



# ABSTRACT BOOK

## 7<sup>th</sup> INTERNATIONAL HORTICULTURE CONFERENCE

### FEBRUARY 23-25, 2023

Sustainable Horticulture  
*Challenges, Innovations & Adaptations*

**Editors:**

**Kashif Razaq (Ph.D)**

**Sami Ullah (Ph.D)**

**ORGANIZED BY:**

**Department of Horticulture, MNS-University of Agriculture, Multan  
&  
Pakistan Society For Horticultural Science**





7th International  
Horticulture  
Conference 2023  
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**INTERNATIONAL HORTICULTURE  
CONFERENCE 2023  
(FEBRUARY 23<sup>rd</sup>-25<sup>th</sup>)**

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## ***PATRON IN CHIEF***



**Prof. Dr. Asif Ali** (*Tamgha-e-Imtiaz*)  
Vice Chancellor  
MNS-University of Agriculture,  
Multan, Punjab, Pakistan.



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## ***PATRON***



**Prof. Dr. Shafqat Saeed**

Dean

Faculty of Agriculture and Environmental Sciences  
MNS-University of Agriculture,  
Multan, Punjab, Pakistan.



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## **CONVENER**



**Dr. Tanveer Ahmad**

Chairman

Department of Horticulture  
MNS-University of Agriculture  
Multan, Punjab, Pakistan



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**TITLE**

Abstract Book of the International Horticulture Conference  
(IHC-2023) February 23<sup>rd</sup> -25<sup>th</sup>, 2023

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## Patron in Chief's Message

Abrupt climate changes are altering the lives of millions of people and disrupting their normal lifestyles. Water scarcity, salinity, extreme temperatures, and a growing population further aggravate the agriculture sector, posing threats to food security. Pakistan ranks as the fifth most affected country by climate change and the third most water-scarce nation. The horticulture sector holds great importance for the country's economic development and can play a major role in generating employment to address food security concerns. Fruits and vegetables are rich sources of dietary fibre, vitamins, minerals, electrolytes, phytochemicals, and antioxidants. These crops can enhance the food and nutritional security, as well as livelihoods of people living across various regions worldwide. Additionally, horticultural commodities possess medicinal properties and are helpful in reducing chronic diseases. Furthermore, ornamental horticulture, which involves cultivation of plants for decorative purposes, has a wide range of benefits for humans. Firstly, it is aesthetically pleasing and can greatly enhance the visual appeal of any space. Secondly, it has been shown to have a calming effect on the mind and body, effectively reducing stress and anxiety.

In Pakistan, the horticulture sector contributes around 6% to the GDP, whereas in other countries, the percentage is above 20%. The primary reason for this reduced share is that the horticulture sector is most susceptible to biotic and abiotic stresses due to its higher perishability and herbaceous nature. Therefore, considering these challenges, it is essential to embrace sustainable and innovative agricultural practices to ensure food security while improving quality attributes. In this respect, I commend and congratulate the Department of Horticulture, MNS-University of Agriculture, Multan, for organizing the 7<sup>th</sup> International Horticulture Conference in collaboration with the Pakistan Society for Horticultural Science (PSHS). This conference provided an excellent opportunity to bring together a diverse array of national and international scientists, faculty members, experts, students, and industry personnel actively working in the vast discipline of Horticultural Science. I encourage all attendees to take the time to read through the conference's abstract book, as it offers an invaluable chance to explore the latest research and trends in the field of Horticulture and to connect with fellow professionals and researchers.

I would like to express my gratitude to all the authors for their valuable contributions to this book and their dedicated efforts in preparing their abstracts. Your commitment and passion for research are truly inspiring.

**Prof. Dr. Asif Ali (TI)**

Vice Chancellor

MNS-Universality of Agriculture Multan, Pakistan





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## Patron's Message

Horticulture has always held a significant position, and its prominence has greatly increased in recent times. The value of horticulture can be demonstrated by its various advantages. Horticulture improves the economic condition of many farmers and has become a means of enhancing livelihoods for farmers. For example, flower harvesting, nursery maintenance, hybrid seed production, tissue culture, propagation of fruits and flowers, and food processing are highly lucrative employment options for women in rural areas. The adoption of advanced horticultural practices can significantly improve crop yields, farmers' profitability, and national economic growth.

The 7th International Horticulture Conference offered horticulturists an invaluable opportunity to present their latest research findings, exchange ideas, and discuss the most recent trends and innovations in the field. The conference program was carefully crafted to encompass diverse topics, such as horticulture education and research, seed production and breeding, plant propagation, greenhouse and nursery management, fruit production, and post-harvest management, as well as ornamental plant production and management. A noteworthy feature of the conference was the inclusion of keynote speeches delivered by distinguished national and international horticulturists who shared their experiences, expertise, and research discoveries. The conference also facilitated numerous networking and collaboration opportunities, allowing delegates to forge new relationships and partnerships within the field of horticulture.

Moreover, the conference showcased an exhibition that highlighted the latest products, technologies, and services in the realm of horticulture. Exhibitors comprised seed and plant breeding companies, manufacturers of greenhouse and nursery equipment, post-harvest handling and processing firms, suppliers of fertilizers and pesticides, and agricultural research institutions.

This abstract book will serve as a valuable resource for researchers and professionals in the field of horticulture. I extend my sincere appreciation to all the authors for their valuable contributions to this publication.

**Prof. Dr. Shafqat Saeed**

Dean, FA & ES

MNS-Universality of Agriculture Multan, Pakistan



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## Convener's message

‘Knowledge is like a garden: If it is not cultivated, it cannot be harvested.’

Pakistan Society for Horticultural Science in collaboration with Department of Horticulture at MNS University of Agriculture, Multan proudly hosted 7th International Horticulture Conference 2023. The conference was held under the theme of "Sustainable Horticulture: Challenges, Innovations, and Adaptations," and brought together experts from around the world to exchange knowledge and ideas on the latest developments in the field of horticulture. The conference served as an excellent platform where national and international experts highlighted a range of concerns related to the horticulture sector especially the decline in horticultural production, which has led to financial losses and impacted the livelihoods of many farmers. This decline can be attributed to various factors, such as inadequate infrastructure, outdated farming techniques, and the unavailability of modern technology.

Moreover, different scientists highlighted that climate change is exacerbating the challenges faced by farmers in developing countries, especially Pakistan. With unpredictable weather patterns and extreme climate events: farmers are experiencing reduced crop yields, and in some cases, total crop failures. This is a significant concern for many farmers who rely on horticulture for their income. Interestingly, international experts diverted the attention of attendees toward farmers' lack of access to the markets, which results in low returns on their investments. Due to the unavailability of proper storage facilities, farmers are forced to sell their crops at lower prices, which leads to reduced profitability. In addition to these concerns, farmers are also facing difficulties accessing credit, which is necessary to invest in their farms and improve their crop yields. This is especially challenging for small-scale farmers who lack the collateral needed to secure loans.

The lack of government support for farmers is also a significant concern. Many farmers feel that the government is not doing enough to address their concerns and that they are not receiving adequate support to improve their farming practices and access markets. To address these concerns, experts emphasized the urgent need to invest in the horticulture sector and provide farmers with the necessary resources to improve their crop yields and access markets. The government of Pakistan must recognize the importance of the horticulture sector and implement policies to support farmers, such as providing access to credit, modern farming equipment, and storage facilities. Moreover, there is a need for the government to promote the adoption of modern farming techniques and provide training programs to educate farmers on these practices. By supporting farmers in this way, the government can help increase their resilience against climate change impacts and ensure the sustainability of the horticulture sector in Pakistan.

The revival of the horticulture sector is crucial not only for the livelihoods of farmers but also for the overall growth of the economy, especially in the face of climate change. By investing in this sector and promoting climate-resilient agriculture practices, Pakistan can increase its export earnings, create employment opportunities, and reduce poverty. In this scenario, this 7th International Horticulture Conference aimed to embrace diversity in horticulture and work to preserve and promote the vast range



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of plant species to cope with different challenges like climate change, food insecurity, and biodiversity loss. Out of a total of 210 abstracts submitted for the conference, 85 were chosen for oral presentations, which were presented in parallel technical sessions covering a diverse range of themes. These sessions offered a unique opportunity for experts from different fields to share their knowledge and insights, engaging in lively discussions and debates on cutting-edge research topics. Meanwhile, 90 abstracts were selected for poster presentations, where researchers had the chance to highlight their work in a visually engaging format, and network with other attendees. Overall, this conference provided a rich and stimulating environment for scholars and practitioners alike to connect, learn, and collaborate on the latest advances in their respective fields.

I express my deepest appreciation for the active participation of all national and international delegates from Italy, Turkey, and Egypt who were physically with us from various institutions. While we had online international experts from the UK, China, Australia, Brazil, Kazakhstan, Afghanistan, India, and Nepal. I am delighted to express my immense gratitude to all the dedicated organizers who poured their hearts and souls into bringing this conference to life. Without their tireless efforts and unwavering commitment, this remarkable event would not have been possible. The meticulous planning, diligence, and sheer hard work of the organizers ensured that every aspect of the conference was executed with flawless precision. Their dedication to creating an enriching and rewarding experience for all attendees was truly inspiring. So, to all the organizers involved in making this conference a success, I extend my heartfelt appreciation and admiration. Thank you for your hard work, dedication, and tireless commitment to excellence!

I also extend my heartfelt thanks to our sponsors who contributed generously to the conference, whose dedication and commitment in uplifting the horticulture industry are vital to our mission.

Best regards,

**Dr. Tanveer Ahmad**

President, Pakistan Society for Horticultural Science  
Chairman, Department of Horticulture  
MNS University of Agriculture, Multan



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### CONFERENCE PROGRAM

**Inaugural Session: Thursday, 23<sup>rd</sup> February 2023**

**Main Hall (Canopy)**

**Zoom Link**

<https://us06web.zoom.us/j/87425182418?pwd=NWg1NjlQcklIYjJRYnV0elpKVHBBHQT09>

Meeting ID: 874 2518 2418

Passcode: 022593

Time	Activity
09:30 am 10:00 am	Registration and Seating of the Participants
10:00 am 10:10 am	Recitation with Translation
10:10 am 10:20 am	Na'at
10:20 am 10:40 am	Welcome Address <b>Prof. Dr. Asif Ali (TI)</b> Vice Chancellor MNS University of Agriculture, Multan
10:40 am 10:55 am	Opening of Conference (Conference Overview) <b>Dr. Tanveer Ahmad</b> Chairman, Department of Horticulture, MNSUAM (Convener, Conference/President Pakistan Society for Horticultural Science)
10:55 am 11:40 am	Keynote Speaker <b>Prof. Dr. Ghulam Sarwar Markhand</b> Meritorious Professor Date Palm Research Institute Shah Abdul Latif University, Khairpur, Sindh, Pakistan.
11:40 am 12:00 pm	Address of Chief Guest <b>Prof. Dr. Iqrar A. Khan (SI)</b> Vice Chancellor, University of Agriculture, Faisalabad
12:00 pm 12:10 pm	Vote of Thanks <b>Prof. Dr. Shafqat Saeed</b> Dean Faculty of Agriculture & Environmental Sciences MNS University of Agriculture, Multan
<b>Lunch and Prayer Break 12:30 pm to 01:30 pm</b>	

#### Technical Session-I: Main Hall (Canopy)

Breeding and Genetics for Crop Improvement

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Prof. Dr Jafar Jaskani, Director ORIC, UAF

**Co-chair:** Prof. M. Hammad Nadeem Tahir, Director, IPBB, MNS-UAM

**Moderator:** Dr. Kashif Razzaq, Associate Professor, MNS-UAM

**Zoom Link**

<https://us06web.zoom.us/j/87425182418?pwd=NWg1NjlQcklIYjJRYnV0elpKVHBBHQT09>

Meeting ID: 874 2518 2418

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Time	Activity
01:30 pm 01:50 pm	<b>Dr Arif Atak</b> Bursa Uludag University Bursa, Turkiye Vice-chair Division of Vine and Berry Fruits (ISHS) <i>Effect of Global Climate Change on Table Grape Cultivation</i>
01:50 pm 02:10 pm	Online presentation <b>Dr. Yongfeng Zhou</b> Agricultural Genomics Institute at Shenzan Chinese Academy of Agricultural Sciences, China <i>Population Genomics and Breeding of Grapevine</i>
02:10 pm 02:25 pm	<b>Dr. Muhammad Usman</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad-Pakistan <i>'Prospects of Mutation Breeding in Crop Improvement: A Citrus Outlook'</i>
02:25pm 02:40 pm	<b>Dr. Muhammad Khalil-Ur-Rehman</b> Department of Horticultural Sciences, The Islamia University of Bahawalpur <i>Utilization of Biotechnological Tools for the Improvement of Arid Fruit Crops</i>
02:40 pm 02:35 pm	<b>Dr. Tahira Jatt</b> Department of Botany, Shah Abdul Latif University, Khairpur, Sindh, Pakistan. <i>Genome Size Variations among different Date Palm Cultivars (Phoenix dactylifera L.) by Flow Cytometry</i>
02:35 pm 02:50 pm	<b>Dr. Wang Li</b> (Online presentation) College of Horticulture Hebei Agricultural University, China <i>Molecular Basis of Seedlessness in Grapes</i>
02:50 pm 03:05 pm	<b>Dr. Shujaul Mulk Khan</b> Department of Plant Sciences, Quaid-i-Azam University Islamabad <i>Climate Smart Horticulture via promoting Grapes Cultivation in Pakistan</i>
02:50 pm 03:05 pm	<b>Dr. Muhammad Abu Bakar Saddique</b> Institute of Plant Breeding and Biotechnology, MNS University of Agriculture Multan <i>'Genome-wide Characterization and Expression analysis of GGPPS Gene Family in Spinach (Spinacia oleracea L.)'</i>
<b>Tea Break 03:05 pm to 03:20 pm</b>	



