were identified in the area. It was seen that Lamiaceae, Fabaceae and Brassicaceae were the first three families most visited by pollinators in the area. Plant families were mostly visited by *Hymenoptera*. *Coleoptera* frequently visited members of Apiaceae, Asteraceae, Lamiaceae and Rosaceae. *Diptera* preferred Lamiaceae and Brassicaceae members mostly. *Hymenoptera* are the pollinators that frequently visit members of Lamiaceae, Fabaceae and Brassicaceae. The pollinators of the *Lepidoptera* group mostly preferred Fabaceae and Lamiaceae members. Amaranthaceae, Berbaridaceae, Caprifoliaceae, Crassulaceae, Liliaceae, Plumboginaceae, Saxifragaceae families have the least pollinator diversity.

Keywords: Ergan mountain, *Hymenoptera*, plant families, pollinator, Türkiye.

Acknowledgement The study was supported by TUBITAK with the project number 120Z388.

Oral Presentation OP-24
Friday
Hall-1 Tekin Babaç Session

Plant Resources of the Mountain Xerophytic Communities of Azerbaijan

Musa Cabbarov[1], Vagif Atamov[2*]

[1]Baku State University, Faculty of Biology, Baku, Azerbaijan

[2]Recep Tayyip Erdogan University, Faculty of Science, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: vagif.atamov@erdogan.edu.tr

Abstract

Plants show diversity according to their beneficial properties. Within this diversity, there are feed, water, medicinal, spice and essential oil plants and their subgroups. Plants have been used for cosmetics, perfumery, nutrition and therapeutic purposes for thousands of years. It is an indispensable part of the aromatic industry, which has recently been used in the home and pharmaceutical industry. The main purpose of this study was to examine the floristic features of the mountain-xerophyte plant communities of Azerbaijan with beneficial properties. Herbarium samples collected during the supply studies carried out in Talysh and Nakhchivan Autonomous Republic of Azerbaijan in 2017-2021 vegetation periods constituted the material of the research. Elements of mountain-xerophyte flora in the studied areas were systematically grouped according to useful groups. It was revealed that 420 fodder plants are richer in the vegetation of the region, followed by 280 ornamental plants, 220 medicinal plants with essential volatile oils, and 125 types of vitamin-containing plants, 86 with cypress, 56 with balveren, and 50 with food properties. Among plant taxa, 93 resin and rubber content and 78 poisonous plants were found. Ornamental plants in the flora of the research area: Taxa belonging to Liliaceae, Iridaceae, Orchidaceae, Rosaceae, Scrophulariaceae, Campanulaceae, Asteraceae families are more common. Among the plants used for medicinal purposes: Urticaceae. It was determined that the taxa belonging to the families Polygonaceae, Berberidaceae, Papaveraceae, Rosaceae, Hypericaceae, Elaeagnaceae, Apiaceae, Lamiaceae, Plantaginaceae, Rubiaceae, Valerianaceae constitute 9.3% of the total flora. Among the species: *Juniperus oblonga* M. Bieb., *Ephedra procera* C.A.Mey., *Urtica dioica* L., *Rumex scutatus* L., *Polygonum alpestre* C.A.Meyer, *Berberis vulgaris* L., *Papaver orientale* L., *Cotoneaster multiflorus* Bunge, *Crataegus orientalis* Pall. ex Bieb., *Tilia caucasica* Rupr., *Origanum vulgare* L., *Thymus trautvetteri* Klokov & Des.-Shost., *Plantago lanceolata* L., *Galium verticillatum* Danthoine ex Lam., *Valeriana leucophaea* DC. and others. In the field of research there are ethereal essential oil plants. Etheric essential oil plants are more common in taxa of Apiaceae and Lamiaceae families in the research area. Plants belonging to this group have large reserves in mountain xerophyte communities. Many of the plants that stand out with their beneficial aspects are also known as vitamins

and honeydew plants, apart from essential oils. This type constitutes 15.63% of the total flora. Among the resinous plants, *Dorema glabrum* Fisch. & C. A. Mey., *Prangos ferulaceae* (L.) Lindl. *Euphorbia marschalliana* Boiss., *Crambe orientalis* L., *Cynanchum acutum* L., *Clematis orientalis* L. are common. There are also many rare, endemic species in the region: *D. glabrum*, *Rheum rupestre* Litv. ex Los.-Losinsk., *Colutea komarovii* Takht *et. al.* Improvement measures should be taken for its effective use in localities rich with beneficial plants.

Keywords: Azerbaijan, mountain xerophytic, flora, community**.**

Oral Presentation OP-25
Friday
Hall-1 Rahim Anşin Session

Taxonomic Problems and Distribution of the Genus *Gundelia* L. (Asteraceae)

Metin Armağan[1*], Osman Tugay[2], Aslı Doğru-Koca[3], Golshan Zare[4], Osman Kola[5], Mahmut Miski[6], Nur Tan[7], Ernst P. Vitek[8]

[1]Necmettin Erbakan University, Eregli Faculty of Agriculture, Department of Field Crops, Konya, Türkiye.

[2]Selcuk University, Faculty of Pharmacy, Pharmaceutical Botany, Konya, Türkiye.

[3]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

[*4]Hacettepe University, Faculty of Pharmacy, Pharmaceutical Botany, Ankara, Türkiye.

[5]Adana Alparslan Türkeş Science and Technology University, Faculty of Engineering, Department of Food Engineering, Adana, Türkiye.

[6]İstanbul University, Faculty of Pharmacy, Department of Pharmacognosy, Istanbul, Türkiye.

[7]İstanbul University, Center for Research and Practice in Drug Development from Natural Sources, Türkiye

[8]Naturhistorisches Museum Wien, Department of Botany, Wien, Austria.

*Corresponding author's e-mail: metinarmagan@gmail.com

Abstract

Gundelia tournefortii was described by Linnaeus and known as a monospecific for a long time. In flora of Türkiye the genus is represented by one species as *G. tournefortii*. While the genus *Gundelia* is known with only one species in Türkiye, it showed a rapid increase with the publication of *G. dersim* and *G. munzuriensis* species in 2014. Today, it is represented by 18 species all over the world. 16 of them, 11 of them are endemic, are distributed in Türkiye. In the studies, flower color, the number of flowers in the cephaloid and the shape of the fruit were decisive in distinguishing the new taxa from the others. However, due to the variations in these characters, the morphology-based species identification key has not been established yet. During the field studies carried out between 2020-2022, records were taken from a total of 262 different locations. The samples were taken from different populations to represent the species and the morphological characters of each sample were examined by light microscope. Gundelia spreads everywhere in Türkiye except the Black Sea, Marmara and coastal Aegean regions. Geographical boundaries play a decisive role in their distribution. *G. siirtica* and *G. munzuriensis* are the taxa with the narrowest distribution, while *G. armeniaca* and *G. rosea* are the most common taxa. The flower color of *G. komagenensis* was defined as yellow, but the populations having with four different colors were observed. These colors also include the description of *G. cappadocica*. *G. mesopotamica* can be easily distinguished, especially by the length of its apical bracts, but in the same population, the individuals having short bracts are abundant. Since the distribution areas of *G. cilicica* and *G. tournefortii* overlap each other, the flower characters cannot be

distinguished from each other. As a result of the investigations, especially the flower colors used in the species separation showed a lot of variability. The number of flowers in the cephaloid can be decisive for some species. The bract lengths, hairs and plant sizes are the most variable characters.

Keywords: *Gundelia*, taxonomy, distribution, Türkiye.

Acknowledgement: The authors would like to thank The Scientific and Technical Research Council of Türkiye (TÜBİTAK-1001, Project No, 119Z882) for their financial support.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-26
Friday
Hall-1 Rahim Anşin Session

Phylogenetic Relationships of *Cichorium* L. (Asteraceae) Species in Turkey Based on Multilocular Dataset

Nilay Şen[1*], Golshan Zare[2], Aslı Doğru-Koca[1]

[1]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye

[2]Hacettepe University, Faculty of Pharmacy, Department of Pharmaceutical Botany, Ankara, Türkiye

*Corresponding author's e-mail: nilaysen97@gmail.com

Abstract

The genus *Cichorium* L. (Asteraceae) is distributed worldwide with seven species. Of these, *C. intybus* L., *C. spinosum* L., *C. pumilum* Jacq., *C. glandulosum* Boiss. & A.Huet species naturally grow in our country. On the other hand, it is recorded that *C. endivia* L. is cultivated in Istanbul. In some studies in the literature, while the DNA sequence of ITS 1, 5.8S rRNA, ITS 2 and *trn*L-*trn*F markers which belong to *Cichorium* species has been studied with more than one population, the DNA sequence of *psb*A-*trn*H, *ndh*F, *rbc*L, *mat*K marker has been studied with 1-3 populations. However, according to calculated evolutionary trees, it is observed that the species don't generate monophyletic clades. In particular, *C. intybus*, *C. endivia*, *C. spinosum* and *C. pumilum* species, which have a relatively wider distribution and also grow in Turkey, are nested in each other. In this study, DNA sequences of *trn*L, *trn*L-*trn*F, *psb*A-*trn*H, *rpl*32, *rpl*16, *mat*K, *ndh*F, *rpoC*1, *rbc*L, *rps*16 markers in the chloroplast along with the ribosomal ITS 1, 5.8S rRNA and ITS2 intergenic regions of *Cichorium* species naturally distributed in Turkey were studied. With this multilocular dataset obtained, evolutionary trees were calculated in both the 'maximum likelihood' and the 'Bayesian' approaches, and as a result, it revealed the evolutionary relationships of the species. Furthermore, detailed macromorphological studies of these species were made. The phylogenetic positions and morphological characters of the species were demonstrated comparatively.

Keywords: Cichorioideae, evolutionary relationship, morphology, daisy family, Türkiye.

Oral Presentation OP-27
Friday
Hall-1 Rahim Anşin Session

Taxonomical Notes on *Paronychia beauverdii* Czecz. (Caryophyllaceae) Based on nrDNA ITS in Türkiye

Zeynep Türker[1*], Kamil Coşkunçelebi[1], Ümit Budak[2]

[1]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye.

[2]Bozok University, Faculty of Sciences and Arts, Department of Biology, Yozgat, Türkiye.

*Corresponding author's e-mail: zeynep_turkeer@hotmail.com

Abstract

Paronychia beauverdii Czecz. endemic to Turkey is a perennial species. The species is characterized by leaves and sepals without aristas, the sepals are equal or somewhat unequal in length (at least 2.75-3.25 mm), sepals are not penicillate and stylus up to 0.7 mm. In this study, we aimed to clarify the taxonomic position of *P. beauverdii* and its close relatives. Molecular studies based on several accessions belonging to *P. galatica* Chaudhri (UB 2577), *P. beauverdii* (UB 2576), *P. paphlagonica* Chaudhri subsp. *paphlagonica* (UB 2583, UB 2584) revealed that they all are clustered in the same clade with high support value (BS >%65). According to the flora of Turkey *P. galatica* and *P. paphlagonica* are distinct species, however present data obtained from morphological and molecular studies showed that *P. paphlagonica* is conspecific with *P. beauverdii and P. galatica* is a subspecies of *P. beauverdii.*As a result of this study, it was determined that *P. beauverdii* is represented by *P. beauverdii* subsp. *beauverdii and P. beauverdii* subsp. *galatica* in Turkey.

Keywords: Endemic, *P. galatica, P. paphlagonica*, taxonomy.

Acknowledgment: This study was supported by TUBITAK with project number 111T820.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-28
Friday
Hall-1 Rahim Anşin Session

Chromosomal Evolution of *Muscari* and Closely Related Genera

Tuna Uysal[1*], Meryem Bozkurt[1], Ela Nur Şimşek Sezer[1], Hakkı Demirelma[1], Ahmet Aksoy[2], Kuddisi Ertuğrul[1]

[1]Selçuk University, Faculty of Science, Department of Biology, Konya, Türkiye.

[2]Akdeniz University, Faculty of Science, Department of Biology, Antalya, Türkiye.

*Corresponding author's e-mail: tuysal@selcuk.edu.tr

Abstract

In this study, chromosome numbers and morphologies of a total of 65 taxa belonging to the *Asparagaceae* genus, which is widespread in our country, especially the *Muscari* genus together with species belonging to closely related genera, were studied. The basic chromosome number of the species in the *Muscari* genus was determined as x=9 in accordance with the literature. Species in different subgenus showed grouping in accordance with the taxonomy made in Flora of Turkey, mainly in terms of Total Chromosome Length (THL). In this grouping, the sub-genus with the largest chromosomes in accordance with the THL was *Muscari*. Medium-sized chromosomes were seen in subgenus *Leopoldia* species. The smallest chromosomes were determined in subgenus *Botryanthus* species and taxa in *Pseudomuscari*, which is considered a separate genus in the current literature. Polyploidy, which is seen as an important mechanism in terms of chromosomal evolution, has been determined only in a limited number of taxa in the subgenus *Botryanthus*. *Hyacinthella* species, one of the genera closely related to *Muscari*, showed similarities with *Botryanthus* species in terms of THL. However, in the species in this genus, a diversity (from x=8 to 11) in terms of basic chromosome number and accordingly the existence of dysploidy as a separate evolutionary mechanism has been determined. *Bellevalia* species attracted attention with their extra-large chromosomes and were at the top of the list among the genera mentioned here in terms of total chromosome length. In addition, the fact that the basic chromosome number of the species belonging to this genus always has 4 (x=4) and very large values in terms of THL suggests that it may be the most basal group among the discussed genera. Six different asymmetry indices (A_1, A_2, CV_{CL}, CV_{CI}, AI and M_{CA}) were taken into account in order to elucidate the chromosomal structure and morphology of the genera in the study and to make an inference about their chromosomal evolution and the chromosomal relations between the genera were discussed in the light of the findings.

Keywords: Asymmetry, chromosome number, endemic, karyotype, Türkiye.

Acknowledgement: We are grateful to the foundation TUBITAK (the project number 117Z222) and S.U. BAP (the Project number 19401172) because of theirs financial support.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-29
Friday
Hall-1 Rahim Anşin Session

Karyological Investigation of *Ornithogalum oligophyllum* E.D. Clarke and *Ornithogalum orthophyllum* Ten. Species

Sibel Oger[1], Yasar Kıran[1], Gulden Dogan[1*]

[1]Firat University, Faculty of Science, Department of Biology, Elazig, Türkiye.

*Corresponding author's e-mail: gdogan@firat.edu.tr

Abstract

The genus *Ornithogalum* L. (Asparagaceae) includes about 160 species worldwide. The genus *Ornithogalum* generally spreads around South Africa and the Mediterranean, and the region where the genus shows maximum richness is primarily South Africa and then Turkey. With the recent studies in Turkey, the number of species of the genus *Ornithogalum* has increased to 61 and 31 of them are endemic. In this study, two species belonging to the genus *Ornithogalum* (*Ornithogalum oligophyllum* E.D. Clarke and *Ornithogalum orthophyllum* Ten.) one of the important genera of the Asparagaceae family, were investigated karyologically. The bulbs of the collected samples were used for cytotaxonomic studies. After obtaining the root tips from the onions in the first stage, pre-treatment of the obtained root tips, fixation, preservation, hydrolysis, staining, and preparation, the targeted karyotype analyzes were determined and ideograms were prepared. As a result of the studies carried out in dividing somatic cells; chromosome numbers of species, relative length of chromosomes, centromere index, centromere status and total length, karyotype symmetry according to Stebbins, intrachromosomal asymmetry index (A1) and interchromosomal asymmetry index (A2) were determined. In *Ornithogalum oligophyllum* species; chromosome number is 2*n*=20, karyotype formula is M+3m+3sm+3st, chromosome length varies between 7.57-17.94 µm, total chromosome length is 112.87 µm, arm ratio is 1.00-4.02, relative length is 6.70-15.89%, Stebbins' that the karyotype symmetry is 1B, the intrachromosomal asymmetry index (A1) is 0.46, and the interchromosomal asymmetry index (A2) is 0.29, was determined. In *Ornithogalum orthophyllum* species; chromosome number is 2*n*=14, karyotype formula is 3m+2sm+2st, chromosome length varies between 3.49-8.90 µm, total chromosome length is 54.89 µm, arm ratio is 1.22-3.70, and relative length is 6.35-17.78%, Stebbins' that the karyotype symmetry was 3B, the intrachromosomal asymmetry index (A1) was 0.48, and the interchromosomal asymmetry index (A2) was 0.26 was determined.

Keywords: *Ornithogalum,* chromosome numbers, cytotaxonomy, karyotype.

Oral Presentation OP-30
Friday
Hall-1 Mehmet Koyuncu Session

A Sectional Overview of *Tragopogon* L. (Asteraceae) in Turkey

Mutlu Gültepe[1*], Kamil Coşkunçelebi[2], Serdar Makbul[3], Tuğçe Pelin Gençkaya[2], Gülay Kaya[4], Murat Erdem Güzel[5]

[1]Giresun University, Dereli Vocational School, Department of Forestry, Giresun, Türkiye
[2]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye
[3]Recep Tayyip Erdogan University, Faculty of Arts and Sciences, Department of Biology, Rize, Türkiye
[4]Manisa Celal Bayar University, Faculty of Arts and Sciences, Department of Biology, Manisa, Türkiye
[5]Karadeniz Technical University, Faculty of Science, Department of Molecular Biology and Genetics, Trabzon, Türkiye
*Corresponding author's e-mail: mutlu.gultepe@giresun.edu.tr

Abstract

Tragopogon L. (Asteraceae), one of the largest genera of subtribe *Scorzonerinae*, includes nearly 150 species all over the world, and 26 taxa which are half of endemic to in Turkey. There have been sectional treatments in some regional floras however, a sectional classification was not proposed in the Turkish Flora. In the present paper, Turkish representatives were evaluated at sectional level based on general morphology, palynology, fruit micro-morphology, chromosome numbers, fruit and general anatomy, and nucleotide sequences. According to general morphology Turkish representatives were fell into eight sections however, these sections were not compatible with achene micro-morphology, fruit, and general anatomy and palynological features. Additionally, chromosomal data are not supporting to treat Turkish representatives most of which are diploid and little of which are tetraploids at sectional level. Although the molecular data provided better solutions than the above-mentioned biosystematics data, the results did not fully support the sectional treatment based on morphology-based distinction.

Keywords: Anatolia, anatomy, chromosome, molecular data, pollen, section, *Tragopogon.*

Acknowledgement: This study was supported by TUBITAK (110T954 and 120Z001), Giresun University (FEN-BAP-A-140316-22) and Recep Tayyip Erdogan University (FBA-2018-978).

Oral Presentation OP-31
Friday
Hall-1 Mehmet Koyuncu Session

Potential Distribution and Reassessment of Threat Category of *Adonis paryadrica* (Ranunculaceae) Endemic to Turkey in the Light of New Records

Murat Erdem Güzel[1*], Mutlu Gültepe[2], Ali Kandemir[3], Kamil Coşkunçelebi[4]

[1]Karadeniz Technical University, Faculty of Science, Department of Molecular Biology and Genetics, Trabzon, Türkiye.

[2]Giresun University, Dereli Vocational School, Department of Forestry, Giresun, Türkiye.

[3]Erzincan University, Faculty of Science and Arts, Department of Biology, Erzincan, Türkiye.

[4]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye.

*Corresponding author's e-mail: muraterdemguzel@hotmail.com

Abstract

Adonis paryadrica (Boiss.) Kandemir & Aytaç (≡*A. cyllenea* Boiss., Heldr. & Orph. var. *paryadrica* Boiss.) endemic to Turkey is a perennial herb. The species had been only kwon from the type gathering and thought to be extinct in the wild up to 2014. A recent study approved its distribution around the locus classicus and a further record from Erzincan relatively far away from the locus classicus. Field trips were performed chiefly in Eastern Black Sea Division in 2018 between March and September and further locality information were compiled by personal communication to determine the area of occupancy (AOO), extent of occurrence (EOO) of *A. paryadrica*. We sampled the species from ten localities and compiled two further localities. Current potential distribution of the species was determined with Maxent software and visualized with ArcGis software. AOO and EOO of the species were calculated based on determined X,Y coordinates with online GeoCat software. Maxent modeling revealed that the current distribution of the species is mostly consistent with its current potential distribution with a few exceptions. According determined X, Y coordinates, AOO and EOO of the species were calculated as 3,756.072 km2 and 44 km2, respectively. The conservation statute of the species is Endangered (EN) based on both EOO and AOO according automatic calculation of GeoCat. Corresponding to the GeoCat results it is concluded that the conservation statute of the species should be EN due to location number of the species more than ten and lack of any serious risk on the species.

Keywords: IUCN, maxent, potential distribution.