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### Technical Session-II: Room 110

Floriculture and Landscape

Thursday, 23<sup>rd</sup> February 2023

**Chair:** Prof. Dr. Amir Nawaz, Chairman, Department of Horticulture, BZU, Multan

**Co-chair:** Dr. Rana Mazhar Abbas, Associate Professor, UoK, Karachi

**Moderator:** Mr. M. Usman Khan, Lecturer, MNS-UAM

#### Zoom Link

<https://us02web.zoom.us/j/83968891082?pwd=ZmJicHovOFpQRjRuaFBGZFRRMiFkZz09>

Meeting ID: 839 6889 1082

Passcode: 007165

Time	Activity
01:30 pm -01:45 pm	<b>Dr. Iftikhar Ahmad</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad-38040, Pakistan <i>Modern Floricultural Technologies &amp; Opportunities for South Punjab, Pakistan</i>
01:45 pm -02:00 pm	<b>Prof. Dr. Bushra Sadia</b> Center of Agricultural Biochemistry and Biotechnology (CABB) <i>Establishment of Proficient in vitro Regeneration System for Night Jasmine (Nyctanthes arboristis L.)</i>
02:00 pm- 02:25 pm	Online presentation <b>Dr. Margherita Beruto</b> Regional Institute for Floriculture, Italy Chair, Division of Ornamental Horticulture (ISHS) <i>Ornamental Horticulture Industry: Challenges and Opportunities</i>
02:25 pm- 02:40 pm	<b>Dr. Kashif Waseem</b> Department of Horticulture, Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan. <i>'In Vitro Regeneration of Chrysanthemum (Dendranthema morifolium L.) as influenced by Plant Growth Regulators'</i>
02:40 pm- 02:55 pm	<b>Ms. Ayesha Jabeen</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad0, Pakistan <i>Standardization of Postharvest Handling Protocols for Cut Celosia Stems</i>
02:55 pm- 03:10 pm	<b>Ms. Hifsa Safdar</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad <i>Cut Helianthus annuus- A New Promising Specially Cut Flower for Pakistan Markets</i>
<b>Tea Break 03:10 pm to 03:25 pm</b>	



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### Technical Session-III: Room 132

Olericulture

Thursday, 23<sup>rd</sup> February 2023

**Chair:** Prof. Muhammad Azam Khan, Chairman, Department of Horticulture, PMAS Arid Agriculture University, Rawalpindi

**Co-chair:** Dr. Shujaul Mulk Khan, Department of Plant Sciences, Quaid-i-Azam University, Islamabad

**Moderator:** Dr. Hafiz Nazar Faried, MNS-UAM

Time	Activity
01:30 pm - 01:45 pm	<b>Dr. Anam Noor</b> Department of Horticulture, Faculty of Agricultural Sciences & Technology, Bahauddin Zakariya University, Multan 60800, Pakistan <i>Effect of Different Packaging Materials on Seed Quality of Onion (<i>Allium cepa</i> L.) during Storage Period</i>
01:45 pm - 01:50 pm	<b>Dr. Sakeena Tul-Ain Haider</b> Department of Horticulture, Bahauddin Zakariya University Multan, Pakistan <i>Effects of Different Growth Hormone Combinations for Rapid in vitro Plant Regeneration of Tomato Plant</i>
01:50 pm- 02:05 pm	<b>Dr. Fareeha Shireen</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan <i>Wild Watermelon Rootstock Improves Watermelon Growth by Enhancing Boron Uptake Under Low Boron Conditions</i>
02:05pm- 02:20 pm	<b>Dr. Osama Bin Abdul Hafeez</b> UAF Subcampus Burewala <i>Effect of Irrigation methods, Silicon application and Mulching on the Onion growth and Productivity</i>
02:20 pm- 02:35 pm	<b>Mr. M. Anwar Ul Haq</b> Department of Horticulture, Bahauddin Zakariya University, Multan <i>Integrated Use of <i>Bacillus</i> sp. and Phosphorus Fertilizer to Increase the Okra Crop Performance under Calcareous Soil</i>
02:35 pm- 02:50 pm	<b>Mr. Safer ud Din</b> Department of Horticulture, University of Agriculture Faisalabad. Sub-campus Depalpur, Okara Pakistan <i>Varietal diversification of various potato genotypes under agro-climatic condition of Okara district, Pakistan</i>
02:50 pm- 03:05 pm	<b>Mr. Moazzam Anees</b> Lecturer, Department of Horticulture University of Punjab, Lahore <i>Impact of zinc and iron coated urea on nitrogen use efficiency of spinach (<i>Spinacia oleracea</i>)</i>
<b>Tea Break 03:05 pm to 03:20 pm</b>	



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### Technical Session-IV: Sybrid Room Block A

Horticultural Crop Production and Management

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Dr. Khurram Ziaf, Associate Professor, Institute of Horticultural Sciences, UAF  
**Co-chair:** Dr. Raheel Anwar, Associate Professor, Institute of Horticultural Sciences, UAF  
**Moderator:** Ms. Shafa Nayab, MNS-UAM

Time	Activity
01:30 pm - 01:45 pm	<b>Mr. Muhammad Adnan Sadique</b> National University of Sciences & Technology, Islamabad, Pakistan <i>Pre-harvest Spray of Boron (B), Zinc (Zn), and Potassium Nitrate (KNO<sub>3</sub>) to Improve the Fruit Quality of Guava cv. Gola</i>
01:45 pm - 02:00 pm	<b>Dr. Hasan Sardar</b> Department of Horticulture, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan <i>Effect of Melatonin on Growth, Yield, Physiological and Biochemical Properties of Broccoli (Brassica oleracea L.) under Salt Stress</i>
02:00 pm- 02:15 pm	<b>Dr. Muhammad Azher Nawaz</b> Department of Horticulture, College of Agriculture, University of Sargodha, <i>Development of Vegetable Grafting Technology in Pakistan; Some Recent Research Outcomes</i>
02:15pm- 02:30 pm	<b>Dr. Muhammad Shafique</b> UAF Sub Campus Burewala <i>Effect of Growing Media on the Growth, Yield and Quality of Containerized Chili (Capsicum annum L) Production Supplemented with K<sub>2</sub>SO<sub>4</sub> Foliar Application</i>
02:05pm- 02:20 pm	<b>Dr. Nida Firdous</b> Department of Food Science and Technology, MNS University of Agriculture, Multan. <i>Application of Aloe-vera Gel Based Edible Coating to Maintain Postharvest Quality of Tomatoes</i>
02:30 pm- 02:45 pm	<b>Dr. Muhammad Ahsan Qureshi</b> Department of Horticulture, College of Agriculture, University of Sargodha, Pakistan <i>Endogenous Growth Hormones and Leaf Gas Exchange Parameters of Kinnow Mandarin Influenced by Different Rootstocks</i>
02:35 pm- 02:50 pm	<b>Dr. Mehdi Maqbool</b> Assistant Professor, Department of Horticulture, University of Poonch, Rawalakot <i>Achieving Sustainable Nutrition With Research Value Chain Approach Under Changing Climatic Scenarios</i>





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02:50 pm- 03:05 pm	<b>Dr. Naseem Sharif</b> Horticultural Research Institute, Ayub Agricultural Research Institute, Faisalabad, <i>Morphological and Biochemical Diversity among Fifteen Jujube Cultivars of Sindh Province, Pakistan</i>
<b>Tea Break 03:05 pm to 03:20 pm</b>	

### Technical Session-V: Main Hall (Canopy)

Postharvest Handling and Management

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Prof. Dr Ahmad Sattar Khan, Director, Institute of Horticultural Sciences, UAF

**Co-chair:** Dr. Shaghef Ijaz, Department of Horticulture, BZU, Multan

**Moderator:** Dr Sami Ullah, MNS-UAM

**Zoom Link**

<https://us06web.zoom.us/j/87425182418?pwd=NWg1NjlQcklIYjJRYnV0elpKVHBBHQOT09>

Meeting ID: 874 2518 2418

Passcode: 022593

Time	Activity
03:20 pm - 03:45 pm	Online presentation <b>Prof Dr. Zora Singh</b> Edith Cowan University, Western Australia Vice-chair Division Tropical and Subtropical Fruit and Nuts <i>Future Drivers of Horticulture and Ensuring Global Food and Nutritional Security</i>
03:45 pm- 04:05 pm	<b>Prof. Dr. Giancarlo Colleli</b> Department of Science of Agriculture, Food, Natural resources and Engineering, University of Foggia, Italy Chair, Division Postharvest and Quality Assurance (ISHS) <i>Trends in Postharvest Handling of Fresh Fruit and Vegetable</i>
04:05 pm- 04:20 pm	Online presentation <b>Dr. Dalong Guao</b> Henan University of Science and Technology, China 'Folic acid delays postharvest quality deterioration of table grape'
04:20 pm- 04:35pm	<b>Prof. Dr Ahmad Sattar Khan</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan <i>Recent Advances in Postharvest Management of Litchi Fruit: An Overview</i>
04:35 pm- 04:50 pm	<b>Dr. Raheel Anwar</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan <i>Pre- and Postharvest Practices Improving Productivity and Storability of Strawberry Fruit</i>



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04:50 pm- 05:05 pm	<b>Dr. Ghulam Khaliq</b> Faculty of Agriculture, Lasbela University of Agriculture, Water and Marine Sciences, Uthal, Balochistan, Pakistan <i>Exogenous Melatonin Enhances Defence System and Maintains Quality of Apple Fruit during Storage</i>
05:05 pm- 05:20 pm	Online Presentation <b>Dr. Xiaoyang Zhu</b> South China Agricultural University, China <i>The Postharvest Regulation of Chilling Injury in Banana Fruit and the Possible Mechanism of Ripening Disorder Formation</i>
<b>Prayer Break and Poster Evaluation 05:20 pm to 05:30 pm</b>	

### Technical Session-VI: Room 110

Plant Protection and Stress Management

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Prof. Dr. Shafqat Saeed, Dean Faculty of Agriculture and Environmental Sciences,  
MNS-UAM

**Co-chair:** Prof. Dr. M. Ashfaq, Director Institute of Plant Protection, MNS-UAM

**Moderator:** Dr. Gulzar Akhtar, MNS-UAM

#### Zoom Link

<https://us02web.zoom.us/j/83968891082?pwd=ZmJicHovOFpQRjRuaFBGZFRRMlFkZz09>

Meeting ID: 839 6889 1082

Passcode: 007165

Time	Activity
03:20 pm - 03:35 pm	<b>Dr. Muhammad Saqib</b> Department of Horticulture, The University of Agriculture, Dera Ismail Khan, Pakistan. <i>Evaluation of Melatonin Supplementation in Cadmium Stressed Bell Pepper</i>
03:35 pm- 03:50 pm	<b>Dr. Arshad Javaid</b> Department of Plant Pathology, Faculty of Agricultural Sciences, University of the Punjab, Quaid-i-Azam Campus, Lahore 54590, Pakistan <i>'Stem Extract of Chenopodium Murale as a Source of Natural Fungicidal Compounds against Pathogen of Fusarium wilt of Tomato</i>
03:50 pm- 04:05 pm	<b>Mr. Attif Ramzan</b> Department of plant pathology, University of Agriculture Faisalabad, Pakistan <i>'Postharvest Shelf-life Extension of Guava by using HPMC (Hydroxypropyl Methyl Cellulose) Based Edible Coating'</i>
04:05 pm- 04:20 pm	<b>Dr. Asifa Hameed</b> Mango Research Institute, Multan, <i>Evaluation of Insecticides Residues in Mango Fruit</i>



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04:20 pm- 04:35 pm	<b>Dr. Muhammad Waqar Alam</b> Department of Plant Pathology, University of Okara <i>Combine Application of Essential Oils and Gum Arabic Coating Influences Postharvest Decay and Quality of Pomegranate Fruit during Cold Storage</i>
04:35 pm- 04:50 pm	<b>Mr. Muhammad Subhan Shafique</b> Department of Biological Sciences, University of Lethbridge, Lethbridge, ABT1K3M4, Alberta, Canada. <i>Molecular characterization of the Begomovirus causing chili leaf curl disease by targeting coat protein region of DNA-A component</i>
04:50 pm- 05:05 pm	<b>Dr. Rozina Aslam</b> Department of Biochemistry and Biotechnology, The Islamia University of Bahawalpur, Bahawalpur <i>Occurrence of Citrus Huanglongbing in Cholistan, Pakistan</i>
<b>Prayer Break and Poster Evaluation 05:05 pm to 05:30 pm</b>	

### Technical Session-VII: Room 132

Food Nutrition, Safety and Value Addition

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Prof. Dr. Umar Farooq, Chairman Department of Food Science and Technology, MNS-UAM

**Co-chair:** Dr. Zahoor Hussain, Department of Horticulture, Ghazi University, DG Khan

**Moderator:** Dr. Hafiz Nazar Faried, MNS-UAM

Time	Activity
03:20 pm - 03:35 pm	<b>Dr. Muhammad Amin</b> Department of Horticultural Sciences, FA&E, The Islamia University of Bahawalpur, Pakistan <i>Nutritional Functions in Olive Leaves</i>
03:35 pm- 03:50 pm	<b>Dr. Nighat</b> Department of Food Science and Technology, MNS- University of Agriculture, Multan <i>Jamun (Syzygium cumini) seed; antioxidant effect and its biological activities</i>
03:50 pm- 04:05 pm	<b>Dr. Ambreen Naz</b> Department of Food Science and Technology, MNS- University of Agriculture, Multan <i>Dried minor fruits based value-added nutritious bar</i>
04:05 pm- 04:20pm	<b>Mr. Muhammad Irfan</b> School of Food Science and Engineering, South China University of Technology, Guangzhou, 510641, China <i>Recent developments in microbial decontamination of fruits</i>



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	<i>and vegetables</i>
04:20 pm- 04:35 pm	<b>Ms. Umrah Zafar</b> Department of Food Science & Technology, MNS University of Agriculture, Multan, Pakistan <i>Role of nutraceuticals &amp; functional foods to control food crisis</i>
04:35 pm- 04:50 pm	<b>Dr. M. Azam</b> Institute of Horticultural Sciences, Faculty of Agriculture, University of Agriculture Faisalabad, Pakistan. <i>Influence of Pre-harvest Ginger Extract Application to Enhance the Postharvest Storage Fruit Quality Attributes of Papaya cv. Red Lady under Low Temperature Storage</i>
04:50 pm- 05:05 pm	<b>Ms. Misbah Sharif</b> Department of Food Science and Technology, MNS-University of Agriculture Multan. <i>Postharvest Management of Fruits and Vegetables: An Approach to Reduce Malnutrition and Ensure Food Security</i>
<b>Prayer Break and Poster Evaluation 05:05 pm to 05:30 pm</b>	

### Technical Session-VIII: Sybrid Room Block A

Horticulture Marketing, Entrepreneurship and Digitalization

**Thursday, 23<sup>rd</sup> February 2023**

**Chair:** Prof. Dr. Nasir Nadeem, Department of Agribusiness and Applied Economics, MNS-UAM

**Co-chair:** Dr. M. Usman, Associate Professor, Institute of Horticultural Sciences, UAF

**Moderator:** Ms. Anam Masood, MNS-UAM

Time	Activity
03:20 pm - 03:35 pm	<b>Mr. Rizwan Rafique</b> Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Punjab, Pakistan 46000 <i>'Performance Evaluation of STICS Crop Model for Simulating Grapevine Phenology and Yield under Pothwar Climatic Conditions'</i>
03:35 pm- 03:50 pm	<b>Mr. Abdullah Shafiq</b> Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Pakistan <i>Survey and Analysis of Postharvest Practices: A Case Study of Fruit Market, Islamabad</i>
03:50 pm- 04:05 pm	<b>Dr. Atiq Ahmad Alizai</b> Assistant Professor, Department of Horticulture Gomal University, DI Khan



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04:05 pm- 04:20pm	<b>Mr. Abid Ali</b> Department of Rural Sociology - University of Agriculture Faisalabad <i>Women' economic empowerment through value addition of agriculture and horticulture commodities</i>
04:20 pm- 04:35 pm	<b>Mr. Raja Muhammad Talah</b> Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Pakistan <i>Digital entrepreneurship: Way forward for Rising Unemployment</i>
04:35 pm- 04:50 pm	<b>Dr. Muqarab Ali</b> Department of Agronomy, MNS-University of Agriculture, Multan <i>Horticultural Crop Waste Composting: A Wise and Judicious Enterprise</i>
04:50 pm- 05:05 pm	<b>Mr. Abdullah Shafiq</b> Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, Pakistan <i>Survey and Analysis of Postharvest Practices: A Case Study of Fruit Market, Islamabad</i>
<b>Prayer Break and Poster Evaluation 05:05 pm to 05:30 pm</b>	

**Thursday, 23<sup>rd</sup> February 2023**

**Main Hall (Canopy)**

**PSHS General Body Annual Meeting**

<b>Time</b>	<b>Activity</b>
05:30 pm- 05:40 pm	Message from Gopal Prasad Shrestha, President Nepal Horticulture Society
05:40 pm- 06:20 pm	PSHS General Body Annual Meeting
07:00 pm- 08:00 pm	Cultural Night & Dinner

**Technical Session-IX: Main Hall (Canopy)**

**Horticultural Crop Management**

**Friday, 24<sup>th</sup> February 2023**

**Chair:** Prof. Ghulam Sarwar Markhand, Meritorious Professor, Shah Abdul Latif  
University, Khairpur, Pakistan.

**Co-chair:** Dr. Atiq Alizai, Department of Horticulture, Gomal University, DI Khan

**Moderator:** Dr Sami Ullah, MNS-UAM

**Zoom Link**

<https://us06web.zoom.us/j/87425182418?pwd=NWg1NjlQcklIYjJRYnV0elpKVHBBHQT09>

Meeting ID: 874 2518 2418

Passcode: 022593



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Time	Activity
09:00 am - 09:15 am	<b>Prof. Dr Jafar Jaskani</b> Director ORIC, University of Agriculture, Faisalabad, Pakistan <i>Pakistan Horticulture Industry: Current Status and Potential Future Interventions for Enhancing Competitiveness</i>
09:15 am - 09:30 am	<b>Prof Dr. Muhammad Azam Khan</b> Department of Horticulture, PMAS-Arid Agriculture University Rawalpindi, 46300, Pakistan <i>Adoption and Use of Precision Agriculture Technologies in Potato Production</i>
09:30 am - 09:45 am	<b>Dr. Muhammad Nafees</b> Department of Horticultural Sciences, Faculty of Agriculture & Environment, The Islamia University of Bahawalpur <i>IUB-Horticulture R&amp;D Activities: Past-Present and Future Prospects</i>
09:45 am - 10:00 am	<b>Dr. Syed Summar Abbas</b> Horticultural Genetic Resources Lab, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan <i>Uncovering Haplotype Diversity of Pakistani Date Palm Cultivars using DNA Barcoding</i>
10:00 am - 10:15 am	<b>Dr Sayed Esmail Emran</b> (Online Presentation) Forestry and Horticulture Department, Agriculture Faculty, Balkh University Mazar-e-Sharif, Afghanistan <i>Pomegranate Production in Afghanistan: Production Trends and Opportunities</i>
10:15 am - 10:35 am	<b>Prof. Ali Ahmed Ali Aioub</b> Faculty of Agriculture, Zagazig University, Egypt <i>Plant Growth Promoting Rhizobacteria (PGPR) and Role in Plant-parasitic Nematodes Control: A Fresh Look at an Old Issue</i>
10:35 am- 10:50 am	<b>Dr. Faiza Shafique Khan</b> Key Laboratory of Horticultural Plant Biology (Ministry of Education), College of Horticulture and Forestry Science, Huazhong Agricultural University, Wuhan 430070, China <i>Combined Role of Salicylic Acid and Drought Treatment in Sweet Orange Floral Induction</i>
10:50 am- 11:10 am	<b>Dr. Kirtsten Brandt</b> (Online presentation) New Castle University, UK <i>Role of Carrots in Relieving the Double Burden of Malnutrition and Cancer</i>
11:10 am- 11:30 am	Online presentation <b>Prof. KK Jindal</b> University of Horticulture & Forestry Solan, India



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	<i>Using Hi-Tech Horticulture as Modern Intervention for Mitigating Impact of Changing Climate on Productivity of Temperate Fruits- A Case Study of Apple in Indian Himalayas</i>
11:30 am- 11:45 am	<b>Mr. Fazli Wahab</b> PARC Social Sciences Research Institute, Tarnab, Peshawar <i>Assessment of Potato Crop in Project Area of Kurram and Orakzai, Merged Districts, Khyber Pakhtunkhwa, Pakistan</i>
<b>Lunch and Juma Prayer Break 12:30 pm to 02:00 pm</b>	

### Technical Session-X: Room 110

Crop Growth Regulation

**Friday, 24<sup>th</sup> February 2023**

**Chair:** Dr. Ejaz Hussain Shah, Director Potato Research Station, Sahiwal

**Co-chair:** Dr. Sajjad Hussain, Department of Horticulture, BZU, Multan

**Moderator:** Mr. M. Usman Khan, MNS-UAM

**Zoom Link**

<https://us02web.zoom.us/j/86709239711?pwd=cmNhMm44aXlIalE5Y1BScVIPVTOUT09>

Meeting ID: 867 0923 9711

Passcode: 196495

Time	Activity
09:00 am - 09:15 am	<b>Dr. Zahoor Hussain</b> Department of Horticulture, Ghazi University, DG Khan <i>Effect of Putrescine on Creasing, and Rind Textural Properties of Sweet Orange Fruit</i>
09:15 am - 09:30 am	<b>Dr. Muhammad Muzammil Jahangir</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan <i>Exogenous Application of Seaweed Extract Augments Production and Nutritional Profile of Oyster and King Oyster Mushrooms</i>
09:30 am - 09:50 am	<b>Dr. Sajid Ali</b> Assistant Professor Department of Horticulture BZU, Multan <i>Postharvest Application of Carboxymethyl Cellulose Edible Coating Delays Senescence and Maintains Quality of Pomegranate</i>
09:50 am - 10:10 am	Online Presentation Dr. Hao Lihong College of Horticulture, Hebei Agricultural University, Baoding, China <i>IBA Treatment Affects the Rooting Process in Dahlia pinnata Cuttings</i>
10:10 am - 10:25am	<b>Mr. Naveed Ahmad/Dr. Iftikhar Ahmad</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad-38040, Pakistan



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	Imported Soilless Substrates Crisis and Potential Indigenous Agro Industrial Wastes as Alternative Soilless Substrate for High Quality Containerized Plant Production
10:10 am - 10:30am	Online Presentation Dr. Sergey Oleichenko Kazakh National Agrarian University Kazakhstan <i>Features of cultivation and productivity sea buckthorn meadow garden Issyk Kul region Kirgizstan</i>
10:30 am - 10:45 am	<b>Ms. Fatma Bibi</b> Mango Research Institute Multan <i>Nutritional Enhancement of Zinc and Iron in Mango c.v. Sufaid Chaunsa through Foliar Application of Cysteine in Changing Climate</i>
10:45 am - 11:00 am	<b>Mr. Muhammad Usama</b> Institute of Horticultural Sciences, University of Agriculture, Faisalabad 38040, Pakistan <i>Biostimulants Improved the Reproductive Growth and Biochemical Characteristics of Mango (Mangifera indica L.) Cv. Samar Bahist Chaunsa</i>
11:00 am - 11:15 am	<b>Mr. Uzman Khalil</b> Department of Horticulture, MNS-University of Agriculture, Multan, Pakistan <i>Manipulation in Bunch Compactness of Table Grapes by Agronomic Approaches, Antitranspirant Application and Gibberellic Acid</i>
<b>Lunch and Juma Prayer Break 12:30 pm to 02:00 pm</b>	

**Friday, 24<sup>th</sup> February 2023**  
**Science for Farmers and Concluding Session**  
**Main Hall (Canopy)**  
**Zoom Link**

<https://us06web.zoom.us/j/87425182418?pwd=NWg1NjlQcklYjJRYnV0elpKVHBBHQT09>

Meeting ID: 874 2518 2418

Passcode: 022593

Time	Activity
02:00 pm- 02:10 pm	Qirat with translations
02:10 pm- 02:20 pm	Naat
02:20 pm- 02:40 pm	Welcome Address <b>Dr. Tanveer Ahmad</b> Chairman, Department of Horticulture, MNSUAM (Convener, Conference/President Pakistan Society for Horticultural Science)
02:40 pm-	<b>Panel Discussion</b>





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04:30 pm	<ol style="list-style-type: none"><li>1. Prof. Dr. Aman Ullah Malik Professor Institute of Horticultural Sciences UAF</li><li>2. Mr. Abdul Ghaffar Grewal Chief Scientist (Horticulture) Mango Research Institute Multan</li><li>3. Dr. Basharat Ali Saleem Deputy Director (Headquarters) Fruit and Vegetable Project Lahore</li><li>4. Mr Kashif Islam Progressive Farmer Lodhran</li><li>5. Dr Rashid Qureshi Progressive Farmer DG Khan</li></ol>
04:30 pm- 04:50 pm	Address of Chief Guest
04:50 pm- 05:05 pm	Conference Recommendations Prof. Dr. Amir Nawaz Khan Chairman, Department of Horticulture BZU, Multan
05:05 pm- 05:15 pm	Concluding Remarks Prof. Dr. Shafqat Saeed Dean FA & ES MNS University of Agriculture, Multan
05:15 pm- 05:25 pm	Shields Distributions
05:25 pm- 05:50 pm	Refreshment

### Tour Program Saturday, 25<sup>th</sup> February 2023

Time	Activity
10:00 am	Tour to Adnan Noman Farm Head Muhammad Wala, Multan, and City Tour



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## Conference Summary

Department of Horticulture, MNS University of Multan and Pakistan Society of horticultural Science jointly organized 7<sup>th</sup> International Horticulture Conference 2023 with the theme Sustainable Horticulture; *Challenges, Innovations and Adaptations*

**Total Abstracts Received: 210**

**Accepted: 208 (Oral presentations 85, Poster presentations 123)**

**10 Technical sessions** comprising of Nursery, Crop production, Breeding & Genetics, crop protection, postharvest handling and management, food safety and nutrition, marketing, women empowerment)

International speakers from 9 countries (Turkey, Egypt, Italy, Brazil, UK, China, Kazakhstan, Australia, India) shared R & D findings with the conference participants. 550 National and International participants from university, research, academia, extension, industry, and students from all provinces Punjab, KPK, Sindh, Baluchistan and AJK got registered for conference.