Acknowledgment: This study was supported by "Republic of Türkiye Ministry of Agriculture and Forestry" in the scope of "Action Plan on 100 Species Endemic to Turkey" and performed in coordination with "General Directorate of Nature Conservation and National Parks".

Oral Presentation OP-32
Friday
Hall-1 Mehmet Koyuncu Session

Phenetic Variation Among Wild *Vaccinium arctostaphylos* L. (Ericaceae) Populations in Türkiye

Gülşah Yılmaz[1*], Murat Erdem Güzel[2], Serdar Makbul[3], Kamil Coşkunçelebi[1]

[1]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye

[2]Karadeniz Technical University, Faculty of Science, Department of Molecular Biology and Genetics, Trabzon, Türkiye

[3]Recep Tayyip Erdogan University, Faculty of Arts and Science, Biology, Rize, Türkiye

*Corresponding author's e-mail: ylmzgulsah@gmail.com

Abstract

In the present study, 29 macro and micro-morphological characters belonging to seventeen natural populations of *Vaccinium arctostaphylos* L. collected from NE Türkiye were evaluated using cluster analysis. The analysis revealed that the most important three macro-morphological characters as the leaf length, width, and teeth numbers of *V. arctostaphylos* from seventeen populations were distinctly divided into two sub-branches. The results of cluster analysis also showed that two subpopulations of *V. arctostaphylos* differ from each other in terms of vegetative and generative characters. Although the preliminary results indicated that this two subpopulations easily separated from each other based on morphological features, more morphological and molecular data are necessary to recognize a new taxa.

Keywords: Cluster analysis, morphology, Türkiye, *Vaccinium arctostaphylos*.

Oral Presentation OP-33
Thursday
Hall-2 Mahmut Kılınç Session

The Effects of Different Vernalization Models on Plant Growth, Seed Oil Content and Expression Levels of Some Genes Related to Vernalization and Fatty Acid Biosynthesis in Rapeseed (*Brassica napus* L.)

Çağla Sönmez[1, 2*], İrem Çağlı[2], Büşra Elif Kıvrak[3]

[1]Konya Food and Agriculture University, Faculty of Agriculture and Natural Sciences, Department of Molecular Biology and Genetics, Konya, Türkiye.

[2]Konya Food and Agriculture University, Institute of Natural Sciences, Department of Biotechnology, Konya, Türkiye.

[3]Sabancı University, Faculty of Engineering and Natural Sciences, Department of Molecular Biology, Istanbul, Türkiye.

*Corresponding author's e-mail: cagla.sonmez@gidatarim.edu.tr

Abstract

Rapeseed (*Brassica napus* L.) is an economically important oilseed crop which has high amount of seed oil (35-50%) and a rich protein content in its pulp (30-58%). The most important factor that distinguishes the winter and summer rapeseed varieties is whether the plant needs vernalization or not. Vernalization is the need for low temperature below the ambient growth temperature for a certain period during winter in transition from vegetative to generative growth phase. Once the vernalization is complete, plants can flower at the most suitable environmental conditions in spring. The 2011 National Action Plan on Climate Change foresees an increase by 2.5 ° -4 ° C in the annual average temperature in Turkey in the coming years. A rise at this rate is expected to impact the ecosystem as unexpected (extreme) weather events, heat waves, and yield loss in agricultural products due to drought or flood disasters. In this project, physiological parameters, seed oil content and fatty acid compositions and expression profiles of *BnaFLC* genes associated with vernalization and *FATB*, *FAD5, MCOA*, *WD40* genes involved in lipid biosynthesis of two winter (Darmor and Bristol) and one summer (Helios) rapeseed (*Brassica napus* L.) cultivars with different flowering times were investigated in relation to different vernalization times and intermittent temperature increases during vernalization. As a result, it was found that all three *FLC* (*BnaFLCA02*, *BnaFLCC02* and *BnaFLCA10*) gene expressions were highly positively correlated with flowering time in different vernalization models. Helios, which is described as a spring variety, had a vernalization response and vernalization provided early flowering in plants, positively impacted agronomic characteristics such as the number of seeds in capsules. It was concluded that there was an increase in the amount of seed oil and percent oleic acid in Helios due to vernalization. In Darmor cultivar, *FLCC02* gene expression in leaves of plants subjected to devernalization for 1 week after completing 2 weeks of vernalization, then remaining in the

vernalization process for another 6 weeks (8 weeks of vernalization in total) showed a statistically significant increase in *FLCC02* gene expression compared to plants subjected to 8 weeks of continuous vernalization.

Keywords: Rapeseed, vernalization, *FLC*, seed oil content, fatty acid composition.

Acknowledgement: This research was supported by TUBITAK 120Z278 to ÇS and TUBITAK 2209-A project to BEK.

Oral Presentation OP-34
Thursday
Hall-2 Mahmut Kılınç Session

Investigation of the Effect of Giberellic Acid on Gst Enzyme in Maize (*Zea mays* L.) Under Salt Stress

Burcu Seçkin Dinler[1], Hatice Çetinkaya[1*], Zafer Secgin[2]

[1]Sinop University, Faculty of Arts and Sciences, Department of Biology, Sinop, Türkiye.

[2]Ondokuz Mayıs University, Faculty of Agriculture, Department of Agricultural Biotechnology, Samsun, Türkiye.

*Corresponding author's e-mail: bseckin@sinop.edu.tr

Abstract

Gibberellic acid is an important hormone that plays role in plant growth and development. It is highly effective in responses to environmental stress. Under stress conditions, the interactions of some plant hormones (ABA, NO, SA, JA, ETH) with GST enzyme have already been reported, but the effect of GA3 on this enzyme has not been determined yet. This study demonstrates that GA3 could be a signal to increase salt tolerance in maize (Zea mays L.) leaves. The plants were treated with salt stress (350 mM NaCl and 100, 300 and 500 ppm GA3) simultaneously. Relative water content, proline and malondialdehyde (MDA), hydrogen peroxide content, superoxide and hydroxyl radical scavenge capacity, GST enzyme activity and GST gene expressions were investigated in the treated plants at 10th days.GA3 application provided water balance under salt stress and caused a decrease in the amount of proline. MDA, hydrogen peroxide and superoxide radical content were the lowest at of 300 ppm GA3 compared to 100 and 500 ppm. However, the 100 and 500 ppm of GA3 treatments stimulated the GST enzyme activity. On the other hand, in plant groups treated with GA3 at different concentrations, GST gene expressions were different from the salt-treated groups, with an up-regulated changing from 1.5 to 4 fold. As a result, GA3 as a signal molecule provided with a stress tolerance stimulating the GST enzyme activity and alleviated salt stress.

Keywords: Gibberellic acid, glutathione-s-transferase, maize, salinity, antioxidant.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-35
Thursday
Hall-2 Mahmut Kılınç Session

The Role of Exogenous Cysteine in High-Temperature Stress Tolerance in *Arabidopsis thaliana*

Selda Durmuşoğlu[1*], Aykut Sağlam[2], Asım Kadıoğlu[3]

[1]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye.

[2]Karadeniz Technical University, Faculty of Science, Department of Moleculer Biology and Genetics, Trabzon, Türkiye.

[3]Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Türkiye.

*Corresponding author's e-mail: seldaoksuz@ktu.edu.tr

Abstract

One of the abiotic stress factors that seriously impairs plant growth and development and results in significant output losses globally is temperature, which has been rising quickly in recent years. Abiotic stresses and global population growth have prompted scientists to use beneficial strategies for developing high yields and alleviating the stress damage to ensure food security. Exogenous application of amino acids enhances plant tolerance against various environmental stress factors. Cysteine (Cys) is also known to be one of the amino acids playing an important role in plant response to various environmental stress factors. However, there are not enough studies about the effect of Cys in plants under high temperature stress. In the present study, the alleviation of high temperature stress through exogenous Cys treatment to wild type and hsp and glyoxalase mutant seedlings of *Arabidopsis thaliana* was evaluated. Experiments were performed on Arabidopsis Col-0 ecotype and the mutant plants in Murashige Skoog medium. The seedlings were treated with different concentrations of cysteine (0-150 µmol). For high temperature treatment, the seedlings were exposed to 38 ºC for 120 min and then 45 ºC for 90 min after cysteine application and then were allowed to grow an additional 3 days before harvesting. Some growth and stress parameters were measured in harvesting plants. All the results revealed that the seedlings treated with 150 µmol cysteine are the group which best tolerated high-temperature stress conditions. The mutant seedlings values also supported the tolerance role of cysteine to the stress. The findings of the present study suggest that cysteine plays a critical role in regulating plant tolerance to high-temperature stress in plants.

Keywords: *Arabidopsis*, cysteine, high temperature stress, tolerance.

Acknowledgement: The research was supported by the Scientific and Technological Research Council of Turkey (TUBITAK), project no 120Z151.

Oral Presentation OP-36
Thursday
Hall-2 Mahmut Kılınç Session

Effect of Traffic Factor on Heavy Metal Content of Grapevine (*Vitis vinifera* L.) Grown in Salihli (Manisa)

Gülistan Arslan[1], Ali Bilgin[1], Şule Güzel İzmirli[1*]

[1]Recep Tayyip Erdogan University, Faculty of Science and Art, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: sule.guzel@erdogan.edu.tr

Abstract

Due to the increasing population and increasing demand for needs, industrialization and intensive agricultural practices cause environmental pollution. Heavy metals are currently of environmental concern. The accumulation of heavy metals in agricultural soils is of increasing concern because of food safety, potential health risks, and its detrimental effects on soil ecosystems. The determination of heavy metal concentrations of the grape plant, which has a great importance in Turkey's economy and is used for many different purposes, is important in order to evaluate it according to its effects on living and non-living things. The aim of this present study was to investigate the effect of traffic factor on the heavy metal content of fruit, leaves and soil of grape plant. For this purpose, soil, leaf and fruit samples were obtained from vineyards in areas with and without heavy traffic. Lead (Pb), iron (Fe), copper (Cu), manganese (Mn), chromium (Cr) and cobalt (Co) contents were determined in all samples. The wet acid digestion methods for ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometer Perkin Elmer Optima 7000 DV) determination of heavy metals in soil, leave and fruit of the vine plant were used. As a result of the analysis, it was determined that the heavy metal contents of fruit, leaf and soil samples were higher in areas with heavy traffic. It was determined that the soil results obtained were within normal limits according to the Soil Pollution Control Regulation. It was determined that the heavy metal contents in fruit and leaves were within the limit values stated in the literature.

Keywords: Heavy metal, Manisa, pollution, vineyard, *Vitis vinifera.*

Acknowledgement: This study is financially supported by TUBITAK (Project number: 1919B012005692).

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-37
Thursday
Hall-2 Hulusi Malyer Session

Comparison of Total Phenolic and Total Flavonoid Contents of Different Solvent Extracts of *Achillea sintenisii* and *Centaurea depressa*

Derya ALTAY[1*], Murat KOÇ[2]

[1]Ankara Yıldırım Beyazıt University, Public Health Institute, Department of Traditional, Complementary and Integrative Medicine, Ankara, Turkey.

[2]Ankara Yıldırım Beyazıt University, Public Health Institute, Department of Traditional, Complementary and Integrative Medicine, Ankara, Turkey.

*Corresponding author's e-mail: babaarslanderya@hotmail.com

Abstract

Asteraceae is known as one of the largest plant families with thousands of plant species. The genus *Centaurea* is the largest member of the broader Asteraceae family. The genus *Centaurea* is represented in Turkey with 187 taxa, 114 of which are endemic. Various species of Centaurea are used as herbal remedies for their digestive, tonic, expectorant, anti-pyretic, and antidiarrheal effects in traditional medicine. *Achillea* species are represented by approximately 140 species in the world. In folk medicine, these species are used as herbal remedies due to their analgesic, antispasmodic, antiinflammatory digestive and wound healing effects. The aim of this study is to compare the total phenolic and flavonoid contents of various solvent extracts obtained from the aerial parts of *Achillea sintenisii* and *Centaurea depressa*. The total phenolic concentration was measured using the Folin Ciocalteu method. Absorbance of the mixtures was determined at 750 nm relative to a prepared blank using Shimadzu (UV-1240) spectrophotometer. The phenolic content determination, gallic asid was used as the standard. Total flavonoid concentration was measured using a aluminum chloride colorimetric assay. Absorbance of the mixtures was determined at 415 nm relative to a prepared blank using Shimadzu (UV-1240) spectrophotometer. Quercetin was used as a standard in the determination of the flavonoid content. Total phenolic content of plant extracts ingredient contents 3, 053 and 9, 035 varied between them. Total flavonoid content of plant extracts ingredient contents 3, 55 and 12, 25 varied between them.

Keywords: *Achillea sintenisii,* Asteraceae, *Centaurea depressa,* flavonoid, phenolic.

Oral Presentation OP-39
Thursday
Hall-2 Sinasi Yıldırımlı Session

Syntaxonomy of *Quercus* Communities in Euxine Region

Hüseyin Baykal[1*]

[1]Recep Tayyip Erdogan University, Pazar Vocational School, Department of Crop and Animal, Rize, Türkiye.

*Corresponding author's e-mail: huseyin.baykal@erdogan.edu.tr

Abstract

The genus *Quercus* is represented by 20 species, 15 subspecies and four hybrids in Turkey. 10 of these taxa are the most important and dominant taxa of the Turkish forest, scrub and steppe-forest vegetation. In this study, the syntaxonomical classification of the *Quercus* communities in Euxine region (a large scale of Colchis sector and a part of Samsun) of Turkey was investigated by numerical methods, which are widely used in the world. The materials of this study consist of 69 relevés. 20 of these relevés were collected from Samsun and Rize between the years 2016-2017, from May to September, during comprehensive field trips. All data of the relevés, in both the collected ones during the field surveys and provided ones by the current literatures, were recorded and classified according to the traditional Braun-Blanquet vegetation classification method. the plant cover-abundance scale of all relevés, which were recorded according to Braun-Blanquet approach, were converted to Van der Maarel's ordination values and a data set) was arranged. The numerical classification of the relevés was carried out with a community analysis package of programme (CAP 4). Four *Quercus* sp. associations were determined according to two-way indicator species analysis (TWINSPAN) and detrended correspondence analysis (DCA). One of these associations, *Querco pontici-Rhododendretum pontici*, is classified as a new association for science. The status of an association, *Querco polycarpo-Piceetum orientalis*, and two subassociations, *Fraxinetosum angustifoliae* and *Crataegetosum microphyllae* was changed as the synonyms of the association *Carpino betulus-Quercetum petraea*. Syntaxonomically differentiated associations are as follows. 1. *Carpino-Quercetum cerridis*, 2. *Carpino betulus-Quercetum petraea,* 3. *Querco ponticii-Rhododendron ponticii* ass. nov., 4. *Querco ponticii-Betuletum medwediewii*.

Keywords: Syntaxonomy, numerical methods, euxine region, *Quercus* communities.

Oral Presentation OP-40
Thursday
Hall-2 Sinasi Yıldırımlı Session

Nectar and Pollen Sources Plants and Beekeeping in Senoz Valley (Çayeli, RIZE)

Esra Demir Kanbur[1,2*], Vagif Atamov[2], Turan Yüksek[3]

[1]Recep Tayyip Erdogan University, Central Research Laboratory Application and Research Center, Rize, Türkiye.

[2]Recep Tayyip Erdogan University, Faculty of Sciences and Art, Department of Biology, Rize, Türkiye.

[3]Recep Tayyip Erdogan University, Faculty of Engineering and Architecture, Department of Landscape Architecture, Rize, Türkiye.

*Corresponding author's e-mail: esra.demir@erdogan.edu.tr

Abstract

Senoz Valley is a wide valley that starts from the seaside in the Sabuncular Stream basin and extends up to about 3000 meters. Forest, subalpine and alpine vegetations are seen in the valley. Adequate and rich floral capacity affects the yield and quality positively in bee health and in the production of their products. In this sense, the vegetation of the Senoz Valley, which is the research area, has forest vegetation and subalpine vegetation represented by mixed forest associations rich in nectar plants. Most of the study area is in areas dominated by forest vegetation. In our study area, 49 taxa belonging to 16 families were determined as nectar and pollen source plants. Rosaceae and Fabaceae families contain the most taxa. 10 taxa belonging to Fabaceae and Rosaceae families were found. *Ajuga reptans* L., *Lamium album* L. *Castanea sativa* Miller., *Rhododendron ponticum* L., *Tilia rubra* DC. subsp. *caucasica* (Rupr.) V. Engler. *Plantago lanceolata* L. *Vaccinium myrtillus* L., *Vaccinium arctostaphylos* L., *Laurocerasus officinalis* Roemer., *Rubus caucasicus* Focke, *Zea mays* L. species are the bee's nectar and pollen source from spring to autumn.

Keywords: Nectar plants, pollen source, Senoz Valley, beekeeping.

Acknowledgement: This study is financially supported by RTEU BAP (Project Number: FDK-2019-1039) and Çayeli Bakır A.Ş.

Oral Presentation OP-41
Thursday
Hall-2 Sinasi Yıldırımlı Session

Investigation of Vegetation and Bedrock Relationship in Anatolian Steppes

Ali Demir[1], Bilal Şahin[2*]

[1]Ankara Provincial Police Department, Ankara, Türkiye

[2]Çankırı Karatekin University, Food and Agriculture Vocational School, Çankırı, Türkiye.

*Corresponding author's e-mail: bilalsahin@karatekin.edu.tr

Abstract

In this study, the effects of environmental variables on floristic diversity and vegetation change in areas covered with steppe vegetation in Turkey were investigated. For this purpose, data belonging to plant associations identified from steppe habitats in the studies carried out with the Br.-Bl. approach have been used. 300 of these associations were included in this study. Floristic data such as the number of species in the detected plant associations and the number of species in the sample plots were used. Again, environmental data such as bedrock type, slope inclination, height, aspect and soil information of these associations were used. The data set was created by entering the data of these variables into the SPSS 22 program. Correlation and multiple regression analyses were performed with the created data set. In the regression analyses, the bedrock type factor came to the fore as the independent variable affecting the other variables. Bedrock type change is the most important component that floristic structure of the habitat in steppes. Paying attention to this situation in all management and protection works to be carried out on the steppes would be very useful in achieving success.

Keywords: Vegetation change, environmental variebles, steppe vegetation.

Acknowledgement: This study, one of the parts of Ali Demir's graduate thesis.

Oral Presentation OP-42
Thursday
Hall-2 Sinasi Yıldırımlı Session

The Bryophyte Flora of Aydın Mountain (Aydın/Türkiye)

Gözde Aslan[1*],Uğur Çatak[2], Hatice Özenoğlu[3], Mesut Kırmacı[2]

[1]Aydın Adnan Menderes University, Buharkent Vocational School, Department of Chemistry and Chemical Processing Technologies, Aydın, Türkiye.

[2]Aydın Adnan Menderes University, Faculty of Science, Department of Biology, Aydın, Türkiye.

[3]Aydın Adnan Menderes University, Faculty of Education, Department of Mathematics and Science Education, Aydın, Türkiye.

*Corresponding author's e-mail: gozdeaslan88@hotmail.com

Abstract

This Study was planned and completed in order to reveal the Bryophyte flora of Aydın Mountains. Bryophyta is a common name for three closely related groups: mosses, liverworts, and hornworts. Floristic studies carried out on the group are important in terms of understanding our plant biodiversity. 251 taxa belonging to 51 families and 101 genera were found by identifying bryophyte specimens collected from 182 station at different habitat and different vegetation period between 2018 and 2022. Bryophyta, 200 taxa belonging to 28 families and 75 genera, Marchantiophyta, 50 taxa belonging to 22 families and 25 genera and Anthocerotophyta, 1 taxon belonging to 1 family and 1 genus are represented. In addition, different habitats in Aydın Mountains and bryophytes representing these habitats were determined. *Grimmia torquata* Hornsch. in Grev. have been recorded for the first time from Turkey. *Acaulon mediterraneum* Limpr. and *Tortula acaulon* var. *marginata* (Herrnst. & Heyn) R.H. Zander have been recorded for the second time as well. Among 50 Liverwort taxa, Riccia was determined as the richest genus with 17 taxa. *Tortula* (13 taxa), *Grimmia* (12 taxa), *Didymodon* (11 taxa) *Syntrichia* (11 taxa), *Orthotrichum* (8 taxa), *Lewinskya* (7 taxa) and *Fissidens* (6 taxa) are the leafy moss genera with the richest representation. This study, in which a large part of Western Anatolia, unknown in terms of bryophytes was completed; In addition to being a guide for researchers working on the subject, it will provide ready data for the Bryophyte Flora of Turkey, which is planned to be written.

Keywords: Aydın Mountains, West Anatolia, Bryophytes, mosses, liverworts, hornworts.