In this regard the following recommendation came out of the conference

### Key Recommendations:

1. Joint cross disciplinary R & D programs including breeding, biotechnology, value addition, mechanization, and protection.
2. Addressing the climate change related issues of horticulture (Soil, water, and atmosphere related stress)
3. Development and adaptations of precision horticulture related technologies with key focus on implementation of ICT, robotics, remote sensing etc.
4. Use of quality resources and inputs
5. Implementation of food safety and traceability systems from farm to fork.
6. Development, introduction, and adaptations of resistant germplasm
7. Exploring indigenous crop diversity in horticulture
8. Market development initiatives for profitability in horticultural value chain
9. Effective management of endogenous and external ethylene in fresh horticultural produce as it contributes to about 50% of total postharvest losses.



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10. Innovations in postharvest technologies (Non-destructive quality assessment tools, edible coatings, distributions systems etc.)
11. Market oriented commercial product development though prime focus on value addition
12. Development of technologies for value addition in horticultural waste
13. Facilitation of entrepreneurial models for horticulture business
14. Focus on product development and branding in horticulture.
15. Collaboration with national and international horticultural related R & D institution and industry
16. Modern production technology and interventions (Rooftop gardening, vertical gardening, Soilless culture, edible landscape, hydroponics)
17. Development of technologies for value addition in horticultural waste

### **Conclusion**

In conclusion, a comprehensive approach encompassing mitigating the adverse impact of future drivers of horticulture in pre-and postharvest phases, addressing issues of horticultural produce safety and minimizing quantitative and qualitative postharvest losses have balancing roles to feed the expanding world population.



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## **DATE PALM OF PAKISTAN AND CLIMATE CHANGE VULNERABILITY**

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### **Abstract**

The date palm industry in Pakistan besides facing many issues related to a poor management system, improper handling & traditional practices to government ignorance in updating the date palm sector and worldwide export with rightful price, is also influenced by global climate fluctuations. These changes are directly affecting the growing seasons, fruit-setting, and harvesting problems to date palm crop in Pakistan, especially Sind province. The study aimed to highlight the de facto situation of the date palm industry in Pakistan, especially in light of the climate change crisis with a detailed discussion regarding several opportunities such as the availability of abundant land for date palm cultivation, investment opportunities, offering a wide range of varieties, future potential of exotic varieties etc. The threats include international marketing competition, pest and pathogen issues, water shortage problems, and the developing Dates industry in the neighboring country which is our major Dates importer.

**Keynote Speaker**



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## **EFFECTS OF GLOBAL CLIMATE CHANGE ON TABLE GRAPE CULTIVATION**

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### **Abstract**

Climate change has many negative effects on the viticulture sector, as it does in all sectors. There is an urgent need to develop preventive/protective activities against these negative effects for all plant species in order to protect the increasing world population from being adversely affected by this. In particular, the most important effect of climate change is that increasing temperatures create significant abiotic stress on plants and this has negative effects on plant growth also fruit quality. The table grape industry is among the sectors that feel the negative effects of climate change the most, and this effect is increasing every year. Along with global warming, there are also important problems in accessing water. As a solution, there is a need to develop cultivars that are more resistant to drought stress and to make applications that will protect vine plants from heat stress. In recent years, global climate change has also shown its effect in the form of sudden climatic events (excessive precipitation, heavy wind, hail, etc.). In many countries where table grapes are grown, different covering systems to protect the grapevine plants and fruits on them against the increasing extreme weather and climate events/disasters have started to be used more areas. In addition, with the integration of smart agriculture and artificial intelligence applications into these systems, it has become possible to have prior knowledge and preventive action against many extreme weather events. In addition, with climate change, the area of influence of diseases in the grapevine plant has diversified and expanded. Disease agents have gained more immunity against the fungicides used. In this case, the most important issue to be done is to develop new cultivars that can withstand different stress conditions and to use them more in production. It is estimated that these new cultivars, which were developed especially by using the advantages of biotechnology, will soon constitute a large part of production. In addition, taking into account the increasing environmental and human health awareness, it is of great importance that all these are carried out in accordance with the sustainable agriculture model and the use of environmentally friendly cultivars in production.

Foreign Invited Speaker





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## POPULATION GENOMICS AND BREEDING OF GRAPEVINE

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### Abstract

The breeding of horticultural crops especially perennial fruit trees lags far behind annual cereals, largely due to the delayed application of new life-science technologies including genomics. Breeding 4.0 aimed to design the crop genomes by combining beneficial variants of the desired agronomic traits while purging deleterious variants. Breeding programs for maize, rice, and potato have been designed under this framework. However, the breeding of perennial fruit trees is still at an early stage of marker-assisted selection (breeding 2.0). Our investigation on population genetics of crop domestication revealed that the genomic breeding of fruit trees faces its unique difficulties. Comparing to annual cereals, perennial fruit trees have the most heterozygous genomes, largely due to clonal propagation, which hides deleterious variants, including structural variants, from the recessive selection. The breeding of clonal fruit trees requires a more thorough understanding of the genetics of heterozygous genomes because supergenes and regulation disorders might be the major causes of agronomic traits. Based on our population genetic and quantitative genetic studies of beneficial, deleterious, and structural variants in grapevine, breeding programs were proposed by a combination of population genetic simulations.

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## **TRENDS IN POSTHARVEST HANDLING OF FRESH FRUIT AND VEGETABLES**

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### **Abstract**

According to FAO analysis the current trend in population growth is faster than the trend in food supply and production. Moreover, food losses are estimated to be as high as 30% with fresh fruit and vegetable representing more than 60% of these losses. As they are perishable living products they need proper handling and storage in order to avoid losses and decrease in quality which, in turn, leads to waste. In addition fresh fruit and vegetables are a major source of biologically active compounds essential for human wellbeing, which makes losses even more costly. While appropriate temperature and RH% management are of paramount importance in extending postharvest life and maintain product quality, there are a number of innovations which have been developed, and in some cases applied, in the last few years, that might strongly improve postharvest handling and distribution of fresh commodities, including physical and biological control of postharvest diseases, edible coatings, new strategies for atmosphere modification, application of predictive modeling, technologies for high-convenience products, and non-destructive quality assessment, just to mention some of them. In the present talk the potential application of some of these technologies will be discussed starting from experimental evidences obtained in international laboratories with particular reference to the work carried out by the Research Unit on Postharvest Technology at the University of Foggia, Italy, within national and international projects. In addition, potential for international collaboration on topics related to postharvest technology will be considered.

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## **FOLIC ACID DELAYS POSTHARVEST QUALITY DETERIORATION OF TABLE GRAPE**

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### **Abstract**

Grape (*Vitis vinifera* L.) berries are susceptible to quality deterioration after harvest. This study aimed to investigate the effect of folic acid (FA) treatment on the postharvest quality of table grape berries. Harvested 'Kyoho' (*V. vinifera* × *V. labrusca* L.) bunches were immersed in 1 mg L<sup>-1</sup> FA solution for 15 min, then stored for sample collection and phenotype observation. Treatment with FA decreased the rates of berry abscission, water loss, and berry softening, reduced the accumulation of reactive oxygen species (ROS), and altered ROS metabolism associated enzyme activities and gene expression levels. Transcriptome analysis revealed 507, 684, and 250 differentially expressed genes (DEGs) between FA-treated and non-treated berries at 3, 6, and 9 d after treatment, respectively. The DEGs were grouped into six modules according to a weighted correlation network analysis. A hub transcription factor, annotated as a WRKY transcription factor, was screened from the module associated with cell wall metabolism and identified as VvWRKY31. Transient transformation of grape berry slices revealed that overexpression of VvWRKY31 enhanced the relative expression level of VvRboh. The dual-luciferase assay showed that VvWRKY31 was capable of binding to VvRboh promoter. The present results provide insights into the potential molecular mechanism underlying FA-induced delay postharvest quality deterioration of grape berries. Specifically, FA inhibits expression of genes associated with ROS generation by reducing VvWRKY31 expression, thereby delaying quality deterioration induced by excessive accumulation of ROS. These results will be helpful in table grape breeding programs focused on delaying deterioration in postharvest quality.



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## **THE POSTHARVEST REGULATION OF CHILLING INJURY IN BANANA FRUIT AND THE POSSIBLE MECHANISM OF RIPENING DISORDER FORMATION**

Zunyang Song<sup>1</sup>, Jiajia Qin<sup>1</sup>, Tongxin Liu<sup>1</sup>, Xuanwen Hou<sup>1</sup>, Weixin Chen<sup>1</sup>, Wangjin Lu<sup>1</sup>,  
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### **Abstract**

Banana is sensitive to low temperature and easy to be subjected to chilling injury, which causes adverse effects on the fruit quality. The appropriate temperature is 11°C~13°C for banana fruit storage and transportation, and chilling injury may easily occur if the temperature is lower than 11°C, which would seriously influence fruit appearance and quality, resulting in great economic losses. In the present work, the effects of various of cold-resistant agents on banana fruit chilling injury were investigated, and the suitable methods to effectively delay and reduce the chilling injury were screened out. We further analyzed the ripening disorder caused by chilling storage. We found that cold stress severely inhibits the transcript and protein levels of EBF1, ABI5-like, and fruit softening-related genes. The ABI5-like protein binds to the promoters of key starch and cell wall degradation-related genes such as BAM8, PL8, and XYL23-like and activates their activities. EBF1 physically interacts with ABI5-like and enhances the transcriptional activity of the key starch and cell wall degradation-related genes but does not ubiquitinate and degrade ABI5-like protein. This promotes fruit ripening and ameliorates fruit chilling injury in a manner similar to the effect of exogenous abscisic acid (ABA) treatment. The ectopic and transient overexpression of EBF1 and ABI5-like genes in tomato and Fenjiao banana accelerated fruit ripening and softening by promoting ethylene production, starch and cell wall degradation, and decreasing fruit firmness. EBF1 interacts with EIL4 but does not ubiquitinate and degrade EIL4, which is inconsistent with the typical role of EBF1/2 as demonstrated in Arabidopsis. The present work provides technical guidance and theoretical support for low-temperature storage of bananas.



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**PLANT GROWTH PROMOTING RHIZOBACTERIA (PGPR) AND  
THEIR ROLE IN PLANT-PARASITIC NEMATODES  
CONTROL: A FRESH LOOK AT AN OLD ISSUE**

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## Abstract

The increasing demand for agricultural products can be met by maximizing production potential and reducing crop losses caused by common plant-parasitic nematodes. Chemical-based nematode management is a successful technique for mitigating damage and yield losses caused by nematode pests; however, inappropriate and irresponsible application of synthetic pesticides has negative impacts on fauna, bioflora, and natural enemies such as predators and parasites. The use of biocontrol agents is the most appreciated method for nematode control among farmers because it's safe and reduces environmental pollution. There is increasing focus on the biological control of plant-parasitic nematodes using plant growth-promoting rhizobacteria (PGPR) as a biopesticide. Moreover, PGPR strains can promote plant growth by producing various secondary metabolites of these PGPRs. This review focuses on the direct (Nitrogen fixation, phytohormone formation, phosphate solubilization, Potassium solubilization, siderophores and ammonia production) and indirect mechanisms (Hyperparasitism, antibiosis, lytic enzyme production, induced systemic resistance) of action of PGPR in plant-parasitic nematodes management, and the future prospects of PGPR-based plant-parasitic nematodes biocontrol agents.