Acknowledgement: We cordially thank to TUBİTAK for financial support to Mesut Kırmacı (TBAG 119Z393).

Oral Presentation OP-43
Thursday
Hall-2 Sinasi Yıldırımlı Session

Plant Biodiversity of Gaziantep New Botanical Garden

Banu Gökçek[1], Fatih Yayla[2*], Ebru Bozlar[1], Abdulkadir Akgün[1], Ülker Ömür[1]

[1]Gaziantep Metropolitan Municipality, Botanical Gardens and Herbal Research Directorate, Gaziantep, Türkiye.

[2]Gaziantep University, Faculty of Arts and Sciences, Department of Biology, Şehitkamil, Gaziantep, Türkiye.

*Corresponding author's e-mail: fyayla@gantep.edu.tr

Abstract

This study investigated the plant biodiversity of the new botanical garden area of 500 acres to be established in Gaziantep (Turkey). First, woody plants planted as cultures in the area were barcoded and inventoried. The ones that need to be protected in these plants will be determined, and the plans will be made accordingly. According to the data obtained in the study, the Botanical Garden layout plan will be directed. In our study, a total of 275 species and subspecies belonging to 55 families and 120 genera naturally distributed in the area were identified. 5 of these taxa are endemic, and the endemism rate in the area is 2%. The distribution of taxa in the research area into phytogeographic regions is as follows; Iran-Turan has 100 taxa (36%), the Mediterranean has 40 taxa (15%), Europe-Siberian has 5 taxa (2%), 60 wide-spread taxa (22%) and 70 unknown taxa (25%). The largest families in terms of the number of taxa in the research area are Asteraceae (27), Fabaceae (24), Lamiaceae (20), and Poaceae (15). The largest breeds in terms of the number of taxa in the research area are Trifolium (7), Euphorbia (5), Salvia (5), Medicago (5), and Aegilops (5).

Keywords: Gaziantep, flora, new botanical garden, Gaziantep Metropolitan Municipality, Türkiye.

Oral Presentation OP-44
Thursday
Hall-2 Mecit Vural Session

Effect of Different Withering Times on Peptidase Activity of Turkish Tea Leaves

Ahmet Gökkaya[1], Şule Güzel İzmirli[1*]

[1]Recep Tayyip Erdoğan University, Faculty of Art and Science, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: sule.guzel@erdogan.edu.tr

Abstract

Withering is the first step in tea processing and has a significant impact on the final product quality. During the withering of the green tea leaf and its preparation for the next processing step (rolling), the decrease in the moisture content of the leaf is accompanied by the emergence of biochemical interactions that play an important role in the product quality, especially in the aroma. Withering time is an important parameter that affects wilted tea leaves. The aim of this present study was to investigate the effect of withering times (i.e., 0, 16, 17, 18, 19, 20 and 24h) on the peptidase activity of tea leaves. These withering times were performed separately for all tea leaves harvested during the three harvest periods. Peptidase activity was analyzed spectrophotometrically. Peptidase activity was significantly ($P < 0.05$) affected by harvest periods, whereas non-significant ($P > 0.05$) results were noted for peptidase activity in terms of the withering times. The highest enzyme activity was in the 18-hour withered tea leaves and in tea leaves collected in the 2nd harvest period. This study is the first report on the effect of different withering times on peptidase activity of Turkish tea leaves. Withering time is crucial to biochemical properties and controlling and monitoring this stage can help produce high quality black tea.

Keywords: Black tea, harvest period, peptidase, withering.

Acknowledgement: This study is financially supported by TUBITAK (Project number: 1919B012000755).

Oral Presentation OP-46
Thursday
Hall-2 Mecit Vural Session

Determination of Antimicrobial and Quorum Sensing Inhibition Potentials of *Arbutus unedo*, *Aronia melanocarpa*, *Cornus mas*, *Fragaria vesca*, *Frangula alnus*, *Rosa canina*, *Solanum nigrum*, *Sorbus torminalis*, *Vaccinium myrtillus*, *Vitis labrusca* from Rize

Ülkü Zeynep Üreyen Esertaş[1*], İnci Durukan[1], Ali Osman Kılıç[1], Saliha Ekşi[2]

[1]Karadeniz Technique University, Faculty of Medicine, Department of Microbiology, Trabzon, Türkiye

[2]Recep Tayyip Erdogan University, Faculty of Medicine, Department of Microbiology, Rize, Türkiye

*Corresponding author's e-mail: biyolog_ulku@hotmail.com

Abstract

Antibiotic resistance, which has increased rapidly in recent years, is one of the leading public health threats. Studies indicate that this resistance problem, which is expressed in frightening numbers, will cause great loss of life, especially in the 2050s. For this purpose, within the scope of study antimicrobial activity invetigated of the methanol and ethyl acetate extracts of *Arbutus unedo, Aronia melanocarpa, Cornus mas, Fragaria vesca L, Frangula alnus, Rosa canina, Solanum nigrum, Sorbus torminalis, Vaccinium myrtillus, Vitis Labrusca L.* Quorum sensing (QS) is defined as a communication system between bacteria and it is thought that bacteria become pathogenic by signal communication. For the determination of QS suppression activity, *Chromobacterium violaceum* ATCC 12472, *Chromobacterium violaceum* ATCC 31532, *Chromobacterium violaceum* VIR07 *Chromobacterium violaceum* CVO26, *Pseudomonas aeruginosa* PAO1 strains were used. The results of the study showed that the fruits of *C. mas, F. alnus, A. unedo, V. myrtillus* have antimicrobial activity. It was determined that violacein inhibition in *C. mas* and *A. unedo* fruits. Especially *C. mas* methanol extract suppressed pigment in all strains. Some pyocyanin suppression was observed in methanol extracts of *F. vesca and C. mas* plants. In line with these results, it was observed that the antimicrobial compound potential of *C. mas*, one of the fruits, was high. In future studies, it is planned to make more detailed scans by making chemical analyzes of the fruit.

Keywords: Antimicrobial, antiquorum sensing, berries, *Cornus mas.*

Oral Presentation OP-48
Thursday
Hall-2 Mecit Vural Session

Total Qualitative Analysis on *Fumaria officinalis* and *Paronychia kurdica* Species Grown in Inonu University Faculty of Pharmacy Medicinal and Aromatic Plants Garden

Narin Sadıkoğlu[1*]

[1]Inonu University, Faculty of Pharmacy, Department of Pharmacognosy, Malatya, Türkiye.

*Corresponding author's e-mail: narin.sadikoglu@inonu.edu.tr

Abstract

It was aimed to examine the processes from seed to development of plants grown in the Inonu University Faculty of Pharmacy Medicinal and Aromatic Plants Garden and to determine the active ingredients of the selected *Fumaria officinalis* L. subsp. *officinalis* and *Paronychia kurdica* Boiss. subsp. *haussknechtii* Chaudhri species. Seeds of *F. officinalis* subsp. *officinalis* and *P. kurdica* subsp. *haussknechtii* kept in Inonu University Faculty of Pharmacy Medicinal and Aromatic Plants Seed Collection were planted in the garden. The aerial parts of the growing plants are the material of the study. The drugs were powdered for total qualitative analysis and extracts were prepared. Experiments were carried out to search for saponin, anthracene derivatives, starch, flavonoid, tannin, oz, cardioactive glycosides, alkaloid and cyanogenetic glycosides in its content. The active ingredient groups in the content of the plants grown in the faculty garden were identified. As a result of the studies, the presence of carbohydrates, glycosides (cyanogenetic, flavone, cardiotonic), alkaloid and tannin in the content of *F. officinalis* subsp. *officinalis*, the presence of carbohydrates, glycosides (saponin, anthracene, cyanogenetic) and alkaloids were found in the content of *P. kurdica* subsp. *haussknechtii*.

Keywords: *Fumaria officinalis* subsp. *officinalis, Paronychia kurdica* subsp. *haussknechtii,* medicinal and aromatic plants, total qualitative analysis.

Oral Presentation OP-49
Friday
Hall-2 Neriman Özhatay Session

Biological Evaluation of Safrole Oil and Safrole Oil Nanoemulgel as antioxidant, Antidiabetic, Antibacterial, Antifungal, And Anticancer

Mohammed Hawash[1*], Ahmad M. Eid[1]

[1]An-Najah National University, Faculty of Medicine and Health Sciences, Department of Pharmacy, Nablus, Palestine.

*Corresponding author's e-mail: mohawash@najah.edu

Abstract

Safrole is a natural compound extracted from various plants and has shown various biological activities. The current study aimed to investigate the antioxidant, antidiabetic, antimicrobial, and anticancer activity of safrole oil and to study the influence of safrole nanoemulgel on these activities. The antioxidant and antidiabetic in-vitro assays were conducted using standard biomedical methods. The safrole oil nanoemulgel was developed using a self-emulsifying technique. Then the antimicrobial activity of the safrole oil and safrole nanoemulgel were performed on different microbial species, and cytotoxicity was determined against Hep3B cancer cell lines using the MTS assay. Safrole oil showed moderate antioxidant activity compared with standard Trolox, with IC50 value 50.28 ± 0.44 and 1.55 ± 0.32 µg/ml, respectively. Moreover, it had potent α-amylase inhibitory activity (IC50 11.36 ± 0.67 µg/ml) compared with Acarbose (IC50 value 5.88 ± 0.63). The safrole nanoemulgel had pseudo-plastic behaviour, droplet sizes below 200 nm, a polydispersity index (PDI) below 0.3, and a zeta potential of less than − 30 mV. Safrole oil has potential antimicrobial and anticancer activities, and these activities were improved with safrole nanoemulgel. The safrole oil may be applied for the prevention and treatment of oxidative stress, diabetes, different microbial species and cancer, and these activities could be improved by nano-carriers.

Key words: biological activity, Safrole oil, Safrole nanoemulgel

Oral Presentation OP-50
Friday
Hall-2 Neriman Özhatay Session

Phytochemical Profile and *In Vitro* Antioxidant, Antimicrobial, Vital Physiological Enzymes Inhibitory and Cytotoxic Effects of *Artemisia jordanica* Leaves Essential Oil from Palestine

Nidal Jaradat[1*]

[1]An-Najah National University, Faculty of Medicine and Health Sciences, Department of Pharmacy, Nablus, Palestine.

*Corresponding author's e-mail: nidaljaradat@najah.edu

Abstract

Artemisia jordanica (AJ) is one of the folkloric medicinal plants and grows in the arid condition used by Palestinian Bedouins in the Al-Naqab desert for the treatment of diabetes and gastrointestinal infections. The current investigation aimed, for the first time, to characterize the (AJ) essential oil (EO) components and evaluate EO's antioxidant, anti-obesity, antidiabetic, antimicrobial, anti-inflammatory, and cytotoxic activities. The gas chromatography-mass spectrometer (GC-MS) technique was utilized to characterize the chemical ingredients of (AJ) EO, while validated biochemical approaches were utilized to evaluate the antioxidant, anti-obesity and antidiabetic. The microbicidal efficacy of (AJ) EO was measured utilizing the broth microdilution assay. Besides, the cytotoxic activity was estimated utilizing the (MTS) procedure. Finally, the anti-inflammatory activity was measured utilizing a COX inhibitory screening test kit. The analytical investigation revealed the presence of 19 molecules in the (AJ) EO. Oxygenated terpenoids, including bornyl acetate (63.40%) and endo-borneol (17.75%) presented as major components of the (AJ) EO. The EO exhibited potent antioxidant activity compared with Trolox, while it showed a weak anti-lipase effect compared with orlistat. In addition, the tested EO displayed a potent α-amylase suppressing effect compared with the positive control acarbose. Notably, the (AJ) EO exhibited strong α-glucosidase inhibitory potential compared with the positive control acarbose. The EO had has a cytotoxic effect against all the screened tumor cells. In fact, (AJ) EO showed potent antimicrobial properties. Besides, the EO inhibited the enzymes COX-1 and COX-2, compared with the anti-inflammatory drug ketoprofen. The (AJ) EO has strong antioxidant, antibacterial, antifungal, anti-α-amylase, anti-α-glucosidase, and COX inhibitory effects which could be a favorite candidate for the treatment of various neurodegenerative diseases caused by harmful free radicals, microbial resistance, diabetes, and inflammations. Further in-depth investigations are urgently crucial to explore the importance of such medicinal plants in pharmaceutical production.

Keywords: Antimicrobial and antioxidant effects, *Artemisia jordanica*, cytotoxic activities.

Oral Presentation OP-51
Friday
Hall-2 Neriman Özhatay Session

Cytotoxicity and Genotoxicity Evaluation of Aqueous Extracts of Medicinal Plant *Helichrysum* Mill. with *Allium* assay

Ayşe Nihal Gömürgen[1*]

[1]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

*Corresponding author's e-mail: gomurgen@gmail.com

Abstract

The cytotoxic and genotoxic effects of aqueous extracts of *Helichrysum* was evaluated using the *Allium cepa* assay. The crude extracts of *Helichrysum* flowers were prepared with distilled water. Onion bulbs were exposed to 50 mg/mL, 100 mg/mL, 200 mg/mL concentrations of each of the extracts for macroscopic and microscopic analyses, respectively. There was concentration-dependent and statistically significant ($P < 0.05$) inhibition of root growth by the extracts when compared with the control. The EC50 obtained for decoctions of *Helichrysum.* Aqueous flower extracts decreased MI depending on the treatment time and concentration and caused chromosomal abnormalities at all doses in the root meristems of *A. cepa*. Observed chromosome C-metaphase, sticky metaphase, metaphase with fragments, disturbed metaphase, polyploid metaphase, anaphase bridge, anaphase laggard, disturbed anaphase, telophase bridge and micronucleus reinforces cytotoxic and genotoxic effects of aqueous extracts of this medicinal plant.

Keywords: Medicinal plant, allium assay, cytotoxicity, genotoxicity.

Oral Presentation OP-52
Friday
Hall-2 Neriman Özhatay Session

Comparative Cytotoxic Effects of *Centaurea fenzlii* Extracts on Prostate Cancer and Leukaemia Cell Lines

Ela Nur Şimşek Sezer[1*], Tuna Uysal[1]

[1]Selçuk University, Faculty of Science, Department of Biology, Konya, Türkiye.

*Corresponding author's e-mail: elasimsek@selcuk.edu.tr

Abstract

Centaurea is a large genus containing about 700 species that are distributed all over the world. With recent ethno-pharmacological studies have reported that the *Centaurea* species have many biological activities such as antiradical, antioxidant, antibacterial, anti-inflammatory, and anticancer. *Centaurea fenzlii* is an endemic species for our country, and although the cytotoxic effects of this species on some cancer cell lines are known, the existing data should be improved with new data. In this study, the cytotoxic effects of extracts obtained from different parts of the plant on prostate cancer (PC-3) and leukaemia (HL-60) cell lines were investigated. For this purpose, plant material was collected from the natural habitat and dried under appropriate conditions. Then it was ground into powder and extracted by the UAE method. The obtained extracts were applied to the cell lines in 5 different doses (0.0625-1 mg/mL) and at 2 different time intervals (24-48h). The cytotoxic effects of the extracts were investigated via MTT assay. As a result, the extracts showed time and dose-dependent cytotoxic activity in cancer cells and in addition, it has been found to be more effective in prostate cancer cell line than in leukaemia cell line. As a result, it has been demonstrated once again that *C. fenzlii*, like other studied *Centaurea* species, has remarkable anticancer properties. Our future studies, it is planned to investigate the cause of cell death at the molecular level.

Keywords: Endemic, MTT, ultrasonic extraction.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-53
Friday
Hall-2 Ender Yurdakulol Session

Determination of Barley Nitrogen Nutrition Status Based on Image Colour Analysis

Onur Hocaoğlu[1*]

[1]Çanakkale Onsekiz Mart University, Faculty of Agriculture, Department of Field Crops, Çanakkale, Türkiye.

*Corresponding author's e-mail: onurhocaoglu@comu.edu.tr

Abstract

Current developments in agricultural technology make the on-farm assessment of plant fertilizer requirements possible with the use of image analysis. This research aims to evaluate image processing on field photos by its ability to differentiate the color changes on plant canopy due to varying nitrogen regimes. Field trials were conducted during the 2020-2021 growing season in Çanakkale with 8 barley cultivars and 0, 9, 18 and 27 kg da^{-1} nitrogen levels, according to the split block experiment design with three replications. Equivalent photos were obtained from each plot at the beginning of the heading stage, and colors were identified as RGB and HSV color scales with Inkscape graphics software. A preliminary comparison of color sampling methods indicated that extracting the color of randomly selected points on field photos had high variability when circular samplings on plant rows were found reliable if extreme light conditions were avoided. Obtained color data were used in the calculation of several image analysis parameters. Results were evaluated statistically with ANOVA and correlation analysis. ANOVA indicated that effects of genotype and nitrogen level were significant for all parameters except for color B and VIgreen, which were not significantly affected by the nitrogen levels. A comparison of several common image analysis parameters showed that NRGB was the best method to tolerate light sparkles on plant leaves when VIgreen provided the most similar results to SPAD 502 readings. Our results indicated that VIBHUTE and NRGB were the most suitable image analysis parameters for the on-farm evaluation of the nitrogen status of the barley canopy.

Keywords: Barley, nitrogen, image analysis, inskcape, SPAD 502.

Oral Presentation OP-54
Friday
Hall-2 Ender Yurdakulol Session

In vitro Ag Nanoparticles Application Enhanced Rosmarinic Acid Accumulation in *Clinopodium nepeta* subsp. *glandulosum*

Ersan Bektaş[1*], Kaan Kaltalıoğlu[1], Hüseyin Şahin[1]

[1]Giresun University, Espiye Vocational School, Giresun, Türkiye

*Corresponding author's e-mail: ebektas61@yahoo.com

Abstract

In the present study, we investigated the effects of different concentrations of Ag nanoparticles on the accumulation of economically and medicinally important phenolic compound, rosmarinic acid, in the micropropagated *Clinopodium nepeta* subsp. *glandulosum* shoots. *C. nepeta* subsp. *glandulosum* plantlets were obtained from *in vitro* cultured nodal segments in Murashige and Skoog (MS) including vitamins medium including various concentrations of Ag nanoparticles (0, 1.0, 5.0, 10.0, 20.0 and 50.0 mg/mL). Shoots were subcultured three times in the same medium and harvested at the end of the third month. Rosmarinic acid contents of *in vitro* generated shoots were analyzed by using RP-HPLC-DAD. It was observed that there was a significant increase in the amount of rosmarinic acid up to 20 mg/mL in the tested Ag nanoparticle concentration range, and a decrease in the amount of rosmarinic acid higher than this concentration. Highest rosmarinic acid content was determined in the shoots generated in the MS medium supported with 20.0 mg/L Ag nanoparticle concentration. The amounts of rosmarininc acid in all media supplemented with Ag nanoparticle concentrations were found to be considerably higher than the control (MS medium without Ag nanoparticles) and plant materials collected from the natural environment. These results showed that Ag nanoparticle application in *C. nepeta* subsp. *glandulosum* has a positive contribution to the amount of rosmarinic acid.

Keywords: *Clinopodium nepeta* subsp. *glandulosum*, Ag nanoparticle, rosmanrinic acid, micropropagation.

Acknowledgement: This study was supported by Project No: FEN-BAP-A-250221-29 of Scientific Research projects, Giresun University.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-57
Friday
Hall-2 Adil Güner Session

Biological Control with *Trichoderma* Species Against Fungal Disease (*Cylindrocladium buxicola*) on Boxwood Trees in Meydan Village

Şengül Alpay Karaoğlu[1*], Arif Bozdeveci[1], Şeyma Suyabatmaz[1]

[1]Recep Tayyip Erdoğan University, Faculty of Arts and Sciences, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: sengul.karaoglu@erdogan.edu.tr

Abstract

In the village of Meydan, which is within the borders of Kaçkar Mountains National Park, there was a pure boxwood stand (*Buxus sempervirens*) in a forest area of 1.5-2.0 hectares. There were many monumental boxwood trees in the area with a trunk diameter of 60 cm and a height of 5-6 meters. In the last twelve years, it has been observed that boxwood trees in the Hemşin region, as in the whole country, have dried up due to the fungal (boxwood blight) disease caused by *Cylindrocladium buxicola*. There is no specially labeled fungicide (drug) for the control of the *Cylindrocladium*. In order to prevent or delay the drying of the boxwood trees in the location since 2019; light traps against the boxwood moth (*Cydalima perspectalis*) pest, and biological control against boxwood blight disease by using Trichoderma spp. are implemented. In our study, three different *Trichoderma* strains (*T. harzianum*, *T. lixii* and *T. atroviridea*) were used for biological control. The strains were mass cultured at 28°C for 15-20 days in both commercially (PDA) supplied and compost prepared medium in the laboratory environment. *Trichoderma* strains spores were harvested by washing with sterile physiological water. Then the spores of the three strains were mixed at a ratio of 1:1 and diluted with distilled water to contain 1X108 spores. It was sprayed on the trunk and roots of all trees containing life wate. The application was carried out three times a year (May, July, and October) during the years 2019-2022. As a result, the burns on the leaves of the boxwood decreased, the boxworm pest was eliminated, the natural flora under the forest was formed, the remaining boxwood did not dry out, even various visually visible damages on the stem tissue were healed. It was observed that the moss on the trunk of the boxwood decreased, the branches gave fresh shoots, the leaf color became darker, and seeds were formed on the branches (07.2022) for the first time after 10 years. During this biocontrol application period, no live boxwood trees remained in other areas (100-1300 m) where *Trichoderma* was not applied. *Trichoderma* spp. mixtures have been determined to be an important biocontrol agent against to boxwood fungal disease.

Keywords: Boxwood, *Trichoderma*, *Cylindrocladium*, biocontrol agents.

Oral Presentation OP-58
Friday
Hall-2 Adil Güner Session

Determination of Plant Growth Incentive Properties and Bioremidant Potentials of *Bacillus mycoides* and *Bacillus thuringiensis* Isolated from the Rhizosphere of *Dactylorhiza urvilleana* Belonging to the Orchidaceae Family

Ülkü Zeynep Üreyen Esertaş[1*], Emel Uzunalioğlu[2], Arif Bozdeveci[2], Şengül Alpay Karaoğlu[2]

[1]Karadeniz Technique University, Faculty of Medicine, Department of Microbiology, Trabzon, Türkiye

[2]Recep Tayyip Erdogan University, Faculty of Science, Department of Biology, Rize, Türkiye

*Corresponding author's e-mail: biyolog_ulku@hotmail.com

Abstract

Industrial activities have been one of the biggest factors of environmental destruction by destroying natural resources for decades. Heavy metals, which are environmental pollutants, are the biggest threats to the biosphere. Heavy metal accumulation in water and soil finds its place as a major health threat reaching universal dimensions. Therefore, there is a great need for the existence of alternative biological processes in the fight against pollution. Bioremediation is the process of removing environmental pollutants with the help of microorganisms. For this purpose, in our study, isolated from the root soil of *Dactylorhiza urvillena* orchid growing in Ovit plateau in Rize province *B. mycoides* and *B. thuringiensis* were investigated for tolerance to copper, lead, iron, silver, zinc metals and plant growth promoting properties Acetic Acid (IAA) production, siderefor production, phosphate dissolution, ACC (1-Aminocyclopropane-1-Carboxylate) deminase production. It was determined that the isolates had high pH and temperature tolerances. Metal tolerance was found to be high in both strains, but copper resistance was higher in *B. thuringiensis*. It was determined that the siderefor production of *B. thuringiensis* was higher than that of *B. mycoides*. Again, it was determined that the IAA production of *B. thuringiensis* was twice that of *B. mycoides.* Thus, it is thought that the bioremidant potential of the strains is high and field studies are planned.

Keywords: *Bacillus*, metal tolerance, Cu tolerance, PGPB.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-59
Friday
Hall-2 Adil Güner Session

Investigating the Growth Promoting Potential of Bacteria Isolated from Soils of Turkey

Elif Özlem Günçaldı[1*,2] Fatih Karabulut[2], Ümit Barış Kutman[1]

[1]Gebze Technical University, Institute of Biotechnology, Kocaeli, Türkiye.

[2]GÜBRETAŞ R&D Center, Kocaeli, Türkiye.

*Corresponding author's e-mail: eoguncaldi2018@gtu.edu.tr

Abstract

Enhancing agricultural productivity is critical for global food security; however, excessive use of chemical fertilizers and pesticides is harmful for the environment and therefore not sustainable. The integration of microbial organisms into agricultural practices as biofertilizers is gaining interest thanks to their potential to promote growth, increase yield, and improve quality. This study investigated the effects of different plant growth promoter bacteria (PGPB) on growth and yield parameters as well as the nutritional quality of wheat (*Triticum durum*) and rapeseed (*Brassica napus*). The greenhouse experiments evaluated five different microbial inoculants that contain PGPB, including *Bacillus pumilus* (RC22, RC49, RC67, RC356) and *Bacillus subtilis* (RC631), which were isolated from soil samples taken from various regions of Turkey. Results revealed that PGPB treatment is promising for enhancing the growth of both wheat and rapeseed. Treatment with RC356 and RC631 significantly increased the shoot dry weight of rapeseed (9% and 15%, respectively). All PGPB isolates significantly enhanced wheat grain yield, and the highest increase (26%) were observed in plants grown in RC631-treated soil. Element analysis of rapeseed leaves showed that RC67 significantly increased B and Zn concentrations by 14% and 50%, respectively. In addition, RC67 had the highest concentrations of K, S, and Mn in rapeseed leaves. In shoots of wheat, K concentrations were significantly increased with all inoculants (23% by RC22, RC49, RC67; 30% by RC356, RC631) and Mg concentration was significantly increased (30%) with RC49 treatment. Grain K concentration was significantly higher in RC49 and RC67 by 10%. Based on the outcomes of this study, our PGPB isolates are promising for enhancing growth and yield. In addition, effects of PGPB on essential mineral concentrations are important not only for plant but potentially also human nutrition. Further research is needed to elucidate the potential of these isolates under different environmental conditions.

Keywords: Plant growth promoter, bacteria, *Bacillus pumilus, Bacillus subtilis,* biofertilizer.

Acknowledgement: This study was supported by THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKIYE (TÜBİTAK) 2244 - Industrial PhD Fellowship Program (Project 119C030) and GÜBRETAŞ.

Oral Presentation OP-61
Friday
Hall-2 Adil Güner Session

Evaluating of the Effects of Arbuscular Mycorrhiza and *Piriformospora indica* on Growth, Root Morphology, and Stress Tolerance of Wheat Grown in Soilless Culture

Elif Özlem Günçaldı[1*], Halil Yılmaz[2], Bahar Yıldız Kutman[1], Sedef Tunca Gedik[2], Ümit Barış Kutman[1]

[1]Gebze Technical University, Institute of Biotechnology, Department of Biology, Kocaeli, Türkiye.

[2]Gebze Technical University, Faculty of Science, Department of Molecular Biology and Genetics, Kocaeli, Türkiye.

*Corresponding author's e-mail: eoguncaldi2018@gtu.edu.tr

Abstract

Boron (B) toxicity is a common problem in arid and semi-arid environments, leading to impaired growth and limited yield. High levels of B can exist naturally in the soil or groundwater, or they can be introduced into the soil through mining, fertilizers, or irrigation water. Recently, beneficial soil microorganisms have attracted a lot of attention as ecofriendly sustainable inputs to boost soil fertility and crop productivity. Microorganisms such as rhizobacteria, arbuscular mycorrhizal fungi, and other symbiotic fungi such as *Piriformospora indica* have been shown to benefit their host plants by enhancing growth and yield, improving pest and disease resistance, and increasing tolerance to abiotic stresses. This study investigated the effects of root colonization by arbuscular mycorrhiza (AM) or *Piriformospora indica* on the root morphology and stress tolerance of common wheat (*Triticum aestivum*) and durum wheat (*Triticum durum*) plants that were exposed to B toxicity stress. In addition to B toxicity, phosphorus (P) deficiency was also investigated along with mycorrhizal colonization. All experiments were conducted in soilless culture so that the nutritional status of subject plants could be tightly controlled, and the roots could be easily harvested for detailed imaging. Results showed that effects on growth, responses related to abiotic stress tolerance, and alterations in root morphology differed between AM and *P. indica* colonization. When compared to AM, *P. indica* performed better in terms of growth promotion. Colonization with AM resulted in considerable alterations in root architecture including reduced root length, surface area, and tip number (branching) whereas; *P. indica* colonization did not affect root length or surface area but increased average root diameter and tip number. Major differences between effects on mineral nutritional status and activities of antioxidative enzymes were also detected.

Keywords: Boron toxicity, arbuscular mycorrhiza, phosphorus deficiency, *Piriformospora indica,* root morphology.

Acknowledgement: This study was supported by THE SCIENTIFIC AND TECHNOLOGICAL RESEARCH COUNCIL OF TURKIYE (TÜBİTAK) 1001 Project 118Z984 with the title "Investigation of the application potential and physiological effects of *Piriformospora indica* as a biological agent against boron toxicity in wheat".

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Oral Presentation OP-62
Friday
Hall-2 Gülendam Tümen Session

Investigation of the Effect of Sulfate Deficiency on Temperature Tolerance of *Heliotropium thermophilum*

Ece Nisa Imamoglu[1], Aykut Saglam[1*], Asım Kadioglu[2]

[1]Department of Molecular Biology and Genetics, Karadeniz Technical University, Trabzon, Turkey.

[2]Department of Biology, Karadeniz Technical University, Trabzon, Turkey.

*Corresponding author's e-mail: saglama@ktu.edu.tr

Abstract

There is intense sulfate anion in the environment where the thermophile *Heliotropium thermophilum* plant grows. Here we hypotized that sulfate may play a role in temperature tolerance of *H. thermophilum*. In order to investigate the role of sulfate in temperature tolerance, two different concentrations of sulfate-deficient broths were prepared and the plants were grown here at 25°C for 60 days, then divided into 2 groups for temperature applications and kept at 25 °C and 40°C for 7 days. After the applications, seedling fresh weight, relative water content, proline, total soluble sugar, hydrogen peroxide contents, antioxidant enzyme activities (catalase, guaiacol peroxidase, ascorbate peroxidase and glutathione reductase) were determined. *H. thermophilum* could survive at low sulfate concentrations under control conditions (25°C), but stress damages (such as chlorosis, green color retention) at low sulfate concentrations when temperature was applied. In addition, at low sulfate concentrations (0.3 mM and 0.15 mM), there were some decreases in plant fresh weight, relative water level and total sugar level. However, proline and H_2O_2 levels were at the highest level in plants with low sulfate concentration (0.15 mM) and heat treatment. When the antioxidant enzyme activities were evaluated, it was observed that lowering the sulfate concentration caused different results in the antioxidant enzyme activities, Therefore we concluded here that plant sulfate content was important for high temperature tolerance

Keywords: *Heliotropium thermophilum*, sulfate deficiency, high temperature, temperature tolerance.

Acknowledgements: This study was supported by TUBITAK 2209-A project (grant number: 1919B012000384).

Oral Presentation OP-63
Friday
Hall-2 Gülendam Tümen Session

Milestones in Agricultural Revolutions: From Agriculture 1.0 to Agriculture 4.0

Beyazıt Abdurrahman Şanlı[1*], Zahide Neslihan Öztürk Gökçe[1]

[1]Niğde Ömer Halisdemir University, Ayhan Şahenk Faculty of Agricultural Sciences and Technologies, Department of Agricultural Genetic Engineering, Niğde, Türkiye.

*Corresponding author's e-mail: beyazitsanlitblt@gmail.com

Abstract

Originated from around 10,000 years ago, agriculture refers to the combination of art and science that involves cultivation of the soil, growing/development of crops and raising livestock to provide plant/animal products to be used by humanity as food/feed source, sheltering and even production of fuel. A long time has passed since agriculture evolved from its initial phase, Agricultural 1.0, to an advanced stage, Agricultural 4.0. Agricultural 1.0 encompasses practices from antique age to the end of the 19th century, relying mainly on manpower and animal power for cultivation. The Agriculture 2.0 (Green Revolution) era began in the late 1950s when farmers began using agricultural machinery for soil tillage, sowing, irrigation and harvesting as well as new synthetic pesticides and fertilizers, resulting in higher food production and decreased handwork. Despite increasing productivity and efficiency through mechanization overconsumption of fossil fuels, water sources, and chemicals have considerably devastated the environment, prompting transition to new phase known as The Agriculture 3.0 (Precision Agriculture). To improve resource efficiency, productivity, quality, profitability and sustainability of agricultural production, Agriculture 3.0 collects, processes and analyzes temporal/spatial data, and then combine it with other information to make decision on plant/animal production systems for a given region. Over time, as a result of emerging technologies such as the Internet of Things (IoT), Big Data Analytics (BDA), Robotics, Cloud Computing (CC), Artificial Intelligence (AI), Unmanned Aerial and Ground Vehicles (UGV), Agriculture 4.0 (Digital or Smart Farming) offers modern and smart solutions to agricultural/ environmental problems related to crop and livestock production, weeding, pest control and harvesting by utilizing digitalization, automation, and artificial intelligence in combination with various agricultural technologies. As an agricultural country, Türkiye also needs to integrate Agriculture 4.0 applications into its agricultural sector to enhance production potential and gain international competitiveness.

Keywords: Agricultural revolution, agriculture technology, Agriculture 4.0.

Oral Presentation OP-64
Friday
Hall-2 Gülendam Tümen Session

The Importance of Arboretums in the Selection of Woody Plants That Can Be Used in Urban Landscape: Case of the National Botanical Garden of Türkiye Arboretum

Şahin Çimen[1*], Mehtap Öztekin[1], Aysel Ulus[2]

[1]Directorate of National Botanical Garden of Türkiye, Ankara, Türkiye.

[2]Istanbul University-Cerrahpaşa, Faculty of Forestry, Department of Landscape Architecture, İstanbul, Türkiye.

*Corresponding author's e-mail: sahincimen@gmail.com

Abstract

With breeding of natural plant taxa discovered for their aesthetics under optimized conditions the number of ornamental plants is increasing and take their position in nurseries. Selecting appropriate plants for landscape design in accordance with the ecological conditions of a city facilitates sustainable landscape. Landscape plant design based on plant biodiversity in nurseries may lead to wrong plant selections. Inappropriate plant selections increase pressure on water resources in addition to time and economic losses. Landscape architects, when they start working in an area unfamiliar to them, may combine their potential plant selections from local arboretum and botanical garden to design sustainable landscape. Arboretums and botanical gardens can contain species adapted to the ecology of the region. Species present in these locations, show visitors labelling information together with their places of origin and habitat. Within the scope of master thesis titled "*Studies on the Biotopes of National Botanical Garden of Turkey*", species present in Arboretum of National Botanical Garden of Türkiye were described. With the cooperation of Topraksu Institute and TEMA Foundation, 554 taxa were planted in the area established in 1995. During the thesis study in 2019, it was determined that 130 taxa remained, and the point coordinates of 103 evergreen individuals were determined. Number of woody plants in the Arboretum have decreased in years, due to climate change, urbanization, construction changes made by public offices and maintenance. In the present study; it is aimed to promote sustainable landscapes by preferring different woody plant species that grow well in the Arboretum of National Botanical Garden in the urban landscapes of Ankara. For this reason, the Arboretum species that are naturally well developed and compatible with the ecological conditions of the region (which maintain their vitality in a healthy way without irrigation or special care) offer sustainable examples to landscape architects.

Keywords: Arboretum, National Botanical Garden of Türkiye, urban landscape, sustainable landscape.

ABSTRACTS OF POSTER PRESENTATIONS

Poster Presentation PP-01
Thursday

Asteraceae Family Inventory and APG III Revision of Gaziantep University Faculty of Arts and Sciences, Biology Department Herbarium

Ebru Bozlar[1*], Şeyda Yılmaz[1], Serap Şahin Yiğit[1], Fatih Yayla[1]

[1]Gaziantep University, Faculty of Arts and Sciences, Department of Biology, Şehitkamil, Gaziantep, Türkiye

*Corresponding author's e-mail: ebrubzlr@gmail.com

Abstract

In recent years, the rapid development of molecular techniques used in revealing the diversity of living things has led to a considerable increase in the use of these techniques to establish classifications in plant taxonomy. As a result of the molecular discoveries carried out in this field with the help of these techniques, the system used to date in the plant classifications has undergone radical changes. The changes in the angiosperm plants' systematics have been accumulated in the light of new knowledge based on phylogenetic studies and the new classification system for angiosperm plants introduced by the Angiosperm Phylogeny Group (APG III), which is an international research group founded by a team of taxonomists. In this study, Asteraceae family inventory in Gaziantep University Biology Department Herbarium was evaluated and APG III revision was carried out. By reviewing 1061 samples belonging to the family, it was determined that there were 56 genera and 168 species and subspecies taxa belonging to these genera according to Flora of Turkey. According to Flora of Turkey, the first three genera that contain the most taxa in are *Anthemis*, *Centaurea* and *Tragopogon*. As a result of the APG III revision evaluation, it has seen that ten taxa which were examined are endemic to Turkey, and the endemism rate is % 12,5. The phytogeographical distributions of the taxa have been deteemined respectively, unknown or plurireigional 277 (63,97%), Irano Turanian element 89 (20,55%), Mediterranean element 33 (7,62%), Eastern Mediterranean element 17 (3,92 %), Euro-Siberian element 15 (3,46%), Black Sea element 1(0,23%) and Western Mediterranean element 1(0,23%). Although herbariums are known as pressed and dried plant collections, it is necessary to keep herbariums alive and active due to the fact that they give direction to many fields and scientific studies. In this study, the importance of the inventory of herbariums and their continuous updating has been revealed.

Keywords: Asteraceae, herbarium, revision, APG III.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-02
Thursday

Flora of Altındağ (Nizip/Gaziantep)

Ebru Bozlar[1*], Muhittin Doğan[2], Fatih Yayla[2]

[1]Gaziantep Metropolitan Municipality Botanical Gardens and Herbal Research Directorate, Gaziantep, Türkiye.

[2] Gaziantep University, Faculty of Arts and Sciences, Department of Biology, Şehitkamil, Gaziantep, Türkiye.

*Corresponding author's e-mail: ebrubzlr@gmail.com

Abstract

This study investigated the flora of Altındağ (Gaziantep), located within the borders of Nizip district in 2021-2022. The collected plant specimens were taken under protection in the herbarium of Gaziantep Metropolitan Municipality Botanical Garden. A total of 405 taxa belonging to 60 families and 181 genera, species, and subspecies have been identified in the area. The distribution of taxa in the research area into phytogeographic regions is as follows; Iran-Turanian has 107 taxa (26%), the Mediterranean has 86 taxa (21%), Europe-Siberian has 7 taxa (2%), 38 wide-spread taxa (9%) and 167 taxa (41%) are unclear. The largest families in terms of the number of taxa in the research area are Asteraceae (54), Fabaceae (50), Lamiaceae (43), Apiaceae (37), and Poaceae (28). The largest genera in terms of the number of taxa in the research area are Salvia (7), Euphorbia (5), Hypericum (5), Astragalus (5), and Onobrychis (5).

Keywords: Altındağ, flora, biodiversity.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-03
Thursday

Ancestral Character State Reconstruction of Some *Heptaptera* Margot & Reut. (Apiaceae) Species

Büşra Süzener Adak[1], Aslı Doğru-Koca[1*]

[1]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

*Corresponding author's e-mail: adogrukoca@gmail.com

Abstract

The genus *Heptaptera* (Apiaceae) consists of eight species distributed in Southern Europe and Southwest Asia. Among them, *H. cilicica* being endemic, *H. anisopetala, H. anatolica* and *H. triquetra* species occur in our country. In this study, evolutionary family trees were calculated using the 'maximum likelihood' and 'Bayes' approaches based on the ribosomal DNA (ITS 1, 5.8S rRNA, ITS 2) sequence dataset of *Heptaptera* species distributed in Turkey, as well as *H. angustifolia*, which is endemic to Italy, and *H. microcarpa*, which grows in Syria. Nine morphological characters, which are considered to play a role in intra-genus classification, were mapped on the Bayesian hypothesis tree. Seven of these were found to be plesiomorphic for the genus. Being cylindric cross-section of the basal part of the stem; the presence of stalked papillae on the stem; the pinnate basal leaf; bracts standing upright; flat stylopodium; the fruit length less than 14 mm; the inverted ovoid fruit shape are the plesiomorphic character states for the genus *Heptaptera*. It has been determined that the wings in the mericarps are a genus-specific synapomorphic character state.

Keywords: Apioideae, character mapping, phylogeny, Umbelliferae.

Acknowledgement: This study is supported by Hacettepe University Scientific Research Projects Coordination Unit. Project Number: 18549.

Poster Presentation PP-04
Thursday

Caryophyllaceae Family Inventory and APG III Revision of Gaziantep University Faculty of Arts and Sciences, Biology Department Herbarium

Şeyda Yılmaz[1*], Ebru Bozlar[1], Serap Şahin Yiğit[1], Fatih Yayla[1]

[1]Gaziantep University, University, Faculty of Science, Department of Biology, Gaziantep, Türkiye.