Foreign Invited Speaker



## **IBA TREATMENT AFFECTS THE ROOTING PROCESS IN DAHLIA PINNATA CUTTINGS**

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### **Abstract**

Dahlia pinnata is an important ornamental plant, but the physiological mechanism of its rooting is still unclear. In order to study the morphological characteristics and physio-biochemical changes in *D. pinnata* cuttings during the rooting process. The cuttings of the variety were treated with 1000 mg/L IBA, and distilled water was used as the control. The morphological changes during rooting were observed and the dynamic changes of related nutrients, oxidase activity, and malondialdehyde were determined. The results showed that the rooting type of *D. pinnata* belongs to the callus rooting type, and the main rooting stages can be divided into the callus induction period (0~10d), adventitious root expression period (11~20 d), and adventitious root extension period (21 ~ 30 d). In the process of cutting rooting, the content of soluble sugar showed an overall trend of the content of starch showed an overall fluctuating downward trend, and the content of soluble protein showed an overall trend of & The activity of IAAO (Indole-3-acetic acid oxidase) and POD (Peroxidase) and the changing trend of MDA (Malondialdehyde) content were the same and the changing trend of PPO (Poly Phenolic Oxidase) was consistent with SOD (Superoxide dismutase) activity; results indicated that IBA treatment could promote the formation and development of adventitious roots, and accelerate the metabolism of soluble sugar and starch hydrolysis. Further, it can promote the synthesis and accumulation of soluble protein, provide energy and nutrition for the formation and growth of adventitious roots, and increase the activity of IAAO, POD, PPO, and SOD. Integration of all these changes leads to the promotion of rooting activity. Our study provides novel information about the roles of IBA in the rooting process of *Dahlia pinnata* cuttings.



**FEATERS OF CULTIVATION AND PRODUCTIVITY SEA  
BUCKTHORN MEADOW GARDEN ISSYK KUL REGION  
KIRGIZSTAN**

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## Abstract

Wild sea buckthorn is one of the dominants of the IssykKul region. It is distinguished here by significant polymorphism and stable fruiting. Moreover, massive damage to it by pathogenic organisms is observed here to an insignificant extent. In Issykul, since the end of August, harvesting of sea buckthorn has been carried out for the sale of fruits on the local market and in neighboring republics, Kazakhstan and Uzbekistan. The climate of the Issyk-Kul region, especially its coastal part, is favorable for the majority of berries. It is characterized by mildness and the absence of frost. The plantation cultivation of sea buckthorn was restrained due to the circumference of the species and, as a result, problems with harvesting. Altai varieties, especially of the latest generation, allow us to solve this problem however not completely. The problem was solved with the help of the introduction of a promising Kazakh development of. The basics of the technology were developed in 2000 and improved in recent years. Its essence lies in the highly concentrated planting of thornless, large-fruited varieties of Altai breeding, low-cost care of plantings involving the use of mulching films. optimization of the water-nutrient regime with the help of drip irrigation, fertigation and leaf fertilizing with new types of fertilizers and biostimulators. But its main difference is mowing the aboveground part together with the harvest and separating it permanently in the traditional way or with the help of shock freezing, which increases labor productivity by 7-10 times at the harvest. Frozen fruits are shaken off the branches, collected and delivered to the processing sites in this form, i.e. spoilage and damage to the fruits during transportation is excluded. The report presents the results of the study of 4 varieties of sea buckthorn Elizabeth (K), 2. Athena, 3. Inya, 4. Etna grown using meadow garden technology scheme 80 x 30 cm, 40 thousand plant/ha, 6% of pollinators; on a plantation laid in 2019 and yielding a harvest in 2021. A comparative agro-economic assessment of the advantage of meadow garden over traditional technologies is also given 2. Traditional- 4 x 2 m, 1250 plant/ha; 3. Traditional intensive - 3 x 1 m, 3333 plant/ha. The place of research is the coastal part of Lake Issykul, Karakol, Kyrgyzstan. The advantage of meadow garden technology over traditional technologies is unequivocal. At the same time, the profitability of this development increases 3.6-6.1 times during the five-year technological cycle, and the cost of production decreases 1.6-1.9 times, respectively. The cultivation of promising varieties of sea buckthorn using meadow garden technology allows achieving high profitability, reaching more than 30 thousand \$/ha. According to the complex of economically useful features, two varieties of Athena and Yin with fruits of an average weight of 1 g and a yield of 40 t /ha were identified. It should also be noted that on the plantation laid in 2020 with higher-quality seedlings, plant development was much better, and the yield reached 50 t/ha. Thanks to this study and demonstration of the results obtained to Kyrgyz and Kazakh farmers, many of them plan to plant sea buckthorn using meadow garden technology in their farms.



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## **ACHIEVING SUSTAINABLE NUTRITION WITH RESEARCH VALUE CHAIN APPROACH UNDER CHANGING CLIMATIC SCENARIOS**

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### **Abstract**

A constant increase in world's population, novel economic and political pressures, competition for land and water and the double burden of malnutrition i.e., under-nutrition and over-nutrition are serious challenges to be addressed. Lack of dietary diversity and dependency on only few crops for food and feed purposes is a great challenge too. The changing climatic scenarios are also seriously affecting the sustainable food supply systems. Moreover, problems with production and distribution of food are also causing serious postharvest physical and nutritional losses along the chain. Though there could be many solutions to address these acute problems. However, the use of underutilized fruit species could be the sensible approach if their potential is exploited through breeding, production, agro-processing and marketing. Numerous underutilized fruit species worldwide have been reported to be rich in vitamins, minerals and other micronutrients, suggesting that they have the potential to play a role in addressing the major problem of malnutrition. Using indigenous underutilized fruit species to address these acute problems could be the cheapest and sustainable solution for local as well as global communities. However, to unlock the full potential of these naturally grown underutilized fruit species, many barriers exist. These barriers include non-availability of nutritional information and non-existence of proper supply chain systems. To achieve that, a demand led research across the whole value chain is needed. Further efforts are also required to establish certified nurseries, small scale value addition units and a proper supply chain system for these fruit species.

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## **RECENT ADVANCES IN POSTHARVEST MANAGEMENT OF LITCHI FRUIT: AN OVERVIEW**

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### **Abstract**

Litchi is one of the well-known fruits being cultivated in the tropical and subtropical regions around the globe. In recent years, due to pleasant flavour, high nutritional and health promoting benefits this fruit has gained consumer demand throughout the world. At present, litchi is an underutilized but potential emerging fruit crop of Pakistan which is getting enormous popularity among the growers and consumers in the country. Due to high perishability, it exhibits short postharvest shelf and storage life after harvest. Fruits lose their cosmetic quality and turns rapidly brown after harvest which limits their market window. Postharvest pericarp browning is most leading problem badly affecting the fruit quality and impeding its market potential. In past, various preharvest (cultivar, location of cultivation, maturity stage, use of chemicals) and postharvest strategies [edible coatings, cold storage, controlled atmosphere storage, various modified atmosphere packaging, heat treatments, use of hydro colling, gamma radiations, application of various chemical (1-MCP, salicylic acid, amino acids, oxalic acid, ascorbic acid, chitosan, melatonin, kojic acid and hexanal etc.)] have been used to manage overall quality and reduce pericarp browning in litchi fruits with inconclusive and sporadic results, as the effect may vary with variety, maturity stage, concentration of chemicals, and handling conditions. Therefore, at present scientists are still exploring some innovative, environmentally friendly, and safe techniques to manage postharvest issues of litchi fruits. This paper describes the recent developments in the postharvest storage life and quality management of litchi fruit.



## **EFFECT OF PUTRESCINE ON CREASING, AND RIND TEXTURAL PROPERTIES OF SWEET ORANGE FRUIT**

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### **Abstract**

Albedo tissue of sweet orange fruit rind is prone to fracturing and known as creasing (albedo breakdown) and causes substantial economic losses to the growers in the world. The effects of putrescine (PUT) spray application on incidence of creasing, rheological properties of the rind and fruit quality in sweet orange cv. Washington Navel and Lane Late were investigated in two consecutive seasons during 2010-2011 and 2011-2012. Exogenous spray application of PUT (0, 100, 250, 500, 1000  $\mu$ M) was applied at fruit set, golf ball or colour break stage in both cultivars of sweet orange. Thirty-five ripe fruit per tree were harvested randomly around the tree canopy to determine the incidence of creasing, textural properties of the rind and fruit quality. The exogenous spray application of PUT (1000  $\mu$ M) at the golf ball stage resulted a substantial reduction of creasing (22.10 and 24.29%) in cv. Washington Navel and (23.57 and 22.86%) Lane Late during 2011 and 2012, respectively. However, the treatment PUT (1000  $\mu$ M) was more effective to improve fruit firmness (379.89 N), rind hardness (30.82 N), rind tensile strength (76.60, N). In conclusion, a substantial reduction in-creasing and improvement in the fruit quality of sweet orange cv. Washington Navel and Lane Late with exogenous application of PUT (1000  $\mu$ M) suggests the involvement of polyamines in-creasing and fruit quality of sweet orange fruit.



## **ADOPTION AND USE OF PRECISION AGRICULTURE TECHNOLOGIES IN POTATO PRODUCTION**

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### **Abstract**

Precision agriculture (PA) is a cutting-edge technology to increase the productivity of crops in an environmentally responsible and economically viable manner. Cash crops such as potatoes (*Solanum tuberosum* L.) are suitable for the implementation of PA because potatoes require high agrochemical and nutrient inputs, and to reduce the cost of production without compromising quality and yield potential. Crop protection and health monitoring using different sensors (proximal and remote sensors) and variable rate applications are widely adopted PA techniques. Identification and characterization of growth parameters and yield limiting factors due to soil variability is an important aspect to implement PA in potatoes. Therefore, the study was designed to evaluate the combined impacts of soil variability, proximal sensors, variable rate and spot specific spraying systems, and smart irrigation systems on potato production systems. To identify these variability patterns, grids were made in the potato field to collect soil samples and these samples were analyzed for soil properties such as Nitrogen, Potassium, Phosphorus, Electrical conductivity, and pH. Based on soil characteristics, interpolated maps were generated and Geostatistical analyses were performed in ArcGIS 10.8 to find the spatial relationships between soil and crop parameters to identify yield-limiting factors. Multiple regression and cluster analysis were performed on the relationship between yield and soil properties to make management zones. Variable rate fertilization on the basis of these variabilities and management zones can increase nutrient uptake and crop yield and reduces the cost of production as well. Crop health can be monitored using thermal and multispectral cameras mounted on an unmanned aerial vehicle (UAV). Multispectral and hyperthermal images could help to evaluate soil productivity, water stress and plant health that can be overlooked in the visual assessment of soil and crop health by naked eye. Unmanned aerial vehicle spraying systems (UAVSS) can be a suitable alternative to the conventional knapsack sprayers. UAVSS reduce the cost of production as it requires less time to cover more acreage as compared to knapsack sprayers. UAVSS is effective to control the emergence of weeds and different diseases because of uniform distribution of droplets. The preliminary results suggested that the PA technologies can enhance farm productivity, profitability and reduce the negative effect of agricultural practices on the environment by lowering labor and input costs.



## PERFORMANCE EVALUATION OF STICS CROP MODEL FOR SIMULATING GRAPE VINE PHENOLOGY AND YIELD UNDER POTHWAR CLIMATIC CONDITIONS

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### Abstract

Exploring the possibility of early prediction of phenological timings and yield of table grape cultivars has huge socio-economic benefits for the growers. The objective of this study was to calibrate and evaluate the ability of STICS model to simulate four table grape cultivars under the agro-climatic conditions of Pothwar region in northern part of Punjab, Pakistan. For this, phenological responses growth and yield of four table grape cultivars i.e., King ' s Ruby, Sugra one, Perlette, and NARC Black were evaluated at Barakahu, Islam- abad and Chakwal for two consecutive vintages of 2019 and 2020. Daily weather data, soil characteristics, genotype and crop specific data were recorded for model calibration. The result indicate that STICS is a robust model for simulating phenology and yield of table grape cultivars. The model also provided an efficient decision support tool (DST) though crucial predictions for viticulture industry. For instance, it indicated 8-13 days early maturity, 24 % higher yield for the relatively colder location i.e., Islamabad compared to Chakwal. Among cultivars, cv. Sugra One has higher yield compared to other cultivars i.e., 11%, 28% and 49 % higher than cvs. King ' s Ruby, NARC Black and Perlette, respectively. Furthermore, high skill scores of STICS crop model were found for predicting vine phenology e.g., model efficiency (ME) 0.73-0.95 with a prediction variability up to 04 days, for yield and pruning weight, ME was also higher i.e., 0.94 and 0.92 respectively. Moreover, STICS simulations provided valuable insight in timely planning vineyards operations such as pruning, fertilization, and spray scheduling.



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## COMBINED ROLE OF SALICYLIC ACID AND DROUGHT TREATMENT IN SWEET ORANGE FLORAL INDUCTION

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### Abstract

Floral initiation is an acute switching of the vegetative to reproductive phase by external cues and endogenous signals. Salicylic acid (SA) is a phytohormone that plays a key role in abiotic stress tolerance, stress induced floral initiation, and plant growth. In recent years, various studies have reported that SA induces tolerance and growth in woody trees. While citrus flowering is mainly regulated by drought stress. However, little is known about the intricate regulatory networks involved in SA+drought (DR) condition in sweet orange. To understand the molecular mechanism of floral initiation in sweet orange under SA+DR (SD) condition flower induction was performed on potted *Citrus sinensis* trees, and pots were divided into four groups with five replicates. Groups of pots were; well-watered, drought treatment (DR), SA treatment+well-watered (SA), SA treatment+drought (SD). Physiological analysis revealed that SA treatment significantly normalized the drastic effect of drought stress by increasing antioxidant enzyme activity (SOD, POD, and CAT), relative leaf water content, total chlorophyll, and proline. In transcriptomic studies, some key flowering genes were more highly expressed in SD plants than in DR-treated plants. GO enrichment revealed that SA treatment enhances the regulation and growth of meristem activity under drought conditions. In addition, a citrus LIPOYL- TRANSFERSAE 2A homologous (LIP2A) gene was upregulated by SD treatment. Ectopic expression of CsLIP2A exhibited early flowering in transgenic *Arabidopsis*. In summary, this study opens new vistas of research not only in the citrus family but also in other woody plants requiring early floral induction.