*Corresponding author's e-mail: yilmazzseyda@gmail.com

Abstract

Radical changes have been occured in the systems used in plant classification recently, through the development of molecular techniques used in plant taxonomy. Phylogenetic studies are based on changes in the classification system of angiosperms compiled and published by the Angiospermae Phylogeny Group (APG). The APG III system, developed in 2010, is the most available system currently accepted in Turkey. In this study, the inventory of the Caryophyllaceae family in Gaziantep University Faculty of Arts and Sciences Biology Department Herbarium was taken, and the APG III revision was carried out. The study within the scope of 302 plants belonging to the Caryophyllaceae family was examined in the herbarium. It was determined that there were 16 genera and 52 species and subspecies taxa samples belonging to this family according to Flora of Turkey. As a result of the examination of the herbaria, ten species in the Caryophyllaceae family are endemic to Turkey, and the endemism rate is % 1,32. The top three genera with the most taxa are *Silene*, *Vaccaria,* and *Lonicera*. When the corology of the taxa have examined the phytogeographical distributions of the taxa have been determined as Unknown or plurireigional 97 (85,84 %), Irano Turanian element 10 (8,84%), Eastern Mediterranean element 1(0,88) and Mediterranean element 5 (4,42%). As a result of the innovations developed, herbariums are not just warehouses where dry plant samples are stored; on the contrary, considering that there are living, active and dynamic collections, the importance of establishing and constantly updating herbarium inventories becomes apparent.

Keywords: Caryophyllaceae, herbarium, revision, APG III.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-05
Thursday

Effects of CuO Nanoparticle on Growth and Photosynthetic Pigment Contents in *Lemna gibba* L.

Şeyda Yılmaz[1*], Muhittin Doğan[2]

[1]Fen Bilimleri Enstütüsü, Fen Edebiyat Fakültesi, Biyoloji Bölümü, Gaziantep, Türkiye.

[2]Fen Bilimleri Enstütüsü, Fen Edebiyat Fakültesi, Biyoloji Bölümü, Gaziantep, Türkiye.

*Corresponding author's e-mail: yilmazzseyda@gmail.com

Abstract

In recent years, excessive population growth, unplanned urbanization, excessive consumption of people and rapidly advancing industrialization have led to an increase in environmental pollution problems. Especially industrial, agricultural, and domestic wastes have serious effects on aquatic ecosystems. In this study, effects of different CuO nanoparticle concentrations (25,50, and 100 ppm) on growth and photosynthetic pigment contents in *Lemna gibba* L., a free-floating aquatic plant, were investigated. Within the scope of the study, a group of CuO-treated plants was harvested every 24 hours and the remaining plants were grown again in nutrient solution for 5 days (recovery). Tolerance indices of harvested plants were calculated based on weight changes. Accordingly, copper oxide was applied and differences were determined between the tolerance indices of the plants in recovery groups. In addition, it was determined that the chlorophyll-a, chlorophyll-b and carotenoid contents of the plants treated with CuO were generally increased compared to the control until the fourth day, but there were decreases on the fifth day in both applications. As a result, it was observed that the applied nanoparticle caused physiological changes in *L. gibba*.

Keywords: CuO nanoparticle, *Lemna gibba* L., recovery, growth, photosynthetic pigment.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-06
Thursday

Changes in Physiological and Biochemical Parameters in Pepper Varieties under Drought Stress

Şule Demir[1], Nuran Durmuş[1*]

[1]Recep Tayyip Erdogan University, Faculty of Arts and Sciences, Department of Biology, Rize, Türkiye

*Corresponding author's e-mail: nuran.durmus@erdogan.edu.tr

Abstract

The aim of this study is to compare the tolerance mechanisms of four pepper varieties (Yükselince, Tural, Burdem and Varol) under drought stress. 58 days-old pepper seedlings were subjected to 10 days-long drought stress by witholding irrigation. Shoot length, fresh and dry weights of all varieties significantly decreased but the most decline was recorded in Burdem 17.68% for shoot length and 44,35% for shoot fresh weight. Shoot dry weights of Yükselince, Tural, Burdem and Varol varieties at 10 th day of drought were decreased to 28.75; 36.60; 39.74 and 44.79% respectively. Relative water contents of all varieties exposed to drought was statistically lower than those of control plants. Significant differences were determined among the varieties in the contents of photosynthetic pigments and proline. Total chlorophyll reduction was the most in Burdem in the ratio of 17.77%. The increase in the content of proline was higher in Yükselince than other varieties. Proline usually accumulates more in tolerant variety than in susceptible. Also, different levels of lipid peroxidation and antioxidative enzyme activities were observed among the varieties. Lipid peroxidation levels increased under drought stress, especially in Burdem and Varol varieties. Antioxidative enzyme activities showed increases in all varieties as a response to drought stress. Increases in glutathione reductase (GR) and guaiacol peroxidase (GPX) activities were significantly higher in Yükselince compared to Burdem and Varol. Also, in Yükselince, increases in superoxide dismutase (SOD) and catalase (CAT) activities were higher than those of Burdem. From these results, Yükselince which was recorded the lowest reduction in growth parameters and total chlorophyll, the lowest increment in lipid peroxidation, the highest proline content and generally high antioxidative enzyme activities was considered as more drought tolerant. The varieties of Burdem and Varol were more susceptible to drought stress.

Keywords: *Capsicum annuum*, drought tolerance, physiological traits, antioxidant enzyme.

Poster Presentation PP-07
Thursday

Effects of Auxin and Paclobutrazol on Reactive Oxygen Species Regulation in Soybean (*Glycine max* L.) Under Salt Stress

Ufuk Ayvacı[1], Hatice Çetinkaya[1], Fatma Nur Koç[1], Burcu Seçkin Dinler[1*]

[1]Sinop University, Faculty of Sciences and Arts, Department of Biology, Sinop, Türkiye.

*Corresponding author's e-mail: bseckin@sinop.edu.tr

Abstract

Plant hormones play important roles in plant growth, development, and regulation of stress-defence. Auxin (IAA) is a plant hormone that plays a role in plant development and growth while paclobutrazol (PBZ) is a plant growth regulator in the triazole group. Although it has been known that these are effective for plant salt stress, the combination effect was not studied before. Seeds were place in the dark for 5 days for germination. After germination, seedlings were grown in a growth room at 25°C (16 h day/8 h night photoperiod) and watered with Hoagland solution for 8 days. The pots containing the shrubbed seedlings are divided into twelve treatment groups (IAA; 50 ppm, PBZ; 10 ppm, 1st NaCl; 200 mM, 2nd NaCl; 300 mM and their combinations). All solutions were applied within the Hoagland solution and harvested at 10 days. Relative water content (RWC), chlorophyll (CHL), malondialdehyde (MDA), proline, and superoxide radical ($O_2^{\bullet-}$) contents and superoxide dismutase (SOD), ascorbate peroxidase (APX) and glutathione reductase (GR) enzyme activities were determined comparatively. The results showed that IAA and PBZ alleviated RWC, CHL, $O_2^{\bullet-}$ and proline contents. However, IAA under salinity (300 mM) increased the SOD activity by 24.80%, while it was not change under PBZ. Under 300 mM NaCl, the value of APX enzyme activity did not show difference significantly with IAA applications but PBZ increased this activity by 40% according to salt stress alone (300 mM). IAA application under salinity (200 mM) induced GR activity by 55.75%, while it was not changed under 300 mM NaCl +IAA according to salt treatment alone. Totally, IAA was more effective to induce enzymatic antioxidant defence system as against to PBZ.

Keywords: Auxin, paclobutrazol, salt stress, soybean.

Poster Presentation PP-08
Thursday

Aydın Mountains; Biodiversity Reserve Area for *Riccia* (Marchantiophyta) Taxa

Mesut Kırmacı[1*], Hatice Özenoğlu[2], Uğur Çatak[1], Gözde Aslan[3]

[1]Aydın Adnan Menderes University, Faculty of Science, Department of Biology, Aydın, Türkiye.

[2]Aydın Adnan Menderes University, Faculty of Education, Department of Mathematics and Science Education, Aydın, Türkiye.

[3]Aydın Adnan Menderes University, Buharkent Vocational School, Department of Chemistry and Chemical Processing Technologies, Aydın, Türkiye.

*Corresponding author's e-mail: mkirmaci@gmail.com

Abstract

The genus *Riccia* Linnaeus comprises around 250 species, that have a worldwide distribution as far north as the Arctic and reaching to the southern parts of South America, Africa, Australia and New Zealand, but excluding the remote subantarctic islands and the Antarctic Continent, including the Maritime Antarctic Peninsula. The genus is most frequently seen in areas with Mediterranean-type climates. Thirty six taxa (33 species and 3 varieties) are widely distributed in Europe, 33 taxa (31 species, 1 variety, and 1 subspecies) in Southwest Asia and 40 taxa (36 species and 4 varieties) in the Mediterranean. Ricciaceae is the richest family among the Turkish liverworts with two genera (*Riccia* L. and *Ricciocarpos* Corda.). *Ricciocarpos* a monotypic genus, is represented by *Ricciocarpos natans* (L.) Corda and *Riccia* which currently includes 27 taxa (25 species and 2 varieties). In our recent study from the Aydın Mountains on Bryophytes, approximately 251 taxa were identified. 50 of them are liverwort, and *Riccia* is the richest genus with 17 taxa. This number represents more than 60 % of the taxa in our country and is an indication that the Aydın Mountains are a refuge for the genus.

Keywords: Marchantiophyta, liverwort, cryptogamae, flora.

Acknowledgement: We cordially thank to TUBİTAK for financial support to Mesut Kırmacı (TBAG 119Z393).

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-09
Thursday

From Rare to Common: *Festuca pontica* E. Alekseev ex Markgr.-Dann. Geographic Range Extension and New IUCN Category Suggestion

Jelena Erdal[1*], Gencer Yaprak[1], Musa Doğan[1]

[1]Middle East Technical University, Faculty of Arts and Sciences, Department of Biological Sciences, Ankara, Türkiye.

*Corresponding author's e-mail: jelenaerdal@gmail.com

Abstract

Festuca pontica E. Alekseev ex Markgr.-Dann. is an endemic species of northeast Anatolia. The species grows on wet rock cervixes and was known only from three locations, with extent of occurrence estimated to be c. 400 km^2 and area of occupancy c. 15 km^2, within the Trabzon and Rize provinces, Türkiye. Due to restricted range, habitat loss and population size decline, caused by overgrazing and infrastructure development related to urbanization and tourism, the species was listed as Endangered (EN) in IUCN Red List of Threatened Species, based on B1ab(i,ii,iii,v)+2ab(i,ii,iii,v) criteria. During field surveys for the contemporary revision of the genus *Festuca* L. in Türkiye, we have discovered populations of *F. pontica* on 11 new locations within Giresun, Trabzon and Rize provinces. Currently the species' extent of occurrence is estimated to be c. 3950 km^2 and area of occupancy c. 56 km^2. Thus, according to our findings, *F. pontica* still satisfies B1 and B2 IUCN criteria related to the extent of occurrence and area of occupancy. As well as (b) criterion related to decline in extent of occurrence (i), area of occupancy (ii), area, extent and/or quality of habitat (iii) and number of mature individuals (v). But it does not satisfy (a) criterion anymore, the number of locations above 10 (14 in total), does not qualify *F. pontica* for the threatened categories. However, considering that species is endemic of northeast Anatolia, with specific habitat preference, as growing on rock cervixes along the river valleys, it might be severely threatened by the infrastructure constructions in the area, such as roads, tunnels, hydroelectric power stations and tourism facilities that are built along the valleys. Therefore, we suggest *F. pontica* to be considered as Near Threatened (NT), because it might qualify for a threatened category in the near future.

Keywords: *Festuca*, geographic distribution, IUCN, Poaceae.

Acknowledgement: We are grateful to Mrs. Slavica Đorđević and Mr. Serkan Erdal for their generous help with field work and financing.

Poster Presentation PP-10
Thursday

Observations on Some Endemic and Narrowly Distributed Species in Çankırı Province, Türkiye

Bilal Şahin[1*], Aicha Mahamoud Bouh[2]

[1]Çankırı Karatekin University, Food and Agriculture Vocational School, Çankırı, Türkiye.

[2]Ministry of Higher Education and Research, Center for Studies and Research of Djibouti, Djibouti.

*Corresponding author's e-mail: bilalsahin@karatekin.edu.tr

Abstract

In this study, new findings based on observations on the distribution and population status of some species distributed in Çankırı province are given. Of the examined species, 9 are narrow-range endemic and 1 are non-endemic, narrow-range species. The examined species consisted of *Asperula cankiriense*, *Centaurea cankiriense*, *Gypsophila simonii*, *Salsola grandis*, *Astrodaucus orientalis var eriocarpus*, *Campanula kirikkaleensis*, *Linum mucronatum subsp gypsicola*, *Onosma briquetii, Reseda germanicopolitana var germanicopolitana, Onobrychis germanicopolitana*. The current distribution of these species, both in Çankırı and throughout Turkey, and their distribution, population status and habitat preferences based on new observations were examined. In the light of all data, the threat categories of the species were evaluated. Distribution map was created according to the obtained data. Thus, new information about 10 local species found in Çankırı province was presented to the knowledge of the scientific world.

Keywords: Flora, endemic, Çankırı.

Acknowledgement: This study was created with the data obtained from both Aisha Mohamed Bouh's master's thesis and the project coded YY28015B11 supported by Çankırı Karatekin University.

Poster Presentation PP-11
Thursday

Fruit Morphology and Anatomy of the Genus *Eleutherospermum* K.Koch (Apiaceae)

Hamdiye Alatlı[1*], Mustafa Çelik[2], Zehra Altındaş[1], Özlem Çetin[3]

[1]Selçuk University, Graduate School of Natural and Applied Sciences, Türkiye.

[2]Selçuk University, Advanced Technology Research and Application Center, Türkiye.

[3]Selçuk University, Faculty of Science, Department of Biotechnology, Türkiye.

*Corresponding author's e-mail: alatlihamdiye@gmail.com

Abstract

Eleutherospermum K.Koch is a genus of flowering plants belonging to the subfamily Apioideae (Apiaceae), native to Western Asia. The genus includes two species, *E. cicutarium* (M.Bieb.) Boiss. and *E. lazicum* Boiss. & Balance, which distributed naturally in Turkey. In this study, cross-sections of mature fruits were examined, and a detailed anatomical description is presented. The fruit of *Eleutherospermum* is composed of two homomorphic mericarps that are glabrous and slightly laterally compressed. The mericarps have 5 primary ribs which are slightly projecting and filiform. The exocarp consists of a single layer of rectangular cells. Their outer walls are covered by a thin cuticle layer. The mesocarp layer is mostly reduced in mature fruit, and parenchymatic cells are observed in some areas within this tissue. There are five vascular bundles each mericarp, with one bundle in each rib. Vascular bundles are composed of thick-walled polygonal cells. Vittae are small, lined with thin-walled epithelial cells. The endocarp and seed coat consist of single layer cells. The endosperm is strongly impressed in the commissural side and its cells are polygonal and filled with granular material. Mericarps of *E. cicutarium* are nearly semicircular in the transverse section. Each mericarp has five slightly projecting primary ribs. Mericarps of *E. lazicum* are nearly circular in the transverse section. Each mericarp has 5 primary ribs that look like a narrow wing. As a result, there is no significant difference in carpological aspects among *Eleutherospermum cicutarium* and *E. lazicum.*

Keywords: *Eleutherospermum,* Umbelliferae, fruit morphology and anatomy.

Acknowledgements: We express our thanks to the Scientific Investigation Projects Coordinate Office of the Selçuk University for financial support.

Poster Presentation PP-12
Thursday

Investigation of Morphological and Anatomical Characteristics of *Bolanthus turcicus* Grown in Turkey

Derya ALTAY[1*], Murat KOÇ[2]

[1]Ankara Yıldırım Beyazıt University, Public Health Institute, Department of Traditional, Complementary and Integrative Medicine, Ankara, Turkey.

[2]Ankara Yıldırım Beyazıt University, Public Health Institute, Department of Traditional, Complementary and Integrative Medicine, Ankara, Turkey.

*Corresponding author's e-mail: babaarslanderya@hotmail.com

Abstract

Caryophyllaceae is one of the largest families that includes approximately 100 genera and 3000 species. *Bolanthus* (Ser.) Reichb., is one of the smallest genera of the family. The feature that makes this genus important for Turkey is that all of the taxa are endemic to Turkey. This study was carried out in order to contribute to the systematics of the genus by determining the anatomical and morphological features of *Bolanthus turcicus* Koç & Hamzaoğlu. Plant material was collected from the Hasandağı region (Aksaray province). In addition, general appearance of the taxon taken in its natural habitat is presented as well. For anatomical studies, living materials were kept in 70% alcohol. Transverse-sections of root, stem and leaf were taken by hand and stained using Sartur and chloral hydrate reagents. The photos of characteristic structures were photographed by a binocular light microscope with a Leica DFC280 camera at 4x, 10x and 40x magnifications. The anatomical structure of the vegetative organs of the locally endemic *B. turcicus* species was determined for the first time, and it was determined that the anatomical features could be used in the differentiation of *Bolanthus* species. Druze crystals are found on the stem and leaves of the studied species. In addition, it was observed that the stomata wsere diacitic in leaf superficial sections. Important morphological features of the plant with taxonomic value have been revealed.

Keywords: Anatomy, Caryophyllaceae, *Bolanthus,* Turkey.

Acknowledgement: This study is supported by Ankara Yıldırım Beyazıt University scientific research projects- TDK-2022-2303.

Poster Presentation PP-13
Thursday

The Morphological and Anatomical Changes of Leaf of *Laurocerasus officinalis* M.Roem Along an Elevation Gradient

İsmail Zoroğlu[1], Öznur Ergen Akçin[2*]

[1]Arif Nihat Asya Vocational and Technical Anatolian Hight School, Ordu, Türkiye.

[2]Ordu University, Faculty of Science and Art, Department of Molecular Biology and Genetics, Ordu, Türkiye.

*Corresponding author's e-mail: oakcin@gmail.com

Abstract

Understanding the adaptive modifications of plants in relation to changes in environmental conditions, especially altitudes are very important. In this study, it aimed to determine the morphological and anatomical changes of leaf of *Laurocerasus officinalis* M.Roem (Rosaceae) along the height gradient. Specimens were collected at three different altitudes at Ordu vicinity (10m, 400m,1000m). Anatomical studies were carried out on specimens that were fixed in 70% alcohol. Cross and surface sections of leaf were cut free hand and the permanent slides were photographed with a Nikon FDX-35 microscope. Our results showed that some morphological and anatomical characters changed with increase in altitude. Especially stomata index, leaf, cuticula and mesophyll thickness were effected altitude changes. Leaf sizes were decrease with increase in altitude. As the altitude increased, the diameters of the spongy parenchyma cells and the width of the palisade parenchyma cells increased, whereas the lengths of the palisade parenchyma decreased.

Keywords: *Laurocerasus officinalis*, elevation radient, morphology, anatomy.

Acknowledgement: We thank Scientific Research Project Unit of Ordu University, Project no. (TF-1648), for the partial financial support.

Poster Presentation PP-14
Thursday

Wood Anatomy of Two Endemic Lamiaceae Species from Türkiye

Funda Erşen Bak[1]*, Nazmiye Merttürk[2]

[1]Artvin Coruh University, Faculty of Forestry, Department of Forest Engineering, Artvin, Türkiye.

[2]Artvin Coruh University, Institute of Graduate Education, Department of Biology, Artvin, Türkiye.

*Corresponding author's e-mail: fundaersenbak@artvin.edu.tr

Abstract

In this study, the wood anatomical characteristics of two endemic shrub species, naturally grown within Lamiaceae family were investigated: *Thymus pectinatus* Fisch.&C.A.Mey. and *Salvia huberi* Hedge. In this study, the wood anatomy characteristics of these two endemic species are given for the first time. On the wood sections of the studied species, the tangential and radial diameters of the vessels, the vessel wall thickness, the vessel pit diameter, the height of the uniseriate, biseriate, and multiseriate, the number of vessels per unit area, and the number of per mm were determined. On maceration samples, vessel member length, fibre length and width, fibre lumen width, and wall thickness were measured. Qualitative features such as growth ring, perforation plate type, presence of helical thickening and vasicentric vascular tracheids, axial parenchyma, were determined. Lamiaceae woods can be characterized by the more numerous vessels per unit area, helical thickening on the vessel walls, libriform fibres, scanty axial parenchyma, vasicentric vascular tracheids, and heterocellular rays.

Keywords: Wood anatomy, *Lamiaceae*, *Thymus*, *Salvia*, Türkiye**.**

Poster Presentation PP-15
Thursday

Leaf Anatomical Investigations on Some Cardueae (Asteraceae) Taxa from Northern Anatolia (Türkiye)

Melahat Özcan[1*], Zuhal Altun[2]

[1]Artvin Coruh University, Faculty of Forestry, Department of Forest Engineering, Artvin, Türkiye.

[2]Artvin Coruh University, Institute of Graduate Education, Department of Biology, Artvin, Türkiye.

*Corresponding author's e-mail: melahat.ozcan@artvin.edu.tr

Abstract

The tribe Cardueae were divided 12 subtribes or rearrangements made according to recent molecular investigations. Members of tribe are known as thistles. The taxa in the subtribes have rather similar morphological characteristics. Therefore, taxonomic problems mostly occur among taxa. In the present study, we aimed to compare leaf anatomical characteristics of four species (*Cirsium ligulare* Boiss., *Klasea quinquefolia* M.Bieb. ex Willd.) Cass. ex Greuter & Wagenitz, *Psephellus taochius* Sosn. and *Rhaponticum repens* (L.) Hidalgo belonging to the subtribes Carduinae and Centaureinae. Plant materials used in this research were collected from natural habitats during their vegetation periods in 2015 and 2018. Morphological studies were carried out from herbarium materials. Mature leaf samples obtained from herbarium samples were used in cross sections and paradermal sections for anatomical examinations. The species investigated show bifacial (dorsiventral mesophyll) or equifacial (isobilateral mesophyll) leaf type. Secretory cell/cells are located close to the vascular bundles with different numbers in all Centaureinae species. Three investigated species are amphistomatic leaf, while one species, *Klasea quinguefolia* has hypostomatic one. Differently from the others, stomatal density higher in the abaxial surfaces of *Cirsium ligulare*. Trichome types/density are distinct characters and show differences among the species. Data obtained from this study were compared the reports present in literature. These results demonstrate that the most of the compared anatomical characters among taxa can be used as taxonomic markers in their classifications.

Keywords: Leaf anatomy, Secretory cell, Stoma, Trichome type, Türkiye.

Acknowledgement: The research was supported by the Research Fund of Artvin Coruh University (project number: 2021.F10.02.01).

Poster Presentation PP-16
Thursday

Anatomical Properties of *Primula auriculata* Lam. Species

Öznur Ergen Akçin[1], Şükran Öztürk[2*], Gülcan Şenel[3]

[1]Ordu University, Faculty of Science and Art, Department of Molecular Biology and Genetics, Ordu, Türkiye.

[2]Ordu University, Ulubey Vocational School, Department of Laboratory and Veterinary Health, Ordu, Türkiye.

[3]Ondokuz Mayıs University, Faculty of Science, Department of Biology, Samsun, Türkiye.

*Corresponding author's e-mail: sukranguney0@hotmail.com

Abstract

Primula L. genus (Primulaceae) has about 500 species in the world. The genus has 9 species in Turkey. Some *Primula* species are medically used as cough suppressant, sedative, and expectorant. *Primula* species are generally known as "çuhaçiçeği, tutya" in Turkish. *Primula auriculata* Lam. is perennial and glabrous. Leaves are narrowly oblanceolate, obovate-spathulate and pink-purple flowering plant. The aim of this study was to investigate the anatomical properties of *P. auriculata* species distributed in Sivas vicinity. Anatomical studies were carried out on specimens that were fixed in 70% alcohol. Cross sections of root, rhizome, scape and surface and cross sections of leaf were cut freehand. All measurements and observations were made using imaging software. The photographs were taken with Nikon FDX-35 microscope. There are unilayered epidermis and exodermis layers in the root. Parenchymatic cells of the cortex have more starch. There are parenchymatic cells with starch in the rhizome. Leaf is bifacial and amphistomatic. There are idioblast cells in the root, rhizome, scape and leaf of the species. There is anomocytic type stomata on the lower and upper surfaces of the leaves.

Keywords: Anatomy, root, rhizome, scape, leaf, *Primulaceae, Primula auriculata.*

Poster Presentation PP-17
Thursday

Melissopalynological and Physico-Chemical Properties of Cimil Plateau Honey

Gülsüm Yetkin[1]*, Suzan Kundakçı[1], Esra Demir[2], Serdar Makbul[1]

[1]Recep Tayyip Erdogan University, Faculty of Sciences and Art, Department of Biology, Rize, Türkiye.

[2]Recep Tayyip Erdogan University, Central Research Laboratory Application and Research Center, Rize, Türkiye.

*Corresponding author's e-mail: gulsum_yetkin18@erdogan.edu.tr

Abstract

In this study, melissopalynological and physico-chemical properties of the honey produced in the Cimil Plateau were determined. Eight honey samples were taken from Cimil Plateau (Rize provence) from different altitudes and localities. All samples were analyzed by standard laboratory methods to determine moisture, sugar, proline, diastase and 5-Hydroxymethyl furfural parameters. Also, melissopalynological analyzes were made according to the standard technics and determined pollen composition of the honey samples. Melissopalynologic studies showed that the pollens dominantly belong to Asteraceae, Brassicaceae, Campanulaceae, Caprifoliaceae, Caryophyllaceae, Ericaceae, Fabaceae, Lamiaceae, Lauraceae, Onagraceae, Poacea, Polygonaceae, Ranunculaceae and Rosaceae families. The moisture content of the samples was determined to be 16.9-19.1 %, the proline content was 568-758 mg/kg. Our results showed that the examined honey samples are polyfloral and multifloral. This is the first report performed on Cimil honey based on melissopalynological and physico-chemical characteristics. It has been observed that the melissopalynological and physico-chemical analysis results of honey are following European Union Standards and Turkish Food Codex Honey Communique.

Keywords: Cimil, honey, melissoppalinology, Turkish food codex honey communique.

Acknowledgement: This study is financially supported by TUBITAK 2209 A (Project number: 1919B012003596).

Poster Presentation PP-18
Thursday

Pollen Morphology of the Genus *Gundelia* L. (Asteraceae) Grown in Türkiye and Its Taxonomic Significance

Golshan Zare[1*], Aslı Doğru-Koca[2], Osman Tugay[3], Osman Kola[4], Mahmut Miski[5], Nur Tan[6], Ernst P. Vitek[7], Metin Armağan[8]

[1]Hacettepe University, Faculty of Pharmacy, Pharmaceutical Botany, Ankara, Türkiye.

[2]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

[3]Selçuk University, Faculty of Pharmacy, Pharmaceutical Botany, Konya, Türkiye.

[4]Adana Alparslan Türkeş Science and Technology University, Faculty of Engineering, Department of Food Engineering, Adana, Türkiye.

[5]İstanbul University, Faculty of Pharmacy, Department of Pharmacognosy, Istanbul, Türkiye.

[6]İstanbul University, Center for Research and Practice in Drug Development from Natural Sources

[7]Naturhistorisches Museum Wien, Department of Botany, Wien, Austria.

[8]Necmettin Erbakan University, Ereğli Faculty of Agriculture, Department of Field Crops, Konya, Türkiye.

*Corresponding author's e-mail: g_zare@hacettepe.edu.tr

Abstract

Gundelia tournefortii was described by Linnaeus and known as a monospecific for a long time. In flora of Türkiye the genus is represented by one species as *G. tournefortii*. Today, by the introduction of new species, the number increased to 18 taxa in Türkiye. Morphological characters especially inflorescence properties have widely used to introduction and identification these taxa. In this study, we considered the potential value of pollen properties for the classification of *Gundelia* and compared the results with other palynological research. Pollen grain of 26 samples from *Gundelia* were collected in the field during the summer of 2020–2021. The pollen slides were prepared by using Wodehouse method and embedded the pollen in glycerine jelly stained with safranin. Totally 11 characters were measured and evaluated by Principal component analysis. For SEM study, the grains were mounted on stubs and sputter-coated with gold–palladium. SEM examination was carried out using a Zeiss EVO 50 EP microscope. As a result, the pollen grains are monads and the pollen shape is usually globose or flattened spheroid (oblate-spherical or prolate-spherical). Pollen grains of *Gundelia* are tricolporate and ornamentation is echinate, the tectum is microperforate. The spines are evenly distributed, conical-pointed, with swollen bases. Pollen is isopolar, AMB round, symmetrical or asymmetrical and the size of the pollen grains varies between taxa. It was determined that all populations carried abundant Pollenkitt. The pollen shape, length and spine length were important characters for separation of the groups from each other. In the cluster analysis of the pollen

morphological characters, the majority of taxa are located in close clusters and no significant groups were distinguished. As it is seen in the PCA graphic given for population and species, there is no correlation between pollen characters and classification of these taxa.

Keywords: *Gundelia*, pollen, taxonomy, Türkiye.

Acknowledgement: The authors would like to thank The Scientific and Technical Research Council of Türkiye (TÜBİTAK-1001, Project No, 119Z882) for their financial support.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-19
Thursday

Proximate Composition and Extraction of Cell Wall Carbohydrates of Fruits and Seeds of *Phœnix canariensis* L. Grown in Algeria

AichaBouhafsoun[1*], Amina Rouan-Serik[1], Jidjia Ouali[1], Nassima Draou[1], Kheira Errouane[1], Arbia Tebib[1], Rayene Anouche[1], Hassiba Bokhari[1], Riad Mezemaz[1]

[1]University of Science and Technology Mohamed Boudiaf (USTO-MB), Faculty SNV, Department of Biotechnology, Oran, Algérie.

*Corresponding author's e-mail: abouhafsoun@gmail.com

Abstract

In the present study, the fruits and seeds of *Phœnix canariensis* L. from Algeria were studied for their proximate analysis. Studies were also carried out on extraction and analysis of cell wall carbohydrates. The seeds and fruits were dried and grounded for the requirements of various samples. Ash, protein, sugars, fat and lipids were determined by using conventional methods of analysis. The results have shown that both fruits and seeds of *P. canariensis* L. contained varying content of nutrients composition, ash, moisture, titratable acidity and total solids soluble were highest in the fruits. The total lipid content in seeds was twice higher than in fruits (8.2% and 4.73%) respectively, while similar concentration of protein was detected in fruits and seeds. *Phœnix canariensis* L. contained a high concentration of crude fiber which is considered the main component. The highest content was observed in the seeds (50.33%) followed by fruits (40.33%). Quantitative estimation of cell wall polysaccharides revealed that hemicelluloses were high in both fruits and seeds (24.49 and 46.49%) followed by cellulose (17.8 and 19.43 %) then pectins which contained the smaller proportion, however, the results indicated that the seeds contained 2 times of hemicelluloses than fruits. The colorimetric assay revealed that the seeds contained more neutral sugars (15468.42 µg/ml) than the fruits (13373.08 µg/ml).

Keywords: *Phœnix canariensis* L., proximate analysis, parietal polysaccharides.

Acknowledgement: This work is supported by High Teaching and Scientific Research Ministry www.mesrs.dz and Oran University of Sciences and Technology www.univ-usto.dz.

Poster Presentation PP-20
Thursday

Phytochemical Screening and Antioxidant Activity of C*itrus clementina* Peels

Aicha Bouhafsoun[1*], Fadéla Cherifi[1], Hassiba Bokhari[1], Nourhan Abdelhadi[1], Nour Arnouz[1]

[1]University of Science and Technology Mohamed Boudiaf (USTO-MB), Faculty SNV, Department of Biotechnology, Oran, Algérie.

*Corresponding author's e-mail: abouhafsoun@gmail.com

Abstract

Citrus clementina, as other fruits and legumes, are an important source of different antioxidants (phenolic compounds, flavonoids, etc...), these compounds have beneficial effects on human health because they have many biological activities such as antioxidant, anti-inflammatory, antibacterial, etc., which protect and inhibit the harmful effects of free radicals on the human body. The extraction of polyphenols is carried out by maceration in methanol, several screening tests have been carried out in order to highlight the different classes of polyphenols. The quantitative determination of flavonoids and total polyphenols was carried out by molecular absorption spectrophotometry. Phytochemical screening showed that clementine extract is rich in tannins, alkaloids, coumarins, flavonoids, free quinones and anthraquinones. However, saponins are absent. The results of the colorimetric assay of flavonoids show that the latter have a content of 0.970 mg/g of dry matter, while the total polyphenols have a content of 1.14 mg/g of dry matter. The qualitative analysis of flavonoids by TLC revealed the presence of coumarins, flavonoids, alkaloids and terpenoids. Finally, the methanolic extract of *Citrus clementina* bark was tested for its antioxidant activity. In vitro antioxidant evaluation revealed antioxidant capacities in the citrus extract with an IC50 of 43 mg/ml.

Keywords: *Citrus clementina*, antioxidant activity, secondary metabolites, phytochemical screening.

Acknowledgement: This work is supported by High Teaching and Scientific Research Ministry www.mesrs.dz and Oran University of Sciences and Technology www.univ-usto.dz.

Poster Presentation PP-21
Thursday

Removal of Harmful Dyes Using Some Algae

Özgür Eren Zariç[1*], İrem Yeşildağ[1], Sidar Yaygır[1], Abuzer Çelekli[1]

[1]Gaziantep University, Faculty of Arts and Science, Department of Biology, Gaziantep, Türkiye.

*Corresponding author's e-mail: ozgurerenzaric@gmail.com

Abstract

Algae are defined as a group of predominantly aquatic, photosynthetic, and nucleus-bearing organisms that lack the true roots, stems, leaves, and specialised multicellular reproductive structures of plants. Algae have different applications, the most important of which is biological treatment. It is known that the harmful dyes released because of industrial production cause damage to the environment. In this review, information is given on the removal of undesired dyes by using some (*Chara contraria* A.Braun ex Kützing, *Cladophora glomerata* (L.) Kuetzing, *Tetradesmus obliquus* (Turpin) M.J.Wynne). Google Scholar, Scopus, SpringerLink, Web of Science, and Mendeley databases were searched to obtain appropriate publications to support the goal of this study, using "*Chara contraria*", "*Cladophora glomerata*", "*Tetradesmus obliquus*", "Harmful Dyes", "Biological treatment" and combinations of them. Due to the high tolerance value of these algae against harmful dyes, it has been determined that they are used in the removal of harmful dyes. In line with the results; It was determined that it was used in the removal of Lanaset Red G by *Chara contraria*, textile cotton dyes by *Cladophora glomerata* and methyl red by *Tetradesmus obliquus*. Results indicate that these algae show a broad tolerance to hazardous dyes. The importance of algae for biological treatment and its economy has been determined.

Keywords: Textile dyes, biological treatment, Algae, hazardous dye.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-22
Thursday

Microbial Enemies of the Pine Processionary Beetle (*Thaumetopoea wilkinsoni* Tams), A Pest of the Red Pine (*Pinus brutia* Ten.)

İsmail Demir[1*]

[1]Karadeniz Technical University, Faculty of Science, Department of Biology, Türkiye.

*Corresponding author's e-mail: idemir@ktu.edu.tr

Abstract

The red pine (Pinaceae, *Pinus brutia*) is one of the most important fast growing tree species of our country. Not only in Turkish forestry, but also in foreign sources, its use as Turkish Pine-Turkish Red Pine has become widespread recently. Pine processionary beetle (*Thaumetopoea wilkinsoni* Tams.) is the most important pest of red pine. It spreads widely in our country, after the red pine, it also causes damage to other coniferous forest trees such as cedar and black pine from time to time. Significant volume increase losses occur in trees that lose their needles. Tree deaths also occur in heavy attacks. Since it has a very severe allergic feature, it is an important problem in agriculture and forestry production and in the tourism sector. Natural enemies are the most important environmentally friendly and effective control factors used in pest control studies. In this study, the microbial pathogens of the pest were determined to be used in the fight against the pine processionary beetle. Five entomopathogenic fungi were isolated from the pest, their identification was made and some isolates had a 100% death effect on the pest 10 days after the application at $1x10^5$ spores/ml concentration. The bacterial flora of the pest was determined and Tp5 coded bacteria produced a 70% death effect on the pest after 10 days of application at $1x10^9$ bacteria/ml concentration. In addition to these, a cytoplasmic polyhedro virus (CPV) isolated from the pest caused 90% mortality on the pest 15 days after infection at a concentration of $2x10^6$ PIB/larvae. All these microbial enemies are very effective factors in maintaining the population balance of the pine processionary beetle under natural conditions and have the potential to be developed as preparations and used in the biological control of the pest.

Keywords: Red pine, *Pinus brutia*, natural enemies, biological control, entomopathogenic microorganisms.

Poster Presentation PP-23
Friday

A New Record for the Flora of Turkey: *Erigeron karvinskianus* DC. (Asteraceae)

Batıkan Günal[1*], David Merrick[2], Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

[2]Durham University, Department of Mathematical Sciences, Durham, United Kingdom.

*Corresponding author's e-mail: bgunal@pau.edu.tr

Abstract

Erigeron L. is a taxonomically complex genus that comprises at least c. 400 species, mostly in temperate regions. In Turkey, there are 14 taxa, 3 of which are endemic. *Erigeron karvinskianus* DC. (Asteraceae) is native to Mexico, Central America, Colombia, and Venezuela and is naturalized in many other countries, in parts of Africa and Europe, Australia, Hong Kong, Chile and the west coast of the United States. The potentially-invasive species *E. karvinskianus* or Mexican fleabane was newly described from Antalya, Turkey. This study evaluated the morphological traits (habitus, stem morphology, leaves morphology, capitula morphology, ray and disc flowers morphology, achene morphology), and palynological traits (pollen shape, aperture, polar and equatorial diameter, P/E, exine and intine thickness, exine ornamentation, mesocolpium and apocolpium length) to support the presence of this species in Turkey. All measurements were conducted using randomly-selected samples. Minimum, maximum, mean and standard deviation values of characters were calculated statistically. In addition, a comprehensive description of the *E. karvinskianus* and its diagnostic key were given in the study.

Keywords: Asteraceae, *Erigeron karvinskianus*, new record, Antalya, Turkey.

Acknowledgement: This study was supported by the Scientific Research Coordination Unit of Pamukkale University under the project number 2022FEBE022.

Poster Presentation PP-24
Friday

Anti-inflammatory Effects of Essential Oil Extracted from *Salvia syriaca* L. on RAW264.7 Cells

Batıkan Günal[1*], Doğukan Mutlu[1], Şevki Arslan[1], Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: bgunal@pau.edu.tr

Abstract

Natural products from plants have been used for many years in the treatment of various diseases, such as cancer, infection, and inflammation. The plants in the genus *Salvia* have several types of secondary metabolites with antioxidant, antidiabetic, antimicrobial, and cytotoxic activities. Most of the *Salvia* species are used in the traditional medicine of different countries, such as Iran and Turkey. They are widespread in both countries and are rich in volatiles such as mono- and sesquiterpenes in their essential oil. The objective of this study was to evaluate the anti-inflammatory activities of essential oil extracted from the *Salvia syriaca* L. using the Clevenger apparatus. The cell viability was evaluated by MTT assay and anti-inflammatory activity was investigated on lipopolysaccharide (LPS) induced murine macrophage (RAW264.7) cell line. LPS-induced nitric oxide (NO) production was determined by the Griess method. The production of proinflammatory cytokines including IL-6, IL-1β, iNOS, COX-2, and TNF-α was examined using reverse transcriptase-polymerase chain reaction (RT-PCR) analysis. Non-toxic concentrations of essential oil of *S. syriaca* (3.9 and 7.8 µg/mL) dose-dependently inhibited lipopolysaccharide (1 µg/mL)-induced NO production (p<0.05), and the expression of inflammatory cytokines (p<0.05). The essential oil of *S. syriaca* has the potential to be used in the therapy of oxidative damage by reducing NO production and modulating the expression of different cytokine genes. Moreover, further studies are required to elucidate the cellular pathways involved responsible for the anti-inflammatory effects of *S. syriaca.*

Keywords: *Salvia syriaca*, essential oil, anti-inflammatory, nitric oxide, RAW264.7.

Acknowledgement: This work was financially supported by the Scientific Research Coordination Unit of Pamukkale University under the project numbers 2018KRM011.

Poster Presentation PP-25
Friday

Ex vitro Symbiotic Germination of *Gymnadenia conopsea* Seeds

Erdi Can Aytar[1*], Hamdiye Şehirli[1], Ines Harzli[1] Yasemin Özdener Kömpe[1]

[1]Ondokuz Mayıs University, Faculty of Science, Department of Biology, Samsun, Turkey.