## CYCLIC AND BLENDED WASTEWATER IRRIGATION EFFECTS ON SOIL PROPERTIES AND GROWTH CHARACTERISTICS OF CAULIFLOWER (*Brassica oleracea*) AND TOMATO (*Solanum lycopersicum*)

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### Abstract

Wastewater has high amounts of nutrients that are useful for plant growth and development. Additionally, wastewater may contain salts and heavy metals to produce adverse effects on crop productivity. The objective of the current study was to investigate the effect of cyclic and blended use of wastewater on the growth and yield characteristics of vegetables tomato and cauliflower. The treatments of this research were T1: wastewater: groundwater in the ratio 0: 100 (control); T2: 100: 0; T3: 75: 25; T4: 50: 50; T5: 25: 75; T6: cyclic use of wastewater and groundwater under completely randomized design with five replications. Cauliflower was sown in the same pots after harvesting tomato plants. Results revealed that by wastewater irrigation in blend- ed and cyclic use, the growth and yield of tomato and cauliflower were greatly affected. Maximum tomato fruit yield of 229.07 g was found at a 50: 50 ratios followed by 189.17 g with 100: 0, 176.3 g with 0: 100, 137.18 g with 75: 25, 135.9 g with 25: 75, and 115.3 g with cyclic use of wastewater and groundwater. Cyclic and blended use of wastewater and groundwater in different ratios significantly ( $p \leq 0.05$ ) affected nutrient content in tomato fruits and shoots, with maximum accumulation at 50: 50 wastewater: groundwater ratio while the minimum at 0: 100 ratios. Wastewater irrigation increased metals accumulation in tomato plants, with lead (Pb) from 0.05-0.448 mg g<sup>-1</sup> in fruits, 0.003-0.594 mg g<sup>-1</sup> in shoots, 0.005-0.666 mg g<sup>-1</sup> in roots, copper (Cu) 0.004-0.478 mg g<sup>-1</sup> in fruits, 0.008-0.614 mg g<sup>-1</sup> in shoots, 0.010-0.871 mg g<sup>-1</sup> in roots, nickel (Ni) 0.010-0.483 mg g<sup>-1</sup> in fruits, 0.012-0.609 mg g<sup>-1</sup> in shoots, 0.021-0.847 mg g<sup>-1</sup> in roots, and cadmium (Cd) 0.005-0.077 mg g<sup>-1</sup> in fruits, 0.007-0.084 mg g<sup>-1</sup> in shoots and 0.009-0.095 mg g<sup>-1</sup> in roots with the use of wastewater and groundwater in different ratios. In the case of cauliflower, a maximum yield of 730.50 g was found at 50: 50 wastewater: groundwater ratio, followed by 602.55 g at 0: 100 ratio, 535.83 g at 75: 25 ratio, 524.61 g at cyclic use of wastewater, and groundwater, 517.50 g at 25: 75 ratio, and 496.0 g at 100: 0 ratio. Cyclic and blended use of wastewater and groundwater also markedly affected the nitrogen (N), phosphorus (P) and potassium (K) contents as well as Pb, Cu, Ni, and Cd in different plant parts of cauliflower. In conclusion, wastewater could supplement the irrigation water by using it in cyclic and blended forms. Blending at 50: 50 wastewater: groundwater ratio proved most efficient to produce maximum yield, with minimum metals accumulation in plants.



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## **THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON HORTICULTURE IN THE LOWLYING AREA OF THE MOUNTAINOUS REGION OF PAKISTAN**

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### **Abstract**

The impacts of climate change are a hotly discussed topic in the Himalayas, with the major concern being the availability of water supplies for the lowland population. Climate Change's effects might manifest themselves in a variety of ways. Increased snowfall and quick melting may favor the likelihood of flash floods. A flood is one of the most natural disasters. Losses due to flooding have significantly increased in the world. In Pakistan, the summer season becomes hotter due to climate change hence it experiences frequently floods of high magnitude and thus the number of affected populations and economic losses has increased accordingly. The northern areas of Pakistan which consist of the number of Glaciers and Glacier Lakes are the cause of more variability in river flows, with significant differences between valley bottoms (1700 m) and high, glaciated peaks (7000 m). Whereas the rest of the seasons in Pakistan when there is no significant rainfall or snowmelt, the river discharge sharply declined which causes drought. These threats will together have an impact on irrigation canals and fields, new infrastructure, and the related developing communities. The study indicates that climate change has the worst impact on horticulture, either there is a flood or drought.



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**AN INTEGRATED STUDY QUANTIFYING THE CONCENTRATION OF HEAVY METALS AND POTENTIAL HEALTH CONCERNS IN OKRA (*Abelmoschus esculentus* L.) AND SPINACH (*Spinacia oleracea* L.) GROWN WITH THE AID OF WASTEWATER.**

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## Abstract

The buildup of heavy metals is a significant issue in Pakistan where wastewater is commonly used for crop irrigation. The aim of this research was to investigate the presence of hazardous elements such as lead (Pb), chromium (Cr) and cadmium (Cd) in water, agricultural soil, and crops, as well as their potential impact on human well-being. The samples were tested to determine their physicochemical parameters which included electrical conductivity, organic carbon, pH and organic matter. Additionally, the water utilized for irrigation and samples of vegetables (okra, spinach) were analyzed to measure the concentration of Pb, Cr and Cd, as well as the transfer factor from soil to plants (TF), in order to calculate the daily intake of metals (DIM) and their corresponding health risk index (HRI). According to the findings, the irrigation wastewater was tainted with Pb (0.38mg/kg), Cr (0.07mg/kg) and Cd (0.054mg/kg). The tubewell exhibited heavy metal concentrations of Pb (0.01mg/kg), Cr (0.053mg/kg) and Cd (0.03mg/kg). The utilization of wastewater led to a rise in heavy metal levels in the soil, okra and spinach. The heavy metal concentrations in the soil irrigated with wastewater prior to planting vegetables were Pb (0.91), Cr (0.48) and Cd (0.12) in mg/kg. Research indicates that the contamination of food crops by these metals poses a significant health risk to humans and animals, as the risk index is high.





## **HIGH-EFFICIENCY IRRIGATION SYSTEMS IMPROVE THE FRUIT QUALITY AND YIELD IN MANGO (*Mangifera indica* L.)**

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### **Abstract**

Water, energy, food, agriculture, and climate connection is important and complicated. The dramatic change in climate has depleted the water sources and affected the quality and yield of fruit plants. The decline in the quality and yield of fruits is a serious threat to developing countries like Pakistan. To overcome the issues of drought there is an increasing trend of adapting high-efficiency irrigation systems (HEIS) to increase the quality and yield of agronomic and horticultural crops. Jaffer Agro Services has introduced the concept of HEIS in Pakistan and has installed different HEIS in different crops, especially in fruit crops. The replacement of conventional flood irrigation system with drip irrigation system (multiple emitting systems; Drippers, Bubblers) in mango orchards significantly affected fruit quality and yield. The data was collected from 10 mango fruit farms including 5 from Multan and 5 from Sukkur. Plants irrigated with a drip irrigation system showed uniform vegetative growth. HEIS significantly increased farmers' profitability by increasing the uniformity of fruit size, increase in yield (20%), water savings (30%), reduction in fertilizer usage (34%), and decrease in labor cost (40%). Moreover, it also reduced the chances of disease incidence especially, root diseases. We surmise that HEIS can play a significant role in increasing farmers' profitability and enhancing the export of horticulture commodities.



## **EFFECTS OF DIFFERENT GROWTH HORMONE COMBINATIONS FOR RAPID IN VITRO PLANT REGENERATION OF TOMATO PLANT**

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### **Abstract**

Tomato is listed among one of the most important vegetable crops of the world. The present study was conducted to evaluate an effective regeneration system in two tomato cultivars *Solanum lycopersicum* cv. Micro Tom and *Solanum pimpinellifolium* line WVa700 using different growth regulators. The seeds were cultured on MS medium containing different concentrations of plant growth regulators.  $\alpha$ -naphthaleneacetic acid (NAA) and benzylaminopurine (BAP) were used in this experiment and data were analyzed using standard statistical techniques. Results revealed that maximum plant height, plant fresh and dry weight, number of leaves per plant, number of roots, number of shoots, root length, root fresh and dry weight was observed in the media having 1 ppm BAP + 0.50 ppm NAA. However maximum chlorophyll contents SPAD, chlorophyll a, chlorophyll b and total chlorophyll were observed in the seeds treated with 2 ppm BAP + 0.50 ppm NAA. Overall results suggested that application of 1 ppm BAP + 0.50 ppm NAA was more suitable for in vitro regeneration, proper growth, and development of tomato plants.



## **IN VITRO REGENERATION OF CHRYSANTHEMUM (*Dendranthema morifolium* L.) AS INFLUENCED BY PLANT GROWTH REGULATORS**

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### **Abstract**

A set of experiments were conducted to check the in vitro regeneration response of Chrysanthemum leaf discs as influenced by the various applications of BAP and IAA alone or in combination. The results showed that MS media supplemented with various concentrations of BAP and IAA singly or in combinations, significantly affected the in vitro shoot multiplication in Chrysanthemum leaf disc. Least IAA concentration (0.1 mg/l) excelled all the other treatments (0.0, 0.3 & 0.5 mg/l IAA), when used alone, as it produced earliest shoot initiation, maximum shoot initiation percentage, shoot /explant, shoot length, number of leaves & nodes. Amongst the various BAP concentrations (0.0, 0.5, 1.0 & 2.0 mg/l) used, intermediate BAP (1.0 mg/l) concentration showed its supremacy amongst all the other treatments, as it significantly took least (5.0) days to shoot initiation, maximum shoot initiation %age, shoot/explant, shoot length, number of leaves & nodes/shoot. As far as the combination of IAA & BAP is concerned, MS media was supplemented with lower concentrations of IAA (0.1 and 0.2 mg/l) along with intermediate concentrations of BAP (1.0 and 2.0 mg/l) showed significantly better results, as compared to all the other combinations used, regarding the in vitro regeneration of chrysanthemum plantlets. Rooting of chrysanthemum micro- shoots were enhanced, when ½ strength MS media was supplemented with 0.2 mg/l IBA.



## **IN VITRO PROPAGATION OF TURMERIC FOR QUALITY PLANTING MATERIAL**

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### **Abstract**

Turmeric is mainly cultivated through seed derived rhizomes which have slow vegetative growth and frequently transmits fungal and bacterial diseases over generations. Micropropagation and microrhizome induction in turmeric paves a way to circumvent these limitations and provide a promising source for production of healthy plant material with increased quality attributes. Present research study is an attempt towards the micro-propagation and microrhizome induction in turmeric to improve its production in Pakistan. In vitro cultures of turmeric were established by using explants sterilized with mancozeb and sodium hypochlorite for the eradication of pathogens. Shoots were cultured on shoot proliferation media supplemented with various concentrations of BAP alone or in combination with NAA. Among different concentrations of BAP, 4 mg/L BAP gives average 6-8 shoots per explant with a shoot length of 2.5-3.6 cm and emerge 4.0-5.0 expanded leaves per shoot within 8 weeks. Whereas combination of 4 mg/L BAP and 0.25 mg/L of NAA yields 5 number of shoots while 12 leaves per shoot were observed at 1 mg/L BAP and NAA each. BAP alone did not produce microrhizomes but in combination with NAA at 1 mg/L each induced 1.38 microrhizomes per explant with 2-3 buds and 0.22 g fresh weight.



## **OPTIMIZING MICROPROPAGATION AND REGENERATION PROTOCOLS FOR MASS PROPAGATION OF *Gerbera jamesonii***

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### **Abstract**

A study was conducted to develop optimal protocols for mass propagation of *Gerbera jamesonii* at Plant Tissue Culture Cell, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Recently matured healthy gerbera petioles were detached from the pot-grown plants from a greenhouse to be used as explant and brought to laboratory within 1 hour of detachment where sterilization was carried out using 70% alcohol plus 10% bleach followed by rinsing with autoclaved water. Afterwards, petioles were cultured on MS medium supplemented with various concentrations of 6-Benzylaminopurine and 2, 4- Dichlorophenoxy- acetic acid for callus formation. These calli were further cultured on MS medium supplemented with different combinations of 1-Nephtaleneacetic acid (NAA) and 6-Benzylaminopurine (BAP) for regeneration purpose. The results demonstrated that highest callus formation (80%) from explants was recorded when 2.0 mg L<sup>-1</sup> BAP was used followed by 3.0 mg L<sup>-1</sup> BAP with 76.7% of explants responding with successful callogenesis. Calli produced with 2, 4-D were friable, while BAP produced compact calli. Friable calli of gerbera derived using 2, 4-D recorded no organogenesis after shifting to MS medium supplemented with BAP and NAA. Regeneration of shoots in compact calli was highest when supplemented with 3.0 mg L<sup>-1</sup> BAP and 1.0 mg L<sup>-1</sup> NAA with 63.3% shooting success. However, root formation was only found in MS medium supplement- ed with 3.0 mg L<sup>-1</sup> BAP and 1.0 mg L<sup>-1</sup> NAA with 10.0% root induction. In summary, MS medium supplemented with optimal BAP concentrations produced better calli from leaf petiole explants compared to 2, 4-D when it comes to further regeneration and root forming capabilities and may be used for gerbera micropropagation.