*Corresponding author's e-mail: erdican.aytar@omu.edu.tr

Abstract

Gymnadenia conopsea is a terrestrial, photosynthetic orchid where is commonly found in Europe and Asia. *G. conopsea* populations can be found in a wide variety of habitats, including forests, grasslands and wetland meadows. *G. conopsea* orchids live in temperate and subtropical regions across Europe at altitudes ranging from 0 to 4700 m. These orchids leaves grow in spring, and flowering occurs between late June and early August. Many species in the Orchidaceae family are threatened by habitat loss and illegal collection. The global trade of all orchid species is so problematic that it is listed in the Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES). Therefore, it is necessary to reintroduce orchids to nature. In this study, *ex vitro* symbiotic seed germination of the terrestrial orchid type *G. conopsea* was investigated. In this direction, *Ceratobasidium* sp. AG A (Accession Number: MN539158) was inoculated. After 45 days of seed sowing, 51.34% germination occurred. Protocorm and leaf precursor formation rates were 19.07% and 10.34%, respectively.

Keywords: *Ceratobasidium*, conservation, symbiotic seed germination, *Gymnadenia conopsea*, orchid mycorrhiza.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-26
Friday

Ex vitro Symbiotic Germination of Endemic *Dactylorhiza osmanica* subsp. *osmanica*

Hamdiye Şehirli[1*], Erdi Can Aytar[2], Buse Çökmez[2], Vildan Akin Mutlu[2], Bengisu Şentürk[2], Yasemin Özdener Kömpe[2]

[1]General Directorate of Tea Enterprises, Rize, Türkiye.

[2]Ondokuz Mayıs University, Faculty of Science, Department of Biology, Samsun, Türkiye.

*Corresponding author's e-mail: sehirlihamdiye@gmail.com

Abstract

Orchidaceae is one of the plant families containing about 800 genera and between 25000-30000 species. In Turkey, it is represented by 191 taxa, 39 of which are endemic. The genus *Dactylorhiza* is represented by approximately 33 taxa in Turkey. Due to their unique habitats, complex seed germination mechanisms and specialized pollination processes, orchid species are threatened in the current climate change scenario. In addition, in our country, orchid tubers are collected uncontrollably depending on economic factors such as food and (medical drug) production. For this reason, there is a need for urgent conservation and resettlement of orchids. The seeds of all orchids form a symbiotic relationship with certain species of fungi to germinate naturally. In this study, *Dactylorhiza osmanica* subsp. *osmanica* seeds were germinated with *Ceratobasidium* sp. It was inoculated with AG A (Accession Number: MN539158) and the *ex vitro* symbiotic germination process was followed. In this study, the soil used for the *ex vitro* germination was taken from the natural habitat of the orchid species, mixed with perlite and then sterilized. The seeds were placed between sheets of water-resistant nylon mesh (45 µm pore size) and putted in pots containing a sterile soil mixture. Then, the fungal isolate was inoculated into the pots. The germination and development status of the seed packets were evaluated 45 days after sowing. It was determined that the seeds germinated with a rate of 42.17%, 25.27% of them developed into the protocorm stage, and in 26.67% of them leaf precursors were formed.These research results revealed that ex vitro seedling production can be easily used for both salep production and reintroduction of endemic *Dactylorhiza*. The study on the production of orchids from seed in a compost containing fungi is very limited and this study is also very advantageous for cultivating salep orchids in Turkey.

Keywords: *Dactylorhiza osmanica* subsp. *osmanica,* endemic orchid, symbiotic seed germination, *Orchidaceae.*

Poster Presentation PP-27
Friday

Effect of Drought on *Camellia sinensis* Shoot Growth

Hamdiye Şehirli[1*], Yasemin Özdener Kömpe[2], Vıldan Akın Mutlu[2]

[1]General Directorate of Tea Enterprises, Rize, Türkiye.

[2]Ondokuz Mayıs University, Faculty of Science, Department of Biology, Samsun, Türkiye.

*Corresponding author's e-mail: sehirlihamdiye@gmail.com

Abstract

Abiotic stresses cause serious losses in agricultural production worldwide. Growth and yield of *Camellia sinensis*, a perennial, shrub-shaped, tropical plant; It is greatly affected by seasonal fluctuations in weather change as well as precipitation, temperature, drought and mineral nutrition. Drought refers to a period of time when the soil water content is reduced and water is not available at the time of the plant's water deficit. In recent years, the effect of global warming, the formation of the total annual precipitation with sudden and heavy rains, the decrease in the number of rainy days, the washing of the soil by floods caused by sudden rains, the shoot growth of the *C. sinensis* plant grown in the Black Sea Region is highly affected. In drought conditions, the growth of shoots regresses and sometimes even stops. It also reduces the shoot growth rate of the plant in drought. In the study, 3-year-old seedlings produced from the highest yielding Derepazarı-7 clone, selected by the selection made by Öksüz in the Atatürk Tea and Horticultural Research Institute in 1987, were used. The seedlings were planted in pots with a mixture of peat and perlite in an environment of 65-70% relative humidity in greenhouse conditions. In the study, the water holding capacity of the soil, the shoot growth of *C. sinensis* seedlings in pots irrigated with 50%-20% and 10% of the water holding capacity of the soil was investigated. The best shoot development was seen in the water holding capacity of the soil and the seedlings irrigated with 50% of the water holding capacity of the soil. The study lasted for 3 months and the pot irrigated at the water holding capacity of the soil was considered as the control. The shoot length of the seedlings was measured and compared with the control. Shoot growth decreased in seedlings irrigated by 20% and seedlings irrigated 10% were relatively dried up 2 months after the start of the study. As a result, with the increasing drought, which is one of the most important effects of global warming, the future of *C. sinensis* and thus tea production in Turkey is under serious threat.

Keywords: *Camellia sinensis,* global warming, drought.

Poster Presentation PP-29
Friday

IUCN Categories of Endemic Plants in Sorgun Pond Nature Park

Duygu Aydoğmuş[1*], Murat Ekici[2]

[1]Recep Tayyip Erdogan University, Faculty of Sciences and Art, Department of Biology, Rize, Türkiye.

[2]Gazı University, Faculty of Science, Department of Biology, Ankara, Türkiye.

*Corresponding author's e-mail: duygu.aydogmus@erdogan.edu.tr

Abstract

In this study, the information has been presented about the endemic taxa and their IUCN hazard categories were identified during the determination of the Sorgun Nature Park (Güdül/Ankara) flora. The study area is positioned in the A3 square in Davis's grid system. Fieldwork was carried out in Sorgun Nature Park between 2019-2022 and the collected samples were dried following herbarium techniques. The dried plants were identified with the reference of the Flora of Turkey and East Aegean Islands and the Illustrated Flora of Turkey. The current names of the determined taxa were arranged according to the List of Plants of Turkey. The flora of Sorgun Nature Park and Sorgun Village, which is the subject of the master's thesis, was analysed. In total, 36 families, 151 genera, 266 species and subspecies were identified. 40 taxa are endemic to the flora of Turkey and the endemism rate is 6.3%. Endemic taxa in the study area were evaluated according to IUCN hazard categories. As a result of the evaluation, 1 taxa (2.5%) CR (Critically Endangered), 3 (7.5%) EN (Endangered), 2 (5%) VU (Vulnerable), 35 (87.5%) LR (Lower Risk) category were determined.

Keywords: IUCN, flora, Sorgun village.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-30
Friday

Flora of Ambarlik Plateau (Çamlihemşin/Rize)

Abdülkadir Süzen[1*], Vagif Atamov[1]

[1]Recep Tayyip Erdogan University, Faculty of Sciences and Arts, Department of Biology, Rize, Türkiye.

*Corresponding author's e-mail: suzenkadir@hotmail.com

Abstract

In this study, the flora of Ambarlık Plateau (Çamlıhemşin/Rize) was determined. The plant samples were collected from the study area in vegetation periods between 2013–2016 and stored in the Herbarium of the Department of Biology of Recep Tayyip Erdogan University (RUB). According to the results of this study, 286 taxa and 152 genera included 44 families were recorded. Six of identified taxa were Pteridophyta and other 280 taxa were Spermatophyta. Two of the Spermatophyta taxa are represented in Gymnospermae and 278 are represented in Angiospermae subdivision. Of these 278 taxa, 224 belong to Magnoliopsida and 54 belong to Liliopsida classes. The families with the highest taxa in the study area were found to be as Asteraceae (38 taxa), Poaceae (21 taxa), Rosaceae (20 taxa), Caryophyllaceae (16 taxa), Scrophulariaceae (15 taxa), Larniaceae (14 taxa) and Liliaceae (12 taxa). The endemism rate of taxa was determined as 9,09 %. The categories of the rare and endangered species which were assessed and determined according to the IUCN Red List of Threatened Species ver.3.1 2017- 1 in the study area are as follows; LC (Least Concern) with 21 species, NT (Near Threatened) with 2 species, DD (Data Deficient) with 2 species, EN (Endangered) with 2 species and VU (Vulnerable) with 2 species. The distribution of the taxa according to the phytogeographical regions is as follows; Euxine (89 taxa), Euro-Siberian (56 taxa), Hyrcano-Euxine (19 taxa), lrano-Turanian (11 taxa) and unknown (108 taxa). Three of total taxa are cosmopolitan.

Keywords: Endemic plans, flora, Rize, Ambarlık plateau.

Poster Presentation PP-31
Friday

Impact of Some Entomopathogenic Fungi on the Growth of *Zea mays* L. and *Helianthus annuus* L.

Fadime Donbaloglu Bozca[1], Ardahan Eski[2], Sema Leblebici[1*]

[1]Bilecik Şeyh Edebali University, Faculty of Science, Department of Molecular Biology and Genetics, Bilecik, Türkiye.

[2]Bilecik Şeyh Edebali University, Vocational School, Program of Biomedical Equipment Technology, Bilecik, Türkiye.

*Corresponding author's e-mail: leblebicisema@gmail.com

Abstract

Entomopathogenic fungi, a promising alternative to conventional insecticides, have been widely used as biocontrol agents for the regulation of pest populations. Furthermore, recent studies have shown that entomopathogenic fungi also have growth-promoting properties in plants. The purpose of this investigation was to assess the effects of indigenous entomopathogenic fungi strain, *Beauveria bassiana* Pa4, *Cordyceps fumosorosea* KTU-42 and *Metarhizium flavoviride* As-18, on the germination and early development period of sunflower and maize plants. In the results obtained from the study, while there was no significant difference in germination rates of fungi-treated maize seeds compared to control, the germination rates of fungi-treated sunflower seeds were high. The most effective fungus to increase growth on maize was *C. fumosorosea* KTU-42. On the other hand, the same result was obtained with *M. flavoviride* As-18 on sunflower. A significant increase was determined in root weight and length, stem weight and length and stem diameter of maize samples treated with *C. fumosorosea*. In addition, the effect of this fungus on the growth parameters of maize plants was higher than *B. bassiana* and *M. anisopliae*. The growth parameters of *M. flavoviride* treated sunflower plant was generally higher compared to other fungi treated plants and control treatment. Although the root weight and length, stem weight, stem diameter and biomass of *M. flavoviride* treated sunflower plants increased significantly when compared with control treatment, stem length was decreased. However, other fungi only increased the root length of sunflower plants but decreased the stem weight and length, root weight and biomass. *C. fumosorosea* for maize and *M. flavoviride* for sunflower can be used to improve plant growth. The present study reported that these fungi promote plant development and should be considered an important factor in plant production besides pest management.

Keywords: Entomopathogen fungus, germination, plant growth, maize, sunflower.

Acknowledgement: We are grateful to Prof Ismail Demir from Karadeniz Technical University for providing the fungal strains.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-32
Friday

The Anatomical Properties of Endemic *Achillea alimeana* Semiz & Uysal (Asteraceae)

Gülşen Karaçoban[1*], Sevay Ayşe Ulubeli[1], Batıkan Günal[1], Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: gulsenkaracoban@gmail.com

Abstract

In this study, the root, stem, and leaf anatomy of local endemic *Achillea alimeana* Semiz & Uysal (Asteraceae) were studied for the first time. The plant material was collected from Çameli-Denizli, Turkey. Cross-sections were taken with rotary microtome and slides were dyed using the safranin-fast green staining method. Measurements were carried out using the Olympus CX43 microscope system, Olympus EP50 camera system, and EP view software. The minimum, maximum, mean and standard deviation values of anatomical characters and the stomata index were calculated from twenty measurements of each character. The root had a relatively thin periderm, a large cortex layer consisting of 8-10 cell rows beneath the periderm, and the evident layer of endodermis and vascular bundle. The stem was circular-octagonal in cross-section. The epidermis layer was consisting of a single row of cubic-shaped cells. There was lamellar collenchyma beneath the epidermis of octagon corners, and cortex parenchyma between corners. An endodermis layer was evident above the sclerenchymatous bundle. Cambium ring was lying between sclerenchyma and phloem followed by the xylem. The epidermis was containing glandular and non-glandular trichomes on both the stem and the leaf. The shape of the leaves was pinnatisect. While the palisade parenchyma hadmultiple layers, the spongy parenchyma was not dense. The equifacial leaf lamina was amphistomatic and the stomata type was determined as anomocytic. Vascular bundles in the midrib were collateral type. The xylem was covering a larger area than the phloem and faced the upper epidermis.

Keywords: Asteraceae, *Achillea alimeana*, anatomy, endemic, Türkiye.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-33
Friday

The Anatomical Studies on Endemic *Linum punctatum* Presl subsp. *pycnophyllum* (Boiss.& Heldr.) Gustavsson (Linaceae)

Gülşen Karaçoban[1*], Sevay Ayşe Ulubeli[1], Batıkan Günal [1] Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: gulsenkaracoban@gmail.com

Abstract

In this study, the leaf, stem, and root anatomy of the endemic *Linum punctatum* Presl subsp. *pycnophyllum* (Boiss. & Heldr.) Gustavsson (Linaceae) from southwest Anatolia were studied for the first time. The plant material was collected from Çameli-Denizli, Turkey. Cross-sections were taken with rotary microtome and slides were dyed using the safranin-fast green staining method. Measurements were carried out using the Olympus CX43 microscope system, Olympus EP50 camera system, and EP view software. The minimum, maximum, mean and standard deviation values of anatomical characters and the stomata index were calculated from twenty measurements of each character. The root had a relatively dense periderm. Below the periderm, the cortex layer was very extensive and contained dozens of parenchymatic cell rows. The phloem was covering a narrow area and the xylem elements were distributed throughout the pith region. The epidermal layer was consisting of a double row of cubic-shaped cells as epidermis and hypodermis. The cortex layer, the vascular bundle, and the pith area were located beneath the epidermis, respectively. The fiber cells among the cortex layer were observed. The shape of the leaves was linear, the equifacial leaf lamina was amphistomatic and the stomata type was paracytic. The stomata index of the adaxial surface of the leaf was 17.25 while the abaxial surface was 18.73. The palisade parenchyma consisted of 1-2 layers while the spongy parenchyma was dense with ovoid cells. Vascular bundles in the midrib were collateral type. Consequently, our results will be the source of other studies on the ecology and the current distribution of this plant.

Keywords: Linaceae, *Linum punctatum* subsp. *pycnophyllum,* anatomy, endemic, Turkey.

Poster Presentation PP-34
Friday

The General Leaf Structure of Some Representative Turkish *Tragopogon* L. (Asteraceae) Taxa

Gülay Kaya[1*], Mutlu Gültepe[2], Kamil Coşkunçelebi[3], Serdar Makbul[4]

[1]Manisa Celal Bayar University, Sciences and Arts Faculty, Department of Biology, Manisa, Türkiye.

[2]Giresun University, Dereli Vocational School, Department of Forestry Giresun, Türkiye.

[3]Karadeniz Teknik University, Sciences Faculty, Department of Biology, Trabzon, Türkiye

[4]Recep Tayyip Erdoğan University, Sciences and Arts Faculty, Department of Biology , Rize, Türkiye.

*Corresponding author's e-mail: gulay.kaya@cbu.edu.tr

Abstract

In the present study, 15 *Tragopogon* L. taxa were examined by a light microscope in terms of leaf anatomical features. The plant materials were collected from natural populations distributed in Turkey and then fixed in FAA (5 parts stock formalin, 5 parts glacial acetic acid, 90 parts 70% ethanol) for 24 h and stored in 70% ethanol. For anatomical investigations, cross sections were taken from leaves by a freezing microtome, and surface sections were taken by hand with a razor blade. All sections were stained with haematoxylin and well-stained sections were photographed with a light microscope (LM). All examined taxa are characterized by a typical, trigonous, semicircular, or V-shaped midrib which is surrounded by parenchymatic and collenchyma cells. All the examined taxa have equifacial or bifacial mesophyll and hypostomatic or amphistomotic leaf features. It is also determined that the stomata index vary among the examined taxa. This is the first report dealing with some Turkish *Tragopogon* taxa leaf anatomical features. Our results showed that shape of varies midrib in the leaf and the mesophyll tissue and stomata characteristics are valuable traits varied among the examined taxa.

Keywords: Leaf anatomy, light microscope, Tragopogon, Türkiye.

Acknowledgment: This study was supported by the Scientific and Technological Research Council of Turkey (TUBITAK, Project number: 110T954) and Giresun University (Project number: FEN-BAP-A-140316-22).

Poster Presentation PP-35
Friday

The Anatomical Studies on *Ekimia* (Apiaceae) Species in Turkey

Gülşen Karaçoban[1], Sevay Ayşe Ulubeli[1], Batıkan Günal[1], Gürkan Semiz[1*]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: gsemiz@pau.edu.tr

Abstract

In this study, the endemic species, Ekimia ozcan-secmenii Şenol & Eroğlu and Ekimia bornmuelleri (Hub.-Mor. & Reese) H.Duman & M.F.Watson (Apiaceae) have been investigated anatomically for the first time. Cross-sections were taken with a rotary microtome and dyed using Safranin-Fast green staining method. Images were taken by Olympus CX23 light microscope and detailed measurements of the tissues were made by EP50 camera system. The root periderm of E. ozcan-secmenii was relatively thick from the periderm of E. bornmuelleri. The cortex layers of both species were similarly wide and composed of parenchymatic cells. Parenchyma rays were only seen in the structure of E. ozcan-secmenii while elements of the xylem were distributed throughout both species' pith region. Both species had circular stems in cross-section. The epidermal layers of both species were consisting of a single row of cubic-shaped cells. Beneath the upper epidermis, there was a collenchyma layer composed of 3-5 rows, a narrow layer composed of 2-3 rows of cortex parenchyma, vascular bundles enwrapped with sclerenchyma, and the pith region in both species, respectively. The adaxial epidermis of the cauline leaves of both species were cubic while the abaxial epidermis were squamous. Palisade parenchyma of cauline leaves in E. ozcan-secmenii was denser while both species had secretory canals throughout the entire cross-section of the leaves. Stomata cells were observed only in the adaxial epidermis of both cauline leaves. Both species had circular basal leaves with palisade and spongy parenchyma under a row of the cubic epidermis while palisade parenchyma of E. ozcan-secmenii was denser than the palisade parenchyma of E. bornmuelleri.

Keywords: Apiaceae, *Ekimia ozcan-secmenii*, *Ekimia bornmuelleri*, anatomy, Turkey.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-36
Friday

Pollen Morphology of Endemic *Thlaspi leblebicii* Gemici & Görk (Brassicaceae)

Abouzar Hassanpour[1*], Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: gsemiz@pau.edu.tr

Abstract

Thlaspi L. is a taxonomically complex genus that comprises at least 75 species, distributed mainly in Eurasia. The genus has 36 taxa belonging to six sections in Turkey. In this study, the pollen morphology of endemic *T. leblebicii* Gemici & Görk (Brassicaceae) was studied with light microscopy (LM) and scanning electron microscopy (SEM) for the first time. The plant material was collected from natural populations from Sandras Mountain in Beyağaç, Denizli. For micromorphological observations of pollen, the specimens were prepared for electron microscopy. Pollen slides were examined using the Wodehouse method. Pollen shape, polar axis, equatorial axis, P/E, colpus length, colpus width, apocolpium, exine, intine, mesocolpium, aperture, and ornamentation were used as palynological characters. All measurements were conducted using randomly selected samples. Minimum, maximum, mean and standard deviation values of characters were performed. The pollen shape of *T. leblebicii* is subspheroidal with the polar axis ranging from 13.64 to 20.56 µm and equatorial axis from 15.20 to 18.63 µm. Pollen grains are tricolpate and ornamentation is reticulate. The exine thickness ranges from 1.03 to 1.83 µm and the intine thickness ranges from 0.56 to 0.89 µm. As a result of this study, the incomplete palynological data of an endemic species, *T. leblebicii*, was revealed for the first time.

Keywords: Brassicaceae, *Thlaspi leblebicii*, pollen, Denizli, Turkey.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-37
Friday

Pollen Morphology of *Astragalus pelliger* (Fabaceae)

Bayram Atasagun[1*]

[1]Selçuk University, Vocational School of Health Services, Konya, Türkiye.

*Corresponding author's e-mail: byrmatsgn@gmail.com

Abstract

Astragalus L., is the largest genus of vascular plants in the world, with an estimated number of 3000 species. It has two main centers of diversity, Eurasia and America. Many species are narrow endemics. The members of the genus are dominant plants of the steppe vegetation. It is also the largest genus in Turkey, where it is represented by nearly 484 taxa in 63 sections and the rate of endemism is 51%. *Astragalus pelliger* Fenzl is endemic species to Turkey. The main aim of this study is to investigate palynological features for systematics purpose of *A. pelliger*. The plant samples collected from B5 Kayseri from the Erciyes Mountain. Pollen morphology was investigated with light microscopy (LM) and scanning electron microscopy (SEM). The pollen slides were prepared according to the method of Wodehouse. On an average, 30 measurements were made for all quantitative characters. The pollen grains of *A. pelliger* are tricolporate, radially symmetrical and isopolar. The pollen shape is prolate, Amb semi-triangular and ornamentation foveolate-reticulate. Colpus thin and tall, operculate, operculum membrane has granulate ornamentation.

Keywords: *Astragalus*, endemic, Erciyes, palynology, Türkiye.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-38
Friday

Palynological and Micromorphological Characteristics of *Rhaponticoides hierroi* Ö. Eren (Asteraceae)

Foroogh Tavakoli[1*], Batıkan Günal[1], Gürkan Semiz[1]

[1]Pamukkale University, Faculty of Science, Department of Biology, Denizli, Türkiye.

*Corresponding author's e-mail: matina@yahoo.com

Abstract

Rhaponticoides hierroi Ö. Eren (Asteraceae) critically endangered local endemic species is known only from the Antalya. However, during our botanical field studies, the species was sampled from both Muğla and Denizli. In this study, the plant materials were collected from natural populations in Acıpayam, Denizli, and palynological (aperture, polar and equatorial diameter, P/E, colpus and pore length and width, exine and intine thickness, mesocolpium and apocolpium length, exine ornamentation) and micromorphological (achene and pappus morphology) variations between achene surface ornamentations and pollen characteristics were investigated. The achene and pollen samples of randomly selected individuals were used in all measurements. Minimum, maximum, mean and standard deviation values of characters were calculated. Pollen grains are tricolporate and ornamentation is echinate. The shape of pollen is oblate spheroidal, the polar axis (P) ranges from 40.07 to 63.38 µm and the equatorial axis (E) from 42.04 to 67.00 µm. The exine thickness ranges from 1.20 to 2.17 µm and the intine thickness from 1.05 to 1.89 µm. Achenes are cylindrical, 7.17-11.47 x 1.36-2.92 mm, brown, laterally compressed and the basal part is yellowish. The pappus is multiseriate, scabrous and brownish. As the result of this study, the incomplete palynological and micromorphological data of *R. hierroi*, were reported for the first time.

Keywords: Asteraceae, *Rhaponticoides hierroi*, palynology, micromorphology, Türkiye.

Poster Presentation PP-39
Friday

Preliminary Results from Biogeography and Character Evolution of *Lamium* (Lamiaceae)

Ferhat Celep[1*], Fergan Karaer[2], Aslı Yılmaz[3], Jeffrey P Rose[4], Bryan Drew[4]

[1]Kırıkkale University, Faculty of Sciences and Arts, Department of Biology, Kırıkkale, Türkiye.

[2]Ondokuz Mayıs University, Faculty of Education, Department of Mats and Science, Samsun, Türkiye.

[3]Ataturk University, Faculty of Science, Department of Molecular Biology and Genetics, Erzurum, Türkiye.

[4]University of Nebraska-Kearney, College of Arts and Sciences, Department of Biology, Kearney, USA.

*Corresponding author's e-mail: ferhat_celep@hotmail.com

Abstract

Lamium L. is the type genus of Lamiaceae (mint family). Within Lamiaceae, *Lamium* is a member of the subfamily Lamioideae, and consists of about 34 species primarily distributed in Eurasia (especially Turkey), North Africa (including Macaronesia), and Central and East Asia. In addition, some species have been introduced or naturalized in the Americas, Australia, and tropical and South Africa. Europe and Turkey together encompass about 90% of the diversity within the genus. *Lamium* typically occurs in forest understories, rocky mountain slopes and screes, and cultivated field habitats. Phylogenetic analyses using 2 nuclear (*ITS* and *ETS*) and 4 chloroplast regions (*matK*, *rpoA*, *ycf1* and *psba-trnH*) confirmed the monophyly of *Lamium. Based on the phylogenetic trees, biogeographic and character evolution analyses were done with the R program. We evaluated two characters, such as annual vs. perennial and anthers glabrous vs. hairy. Results showed that glabrous anthers evolved twice, and annual vs. perennial characters* evolved a few times in the genus. Biogeographic analysis pointed out that the genus evolved mainly in the Mediterranean and Circumboreal phytogeographic regions.

Keywords: Phylogeny, Lamiaceae, *Lamium*, biogeography, character evolution.

Acknowledgement: We thank to the Scientific and Technical Research Council of Turkey (TUBİTAK) (project no: 112T131 and 121Z374, TUBİTAK) for their financial support.

Poster Presentation PP-40
Friday

Preliminary Results from Fruit Micromorphology of the Genus *Lamium*

Ferhat Celep[1*], Çiğdem Can Özker[1], Zeynep Atalay[2]

[1]Kırıkkale University, Department of Biology, Kırıkkale, Turkey.

[2]TÜBİTAK, Kavaklıdere, Ankara, Turkey

*Corresponding author's e-mail: ferhat_celep@hotmail.com

Abstract

In *Lamium*, species-level identification is usually very difficult, particularly in closely related species. Here, we investigated nutlet micromorphological characteristics of 37 taxa belonging all sections of the genus by stereo binocular microscopy and scanning electron microscopy to show their taxonomic and phylogenetic value. The present study is the most comprehensive nutlet micromorphological study based on the number of taxa studied in the genus so far. The size of nutlets varies from 1.74 mm (*L. purpureum*) to 5.29 mm (*L. cymbalarifolium*) in length, 1.01 mm (*L. orientale*) to 2.63 mm (*L. cymbalarifolium*) in width. The basic shape of nutlets is *obovat, triangular-obovat, oblong, oblong-obovat, widely-obovat, and circular*. Four nutlet sculpturing patterns are present namely colliculate, reticulate, verrucate, and rugose. The variation of surface sculpturing, nutlet shape, size, and exocarp cell shape provide useful diagnostic properties at species and subgenus level. However, nutlet micromorphological characters are of low phylogenetic value in studied *Lamium* species.

Keywords: Lamiaceae, *Lamium*, fruit micro-morphology, taxonomy.

Acknowledgement: We thank to the Scientific and Technical Research Council of Turkey (TUBİTAK) (project no: 112T131 TUBİTAK) for their financial support.

Poster Presentation PP-41
Friday

Chromosome numbers of *Ornithogalum nallihanense* and *Ornithogalum armeniacum*

Simge Öztürk[1*], Ayşe Nihal Gömürgen[1], Nilay Şen[1], Dila Çana[1], Arda Burak Karagöz[1-2], Aslı Doğru-Koca[1]

[1]Hacettepe University, Faculty of Science, Department of Biology, Ankara, Türkiye.

[2]Middle East Technical University, Faculty of Science, Department of Biological Sciences, Ankara, Türkiye.

*Corresponding author's e-mail: ozturksimge442@gmail.com

Abstract

The genus *Ornithogalum* L. (Asparagaceae) is distributed with two hundred accepted species throughout the world. There are sixty-four species in our country and thirty-one of them are endemic. The new species determinations continue for the Ornithogalum species, especially in Turkey. *Ornithogalum nallihanense* Yıld. & Dogru-Koca studied in this research is also one of these newly published species. This species spread out in the north-west of Turkey and typically has only one canaliculate and hirsute leaf. *O. armeniacum* Baker, occurs in the north of the Mediterranean basin such as Turkey, Greece, the East Aegean Islands, and Yugoslavia. In this investigation, chromosome numbers of *O. nallihanense*, and *O. armeniacum* were studied. Both of them are members of the *Ornithogalum* subgenus. The chromosome number of *O. nallihananse* was unknown till today. In previous studies chromosome numbers of *O. armeniacum* was reported as 2n=18 – 20. The bulbs collected from their natural habitats were allowed to develop fresh roots in water. Roots were pretreated with 8-hydroxyquinoline or α-monobromonaftalin for 16 hours at 4 °C, then fixed with acetic alcohol (3:1), hydrolyzed in 1 N HCl at 60 °C for 10 min. Chromosome preparations were made by using a standard Feulgen squash technique. In conclusion, (i) the method was optimized for these two species, (ii) 12 chromosomes for *O. nallihanense* (2n=12) were determined and (iii) the agreement between the literature and our results about the chromosome number of *O. armeniacum* was revealed.

Keywords: Cytogenetic, Türkiye, endemic.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-42
Friday

In vitro Asymbiotic Seed Germination of *Gymnadenia conopsea* (L). R. Br.

Buse Çökmez[1*], Yasemin Özdener Kömpe[1]

[1]Ondokuz Mayıs University, Sciences and Art Faculty, Department of Biology, Samsun, Türkiye

*Corresponding author's e-mail: buse.ckmeez@gmail.com

Abstract

Gymnadenia conopsea (L). R. Br. is a perennial, terrestrial orchid species which belongs to Orchidaceae family. The aim of this study is to investigate the seed germination and protocorm formation of *G. conopsea* seeds. The basal medium of Knudson (KN), Murashige and Skoog (MS), Vacin and Vent (VW), nitrogen-free Van Waes and Debergh (VWD) and Modified Malmgren (MM) were used for the asymbiotic seed germination of *G. conopsea.* The formation of protocorm was measured at the end of 6 weeks (45 days) and at the end of 12 weeks (90 days) of seeds. After 2 weeks, rhizoid formation was occured in two seeds in MM. The protocorm size was measured as 0.1 mm in a nitrogen-free VWD. After 90 days, the highest germination and protocorm formation was reported in MM medium (4.5 ± 1.0^{a}). Germination and protocorm formation were reported as the lowest in the MS medium (1.3 ± 0.3^{b}). According to the results, after 90 days the best germination and protocorm with the best order of germination and protocorm formation was reported on MM (4.5 ± 1.0^{a}), nitrogen-free VWD (4.4 ± 0.5^{a}), KN (2.2 ± 0.8^{ab}),VW (1.7 ± 1.8^{b}) and MS (1.3 ± 0.3^{b}) medium. With this study, a reliable *in vitro* asymbiotic seed germination protocol was described for *G. conopsea*.

Keywords: Asymbiotic, *Gymnadenia conopsea*, seed germination, terrestrial orchid.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-43
Friday

Fungal Diversity of Four Co-occuring Orchid Species

Vıldan Akın Mutlu[1*]

[1]Ondokuz Mayıs University, Faculty of Sciences, Department of Biology, Samsun, Türkiye.

*Corresponding author's e-mail: vildanakin@hotmail.com

Abstract

Orchids depend on fungi for seedling formation and growth. Therefore, associated fungal communities may be one of the most important ecological factors determining the distribution, diversity and local abundance of orchids. Some orchid species that occur together may interact with different fungal partners, while other orchids may be more specific. Orchid distribution can be affected not only by the presence and abundance of suitable mycorrhizal fungi, but also by the overall diversity of related fungi naturally present in the habitat. Therefore, in our study, we tried to determine the fungal relationship among 4 orchid species (*Dactylorhiza romana, Ophrys sphegodes, Ophrys oestrifera, Anacamptis papilionacea*) sharing the same habitat and the variation in fungal preferences of coexisting orchids. The roots of individuals belonging to the 4 orchid species were collected between March-June 2015 from populations in a narrow habitat in Samsun. All the roots were randomly taken from a single population of orchid species to be used for fungal isolation. All of the fungi isolates were grouped according to their morphological characteristics. Molecular identification was made according to the internal transcribed spacer (ITS) gene region of the isolated DNA of the fungus representing each group. In total, 34 fungi belonging to Tulasnellaceae, Ceratobasidiaceae, *Alterneria*, *Aspergillus* and *Paecilomyces* were isolated and cultured. Adult individuals of orchids in association formed mycorrhizal relationships with a wide variety of fungi. It was determined that only one fungus (*Tulasnella*, Accession Number:JX64082.1) was associated with all of the orchid species. With this study, fungal diversity among orchids sharing the same habitat was revealed for the first time in Turkey. In order to better understand the distribution of orchids, germination studies of fungi participating in mycorrhizal relationship are continuing.

Keywords: Orchid, orchid mycorrhiza, phylogeny, biodiversity.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-44
Friday

Genome Wide Association Studies Accelerate Forest Trees Breeding Rate for Disease Resistance

Mehdi Younessi-Hamzekhanlu[1*], Oliver Gailing[2]

[1]Department of Forestry and Medicinal Plants, Ahar Faculty of Agriculture and Natural Resources, University of Tabriz, Tabriz, Iran.

[2]Department of Forest Genetics and Forest Tree Breeding, University of Göttingen,Buesgenweg, Germany.

*Corresponding author's e-mail: mehdiyounessi377@gmail.com

Abstract

The ecological and economic importance of forest trees is evident and their survival is necessary to provide the raw materials needed for wood and paper industries, to preserve the diversity of associated animal and plant species, to protect water and soil, and to regulate climate. Forest trees are threatened by anthropogenic factors and biotic and abiotic stresses. Various diseases, including those caused by fungal pathogens, are one of the main threats to forest trees that lead to their dieback and in some cases to deforestation. Genomics and transcriptomics studies using next-generation sequencing (NGS) methods can help reveal the architecture of resistance to various diseases and exploit natural genetic diversity to select elite genotypes with high resistance to diseases. In the last two decades, Quantitative Trait Locus (QTL) mapping studies led to the identification of QTLs related to disease resistance traits and gene families and transcription factors involved in them, including NB-LRR, WRKY, bZIP and MYB. On the other hand, due to the limitation of recombination events in traditional QTL mapping in families derived from bi-parental crosses, genome wide association studies (GWAS) that are based on linkage disequilibrium (LD) in unstructured populations overcame these limitations and were able to narrow down QTLs to single genes through genotyping of many individuals using high-throughput markers. Association Mapping (AM) and QTL mapping studies, by identifying markers closely linked to the target trait, are the prerequisite for marker-mediated selection (MAS) and reduce the breeding period in perennial forest trees. This presentation is focused on the progress achieved in the field of dissecting forest tree disease resistance architecture through GWAS and QTL mapping studies.

Keywords: Disease resistance, QTL mapping, GWAS.

Poster Presentation PP-45
Friday

Traditional Use and Therapeutic Effects of Comfrey (*Symphytum officinale* L.) Plant

Fatma Gül Delimustafaoğlu[1,2*], Ayşe Baldemir Kılıç[3]

[1]Cappadocia University, Cappadocia Vocational College, Nevşehir, Türkiye.

[2]University of Health Sciences, Faculty of Pharmacy, Department of Pharmacognosy, Ankara, Türkiye.

[3]University of Health Sciences, Faculty of Pharmacy, Department of Pharmaceutical Botany, Ankara, Türkiye.

*Corresponding author's e-mail: fatmaguldelimustafaoglu@kapadokya.edu.tr

Abstract

Symphytum officinale L. (Comfrey) species belonging to the Boraginaceae family is an upright, perennial herb native to Europe and Asia, growing in moist areas along rivers and streams, reaching 1-2 meters in height (1). *S. officinale*, which derives from the Greek word "symphuo" meaning "to grow together" and has been used for over 2000 years in the treatment of various diseases such as bone fractures, joint inflammations, wounds, hematomas, and thrombophlebitis (2-4). In our country, it is known that the root and leaves are used in constipation and internally against haemorrhoids (5). In Europe, it has been reported to be used externally as a poultice in local inflammations such as blunt injuries, fractures, swollen bruises, boils, carbuncles, varicose ulcers, and burns. It has also been reported to be used as an herbal tea to relieve breast pain in lactating women, and to stop ulcers, hernias, colitis, and internal bleeding. Herbal tea has also been used to treat nasal congestion, inflammation, diarrhoea, and cough. It is used as a mouthwash for mouth sores and gingival bleeding (6). Although the therapeutic effects of comfrey are widely known, studies have shown that it can be hepatotoxic and carcinogenic in humans and animals, therefore its use has been limited in many countries (4,7). It is also recorded that comfrey, which is generally used as a spice, is added to salads, fried with other greens, and used to make meatballs (7,8). The chemical composition of the roots includes carbohydrates, tannins, triterpenes, alkaloids, and other components such as allantoin, caffeic acid, carotene, chlorogenic acid, rosmarinic acid, vitamins A and B12, calcium, potassium, and phosphorus (6,9). As a result of pharmacological and phytochemical studies, antibacterial, anti-inflammatory, antioxidant, analgesic, proliferative, and antinociceptive effects of *S. officinale* have been demonstrated, and it has been reported that it can be used for hepato-protection and tissue regeneration (10,11). In this study, information about the traditional uses of *S. officinale*, which has different uses in our country and in the world, has been compiled.

Keywords: *Symphytum officinale*, traditional use, therapeutic effect, Boraginaceae.

IConPB 2022
3rd International Congress on Plant Biology
September 21-23, 2022, Rize -Türkiye

Poster Presentation PP-46
Friday

The Callus Formation in *Vaccinium arctostaphylos* and Effect of Sucrose Amount on Anthocyanin Production

Elif Onan[1]*, Hatice Çölgeçen[1], Havva Karahan[1]

[1]Bülent Ecevit University, Faculty of Science, Department of Biology, Zonguldak, Türkiye.

*Corresponding author's e-mail: elifonan@hotmail.com

Abstract

Anthocyanins are pigments belonging to the flavonoid group of the class of phenolic compounds synthesized by the phenylproponoid pathway. Anthocyanins are known to have benefits against diabetes, brain and heart health, and some cancers in humans and animals. Anthocyanins, natural compounds as alternatives to artificial colorants and shelf-life additives, have been obtained using traditional extraction methods for a long time. However, seasonal production fluctuations, the difficulty of ensuring continuity, the need for too much plant material for production, and the low quality and purity of the obtained product are limiting. Biotechnological methods with the same properties, high purity, which can be produced at all times under laboratory conditions, and where a small amount of starting material is used are seen as more advantageous. In our study, apical meristem and node explants of *Vaccinium arctostaphylos* were used. Callus was produced in woody plant medium (WPM) nutrient medium containing different concentrations of indole acetic acid (IAA) (0.5, 1, 2, 4 mg/L), 2 mg/L IAA + 0.5 mg/L kinetin, and zeatin (0.5, 1 mg/L). At the same time, different concentrations of sucrose (20, 30, 40 and 50 g/L) were added to the WPM medium to increase the amount of anthocyanin production. In the first subculture was determined the callus formation percentage of apical meristem explants of *V. arctostaphylos* is 93% in 4 mg/L IAA+20 g/L sucrose, the callus formation percentage of node explants is 60% in 2 mg/L IAA+20 g/L sucroz. The highest anthocyanin content was determined in the callus produced from the apical meristem explant in the medium containing 2 mg/L IAA+50 g/L sucrose.

Keywords: Anthocyanin, callus, *in vitro*, WPM, *Vaccinium arctostaphylos.*

Acknowledgement: The study was supported by Bülent Ecevit University Science Research Project (Project No: 2021-84906727-03).

ICONPB 2022 SPONSORS

Thank you to our sponsors for their support.

RİZE MUNICIPALITY

RİZE CITY COUNCIL

ÇAYKUR GENERAL DIRECTORATE

REPUBLIC OF TÜRKİYE MINISTRY OF AGRICULTURAL AND FORESTRY

12TH GENERAL DIROCTORATE OF NATURE CONSERVATION AND NATIONAL PARKS

REPUBLIC OF TÜRKİYE MINISTRY OF AGRICULTURE AND FORESTRY GENERAL DIRECTORATE OF FORESTRY

RİZE CHAMBER OF AGRICULTURE

RIZE FOREST MANAGEMENT DIRECTORATE

RİZE COMMERCIAL EXCHANGE/ ÇAYMER/ RIZE TEA BAZAAR

ŞAR BUILDING, INDUSTRY AND TRADE INCORPORATION

İMECE GIDA A.Ş.

HAPELOĞLU SHOPPING CENTER

HAPELOĞLU
ALIŞVERİŞ MERKEZİ

RİZE LEVENT COLLEGE

LEVENT
COLLEGE


ICon PB 2022
FLORA RESEARCH ASSOCIATION
3rd International Congress on Plant Biology
September 21-23, 2022, Rize, Türkiye