## IN VITRO REGENERATION OF CASSAVA GENOTYPES

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### Abstract

Over 800 million people around the world eat cassava as a staple food since it is a cheap source of carbohydrates. The crop, which delivered a reasonable yield on subpar soils, may have reduced world hunger. The number of available planting materials for cassava propagation through cuttings is limited, and the process is also time-consuming and labor-intensive. The slow distribution of improved varieties among growers is a result of the low multiplication rate of cassava. There is a need to evaluate alternative propagation methods that are rapid and tissue culture techniques may be a feasible solution for overcoming these challenges. Therefore, this study aimed to evaluate the in vitro response of cassava genotypes (G1, G2, and G3) imported from Alliance Diversity-CIAT, Thailand. A positive response was observed in the growth of the cassava genotypes in the modified media with PGRs. G2 showed the maximum number of leaves per explant (3.2), shoot length (3.4 cm), and leaf area (1.08 cm<sup>2</sup>) whereas G1 showed maximum inter-nodal distance (1.36 cm), and number of roots (5.4). However, maximum leaf ratio (0.98) and root length (6 cm) was observed in G3. Our study provides preliminary for in vitro propagation of cassava. With the help of the established protocol, a significant number of sturdy, healthy, and resistant cassava seedlings can be multiplied in vitro in less time.



## IN-VITRO MICROPROPAGATION OF POTATO

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### Abstract

Potato (*Solanum tuberosum*) is considered as the fourth major staple food crop. It is the cheapest source of minerals, vitamins, carbohydrates, and proteins. In European countries, potato is used as staple food and its utilization in Asia significantly increased as both fresh and processed forms. In Pakistan, the quality of potatoes does not fulfil international standards that leads to huge economic losses. Therefore, modern biotechnological methods like tissue culture provide an alternative tool for attaining potato tubers free from soil borne diseases (Viruses, Fungus), yellow or white color of flesh and biofortified potato tubers. Proposed study was aimed to produce large number of high-quality tubers via micro-propagation. Cultivated varieties PRI Red, Sahiwal Red, Sahiwal White, Ravi, Sutlej, Rubby and Sadaf used for micro-propagation through tissue culture techniques. Maximum number of tubers were generated in different types and concentrations of PGRs. PRI red variety show maximum number of shoots (13), leaves (10), root length (20 cm) and micro tubers (10-20) were produced per plant in 45 days. Optimized protocol resulted in multiplication of large number of high quality and disease-free plants and tubers. In future, this study can be extended for production of efficient seed system for potato.



## **ANDROGENIC RESPONSES IN GUAVA (*Psidium Guajava* L.) CULTIVARS**

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### **Abstract**

Androgenesis has been documented in a few tree crops, such as citrus and papaya, but nothing is known about guava. The ability of modified Chu (N6) basal media and cold shock pretreatments of floral buds to induce embryogenic calli in the anthers of two guava genotypes was investigated. Across all cold pretreatment intervals (0-72 hours), pollen viability was higher in cultivar Round than in cultivar Pyriform, however, viability was reduced by up to 50% after 72 hours of cold shock. Four different modified Chu (N6) media formulations (M 1, M 2, M 10, and M 11) were used to promote anther swelling. In comparison to cv. Pyriform, anthers of cv. Round showed less phenolic exudation and tissue browning. M 11 media supplemented with PVP (50 mgL<sup>-1</sup>), greater sucrose levels (5%), and cold pre-treated anthers for 24 hours reduced anther browning and promoted calli development. In two media (M 10 and M 11), anthers with uni-nucleated microspores generated more calli. On M 10 media containing 0.5 mgL<sup>-1</sup> 2,4-dichlorophenoxyacetic acid (2,4-D), anthers of cv. Pyriform demonstrated stronger callus induction (69.58 percent), but anthers of cv. Round developed more calli (66.60 percent) on M 11 media containing 0.5 mgL<sup>-1</sup> 2,4-D and PVP after cold shock treatment of anthers. On M 10 and M 11 media, the calli multiplied well and were embryogenic. The proliferating calli in both Round and Pyriform cultivars formed embryogenic masses with delayed maturity and limited germination after being transplanted in light on a growth hormone-free culture. More genotypes are being evaluated for improved embryo germination, and the embryogenic media is being fine-tuned. Our study will lay the foundation for the generation of homozygous lines in guava using androgenesis.





## **CHITOSAN SEED PRIMING ENHANCES GROWTH POTENTIAL OF ALFALFA UNDER DROUGHT CONDITIONS**

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### **Abstract**

Drought is a widespread environmental hazard to alfalfa production, hence needs effective management techniques to minimize the losses of drought mainly in arid and semi-arid areas of the world. Supplemental chitosan supply is essential to alleviate the deleterious effects of drought, however, its use as seed priming agent to improve the growth potential of alfalfa under drought conditions is less explored. The current experiment was conducted in semi-controlled conditions under CRD factorial design. Drought stress was imposed by growing alfalfa plants into two experimental conditions, as one group of plants was kept at 80% field capacity (non-stressed), whereas second set was retained at drought of 40% field capacity. Prior to seed sowing, seeds of cv. Sgd. Lucerne were primed in chitosan solutions of 0.2, 0.4, 0.6, 0.8, 1.0, and 1.2% including hydro-priming. Drought caused a considerable decline in shoot and root lengths by 26 and 30%, respectively; however, plants raised from seeds primed with 0.4% chitosan markedly improved their lengths by 10 and 20%, respectively than hydro-priming. A significant reduction in shoot fresh and dry mass by 30 and 24% was exhibited to drought stress, whereas seed priming with 0.6% chitosan exhibited a marked increase by 14 and 18%, respectively. Chitosan seed priming with 0.4% resulted in considerable increase in root dry mass by 13% than hydro-priming under drought stress. Furthermore, drought exposure markedly reduced the trifoliolate leaves by 29%; however, a significant increase by 17% was noted in plants grown from primed seeds with 0.6% chitosan. Conclusively, chitosan seed priming is effective to increase the growth of alfalfa under drought conditions.



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## **EFFECT OF DIFFERENT PACKAGING MATERIALS ON THE SEED QUALITY OF ONION (*Allium cepa* L.) DURING STORAGE PERIOD**

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### **Abstract**

The speed of the deterioration of seeds depends on conditions of the storage environment. High seed moisture contents and high relative humidity during storage are congenial for fungus growth. Packaging material and seed moisture content affect seed viability. Therefore, the present study was conducted to evaluate the effect of different packaging materials on viability and germination of onion seeds. The seeds of onion were stored in different packaging materials viz., cloth bags, polythene bags, plastic boxes, clay pots, glass jars and tin boxes and stored at room temperature ( $25 \pm 2^\circ \text{C}$ ) for a period of 12 months. The results of the study revealed that the seed quality parameters viz., germination (%), seedling vigor index, root length, shoot length, and seedling dry weight decreased with an advancement of storage period, but the electrical conductivity values were increased with advancement in storage period. It was observed that the seeds stored in glass jars with air-tight lids maintained the seed quality with least deterioration with respect to all the seed quality parameters compared to seeds stored in cloth bags and polythene bags.



## **INDIGENOUS SEED PRODUCTION OF OPEN POLLINATED ANNUAL FLOWERS - A POTENTIAL ENTERPRISE FOR SOUTH PUNJAB, PAKISTAN**

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### **Abstract**

Floriculture production is getting impetus around the globe due to improved life standards and rapidly increasing aesthetic needs of the masses, which is resulting in high demand for floricultural products. As annual flowers have distinct place in landscape with abundant colour diversification, their seed market is becoming a vital sector. Pakistan ranked 4th in agriculture seed import and mostly annual flower seeds are imported from Europe and Japan at very high cost. In Pakistan, it is a much-neglected aspect of floriculture industry, therefore, a study was planned to evaluate the potential of local flower germplasm for open pollinated seed production locally. The study was conducted at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, during 2021-22. Available winter annuals, viz. marigold, annual dahlia, and calendula along with summer annuals, viz. zinnia, rudbeckia, and gaillardia. Data were collected regarding plant height (cm), flower diameter (mm), stem diameter (mm), chlorophyll contents (SPAD), number of branches (n), production time (days), germination rate (%) and thousand seed weight (g). Among tested winter annuals, tallest plant height was observed by annual dahlia (60.4cm) followed by marigold (45.8cm) and calendula (30.6cm). Similarly, higher flower diameter (mm) was observed higher in annual dahlia with (24.7) followed by marigold (14.4) and with least in calendula with (3.5mm). Stem diameter was greater in marigold with (6.2mm) followed by annual dahlia and calendula respectively with (4.2mm), (3.5mm). Chlorophyll contents (SPAD) were recorded higher in annual dahlia (20.2) followed by calendula (20.0) and less in marigold having (18.2). Likewise, number of branches counted was more in marigold (6.6) followed by dahlia (6.5) and calendula with (5.8). Whereas longest production time was observed in dahlia having (145.1days) followed by marigold (137.5 days) and for calendula with (130.0 days). Seed germination rate was significant in marigold and calendula with (85%) followed by dahlia with (80%). 1000 seed weight(g) was higher in marigold having value of (9.5) followed by calendula with (8.4) and annual dahlia with (6.1 g). Correspondingly, among tested summer annuals, tallest plant height was noted in Rudbeckia with (23.5 cm) followed by gaillardia with (15.6 cm) and zinnia with (14.8 cm), Flower diameter (mm) was greater in Rudbeckia (3.2) followed by zinnia (2.9) and gaillardia with (2.0). Similarly, stem diameter was more in rudbeckia (2.0mm) followed by zinnia (1.9mm) and gaillardia with (1.5mm). Whereas chlorophyll contents (SPAD) were recorded greater in zinnia (16.2) followed by Rudbeckia (15.1) and gaillardia with (6.9). Number of branches counted was more in rudbeckia (7.4 n) followed by zinnia (5.4) and for gaillardia (7.0). Prolonged production time in summer annuals was recorded in Rudbeckia (136.2) followed by zinnia (130.7) and for gaillardia (125.1) days respectively. Likewise, seed germination rate was highest in Rudbeckia (80%) followed by zinnia (75%) and (70%) in gaillardia. 1000 seed weight (g) was highest among summer annuals in Rudbeckia with (6.0) followed by zinnia (3.2) and gaillardia with (1.5 g). In summary, marigold, annual dahlia and rudbeckia are among valued annual crops which proved potential crops for better growth and good quality seed yield compared to other selected annuals.



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## **MORPHOLOGICAL AND BIOCHEMICAL DIVERSITY AMONG FIFTEEN JUJUBE CULTIVARS OF SINDH PROVINCE, PAKISTAN**

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### **Abstract**

Jujube (*Ziziphus mauritiana* Lamk.) is called king of arid fruits and is an ideal choice for food security and global climate changing scenario. In Pakistan still it is a neglected fruit and has not attained much attention. This study explores the genetic diversity among fifteen jujube cultivars selected from jujube research station Tandojam Sindh. Results revealed significant differences among measured geometrical, qualitative, and biochemical attributes. The measured geometrical traits like stem girth ranged from 3.2 to 6.8 ft, leaf length ranged from 5.1 to 7.7 cm, leaf width varied from 3.4 to 5.8 cm, fruit weight lies from 8.8 to 31.57 g, seed weight varied between 0.52 to 1.68 g, fruit firmness ranges from 0.16 to 1.78 kg, TSS dispersed between 8.5 to 16.5%, while vitamin-C contents lies between 111.88-160.26 mg/100 g. Vast morphological differences were also recorded for assessed qualitative traits like tree shape, branching habit, leaf shape, leaf margins, leaf veins, fruit shape, fruit apex, fruit base, stone shape and for stone apex. Many of these traits are economically very important and can be helpful to boost fruit yield and quality. Strong positive correlations were detected between leaf, fruit and stone characters. The relevant data obtained for the 15 jujube varieties are valuable for developing and designing machines for processing operations, transportation, separating, packing, sorting, and harvesting. Finally, findings of present studies are promising for managing jujube genetic resources, in cultivar improvement and for successful breeding programs.



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## UTILIZATION OF BIOTECHNOLOGICAL TOOLS FOR THE IMPROVEMENT OF ARID FRUIT CROPS

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### Abstract

In developing countries, growers affiliated with horticulture sector usually grow indigenous fruits crops for their livelihood security and nutritional requirements. Development of superior varieties with good production potential can make considerable difference in farmers income. Genetic improvement of fruit crops is not rapid and needs to be improved like other horticultural crops. In recent years, biotechnological approaches are being used to deeply understand the several issues regarding the improvement of fruit crops. Thus, the exploration of genomic sequences with annotation as well as characterization of genes and enzymes controlling key horticultural attributes like quality, yield and tolerance against different environmental stresses have been transformed in the area of horticultural biotechnology. The arid region fruit crops including pomegranate, date palm, Fig, Mulberry, Falsa are well acclimatized in the hot arid or desert regions of the world with erratic precipitation and low soil fertility. Though it is crucial to deploy advanced biotechnological tools in fruit breeding programs for the development of new fruit varieties with good quality traits. The proposed study will definitely set the basis for molecular breeding of arid region fruit crops by using advanced technology as well as solve livelihood and nutritional security issues under changing climatic conditions.



## UNCOVERING HAPLOTYPE DIVERSITY OF PAKISTANI DATE PALM CULTIVARS USING DNA BARCODING

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### Abstract

Date palm (*Phoenix dactylifera* L.) is one the oldest fruit trees in the world. In Pakistan, date palm has a wide range of diversity among various cultivars. So, there is a need to identify the diversity level of unidentified cultivars based on different molecular studies. DNA barcoding is becoming an important way for the identification and discrimination of species using short, variable, and standardized DNA regions. For the purpose, universal psbk-psbl, rbcL and matK primers were used as a DNA barcode to identify the genetic relatedness of date palm cultivars collected from four provinces of Pakistan. Nucleotide sequences were aligned using MEGA 11.0 to calculate pairwise divergence among the cultivars. Analyzed data depicted a considerable level of diversity among studied cultivars. Phylogenetic trees were constructed based on the psbk-psbl, rbcL and matK sequences, and the results suggested that psbk-psbl, rbcL and matK can be used for determining the levels of genetic variation and DNA barcoding.



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## **AGRO-MORPHOLOGICAL CHARACTERIZATION OF TOMATO (*Lycopersicon esculentum*) GERMPLASM UNDER CLIMATIC CONDITIONS OF POTHOWAR**

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### **Abstract**

Tomato fruit is full of health-promoting compounds consisting of minerals and antioxidants including vitamin C and E, lycopene,  $\beta$ -carotene, lutein and flavonoids such as quercetin. Presently in Pakistan, up till now no detailed evaluation study were done regarding quality parameters of tomato cultivated varieties/germplasm. Therefore, to resolve these issues, the research was conducted at the research area of Vegetable Department of Barani Agricultural Research Institute Chakwal during 2021-22. The study involved evaluation of various lines of tomato for morphological characteristics and fruit quality parameters. For this purpose, 40 various genotypes were evaluated. Significant variations were observed for plant height, number of leaves, leaf area, number of clusters, number of flowers/cluster, number of fruits/cluster, fruit set percentage, fruit size and weight and minimum days to maturity among different genotypes. Maximum variations were also observed for postharvest studies (fruit firmness, total soluble solids, titratable acidity, ascorbic acid content and total sugars). Among indeterminate type, lines Adv-1202 and Adv-1207 were promising lines while for determinate, LBR-4, LBR-9, Nadir, LBR-11, 6232, 07039 and Avinash were the most promising lines and performed very well for those above-mentioned parameters and had quite well heat resistance. Thus, best performing genotypes under climatic conditions of Pothowar can be used in future breeding programmes as parents for trait specific hybrid development.



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## **TRANSCRIPTIONAL REGULATION NETWORKING OF ROSA CHINENSIS DURING FLOWER BUD DEVELOPMENT**

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### **Abstract**

Flower development intricate cascade of transcription and translation involving many genes and transcription factors (TFs). However, the regulatory mechanism of rose flower development largely unidentified. Here, we divide the developing rose flower into two stages, green petals in flower bud and pink petals in partially loosened flower bud. RNA-seq analysis were done to study the differentially expressed genes related to phyto- hormone biosynthesis and signaling, transcription factors controlling protein and pigment related genes by RSEM. We found that genes related to phytohormone biosynthesis and signaling AUX/IAA, SAUR, NCED, BKI1, DET2, PP2C and PR-1 were upregulated while TAA1, ARF, SAUR, MYC2 and ARR were downregulated. Further, we investigate transcription factors controlling functional proteins MYB, bHLH, ZF-HD, C2H2 were enhanced whereas SBP, AP2-EREBP and WD40-like expression were reduced up to five-fold. We also studied pigment related genes mainly involved in anthocyanin biosynthesis PAL, F3H, 3GT and LAR, there expressions were shown variation more than one-fold. Based on the results we got insight for transcriptional regulation of rose flower development that may be used for future study of desirable ornamental traits.





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## ASSESSMENT OF EUSTOMA VARIETIES BASED ON MARKET ORIENTED FLORAL CHARACTERISTICS

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### Abstract

Eustoma, commonly called Lisianthus (*Eustoma grandiflorum*) is a high-ranked ornamental cut-flower with long shelf-life, familiarized in the elite squares of Pakistan. This rose shape like flower has gained importance due to its blue color and availability in blazing sun of summers. The following research was carried out in the fields of floriculture program of Horticultural Research Institute, National Agricultural Research Center, Islamabad. Four varieties of open pollinated lisianthus seeds were sown, evaluated and seeds were collected for further evaluation. The selection criteria altered to color, flower shape (ruffled & non-ruffled), flower petals (single or double) among different varieties of Lisianthus. R-software was used to analyze data regarding diversity among genotypes. Least significance difference have shown that the varieties are significantly different for the parameters under study. Correlation analysis showed that number of flower and number of petals are positively correlated with stem girth, plant height and bud diameter while flower stalk length is positively correlated with stem girth and plant height. Cluster analysis revealed the presence of variation among genotypes. Principal component analysis demonstrated that double petal, ruffled pink Lisianthus is contributing more for parameters like flower stalk length, no. of flowers and plant height. Key words: Eustoma, ruffled, variation, open pollinated, flower stalk girth



## EVALUATION OF F1 HYBRIDS PEA DEVELOPED BY AUTO POLY PLOIDIZATION

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### Abstract

Peas are an important leguminous crop of the winter season. However, its production is severely threatened by biotic and abiotic factors. Autopolyploid appears when an individual has more than two sets of chromosomes, both of which are from the same parental species. To overcome these factors, inter and intra specific methods are adopted in which we transfer desirable traits from one species to another. The autopolyploid technique in peas is very valuable to develop new hybrids by transferring desirable traits. In the present study, hybridization was carried out to evaluate F1 hybrid pea seeds developed by autopolyploidization. In our experiments, the F1 hybrid was evaluated via comparison between treated and non-treated hybrids and parents of peas. The morphological traits of these hybrids and parents were also checked. Results showed that treated varieties took more time 11 days to germinate, and some hybrids showed zero percentage of germination. The maximum number of seeds which was 8.75 was observed in hybrid (P72 × P68). There was increasing trend was noticed in the seed weight of hybrid. According to PCA biplot the pod length, pod thickness and seed per pod falls in the second quadrant and seed diameter and 1000-seed weight falls in the fourth quadrant showed strong negatively correlated due to the opposite presence in the quadrants. The second quadrant contained P100C, P13C, P60C, P79C, P63, P76, P82, A8C, A13, A 18, A23, A10, A6, A14 and A21 genotypes and the fourth quadrant P4, P75, P12, P48, P81, P97C, A11, A21, A16, A19C, A29, A9, A18C and A15 they showed strong negative correlated to each other. Overall results showed that treating seeds with colchicine provides a wide range of variation and changing ornamental characteristics. This procedure provides selection criteria for improving and transferring desirable characters into cultivars.



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## COMPARATIVE EVALUATION OF F<sub>1</sub> HYBRIDS TOMATO DEVELOPED BY INTER AND INTRA-SPECIFIC HYBRIDIZATION

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### Abstract

Tomato (*Solanum lycopersicum* L.) is a member of the Solanaceae family. The tomato is valued for nutritional benefits such as vitamins, carotenoids, and phenolic compounds. Inter specific and intraspecific hybridization is important to improve different parameters of qualitative and quantitative nature. It is possible to introduce helpful genes into cultivated genotypes that are responsible to incorporate desirable characteristics in variety of essential field crops. The research was conducted by using 15 different hybrids and 32 parents. Data was collected for different vegetative and quality traits of tomatoes. All parameters were significantly different from each other except for flowering days, diameter of stem, and fruit firmness. LY36 × Pill hybrid was the best performer for leaf width, flowering days, fruit diameter, and germination percentage. LY33 × Pi8 was found suitable for length of the leaf. For days to maturity, WT50 × LY11 was the best performer. LY1 × LY7 (T7) was best for plant height while LYDI × PER4 (T101) was suitable for the length of the fruit. LY1 × LY7 (T7) followed by LY1 × LY32 (T10) showed maximum yield potential. LY36 × Pill (T91) followed by Pi8 × LY14 (T113) showed a higher percentage of total soluble solids. The study of wild and cultivated tomatoes was helpful regarding to improve yield potential and associated traits of quality and morphological parameters. The higher-performing hybrids can be exploited further for better yield and quality improvement. The authors are grateful to Pakistan Agricultural Research Council for the financial support from Agricultural Linkages Program.



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## DNA BARCODING OF APPLE VARIETIES OF PAKISTAN

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### Abstract

Plant species identification and determination of genetic variability among them, by using DNA barcoding has gained massive interest. Apple belongs to the Rosaceae family. One of the most widely cultivated temperate fruits. It contains a significant amount of biotic compounds such as Vitamins, sugars, carbohydrates, fats, and fibers. The apple is a pome fruit in which the surrounding tissues and ripened ovary both become edible and fleshy. Barcoding is a useful tool for molecular research and species identification as well as the conservation of natural resources and used to regulate and monitor plant diversity records and improve the plant conservation system by identifying plant species and determining genetic variability among them. Short DNA sequences were utilized to identify species. The basic aim of the study was the identification of DNA barcodes for Malus varieties. Plant barcoding locus matK and rbcL genes of chloroplast genome have been widely utilized in DNA barcoding. The chloroplast genome-based rbcL barcode was utilized in this work to investigate Malus domestica. Young leaves were used to extract DNA. The rbcL and matK primer were used to amplify these genotypes for DNA barcoding and the PCR result was sequenced. The size of the fragment amplified by rbcL was 650bp and matK was 776bp. These sequences were submitted to an online database, where they were assigned accession numbers through GenBank. Phylogenetic analysis at the end after developing DNA barcodes. The barcodes developed by using chloroplast region DNA barcodes were able to discriminate Malus varieties at the taxonomic level which could be used in the future for varieties identification.



## GENOME-WIDE IDENTIFICATION AND EXPRESSION PROFILING OF THE GR FAMILY IN GRAPES

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### Abstract

The gene structure analysis, protein conserved motif identification, subcellular localization prediction, synteny, phylogenetic, and cis-acting elements analysis of Growth-regulating factors (GRF) family members were performed in grapes. Expression patterns of grape GRF genes in different plant parts and against different hormone applications were analyzed. Further expression patterns were compared during different stages of seed development in seeded and seedless cultivars. Eight grape GRF genes were identified and divided into four groups (A ~ D). All genes were unevenly distributed on six chromosomes and the number of amino acids was 213 ~ 604. All grape GRFs proteins were predicted in the nucleus. Moreover, VvGRFs in the same clade showed conserved exon-intron structure and motif distribution patterns. Synteny analysis showed that VvGRF3 and VvGRF4 were segmentally duplicated. Various cis-acting elements related to growth and development, hormones response, and stresses were found in the promoter region of VvGRF genes. Expression analysis illustrated that most of the VvGRFs were highly expressed in vegetative organs i.e. leaves. However, VvGRF2 was highly expressed in reproductive organs like flowers and fruits. The expression of VvGRF3 and VvGRF6 was significantly higher during seed development in seedless grapes as compared to seeded grapes, while VvGRF8 showed high expression in seeded grapes. The expression of VvGRF genes was induced against GA 3 and IAA treatments, and most of the VvGRFs were down-regulated at 0.5 or 1 h. The present study provides preliminary information about GRF genes in grapes.



## **EVALUATION OF MELATONIN SUPPLEMENTATION IN CADMIUM STRESSED BELLPEPPER**

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### **Abstract**

Melatonin (ME) is known as a bio-promoter due to its multiple physiological effects on plants including tolerance to abiotic stresses such as salinity, drought, high temperature and heavy metal stress. Excess Cd in the soil system restricts growth, physiological, morphological, anatomical, and metabolic abnormalities in plants. Bell Pepper (*Capsicum annuum*) is one of the important cash crops of Solanaceous vegetables. To evaluate the effect of melatonin on cadmium stressed bell pepper plants, a pot experiment was conducted at Bahauddin Zakariya University, Bahadur sub campus Layyah, Punjab, Pakistan. Experiment was laid out in CRD with three replications. The objective of the present study was to explore the effect of exogenous application of melatonin through soil drench and damage caused by cadmium stress in pepper plants. Forty days old seedlings of two pepper cultivars viz. Super Shimla and Ganga were used. To (control) were simply irrigated with distilled water. Root application of 5µM melatonin (200 ml) was done under T1 for 12 days repeated after every 3 days. After this, T1+T2 were flooded with 0.1mM cadmium sulphate for 60 days. The results indicated that melatonin application resulted in reduced visual damage but increased shoot and root biomass as well as fruiting in pepper plants. Melatonin treatment also improved activities of antioxidant enzymes including SOD, POD and CAT. Thus, the results of this research indicated that treatment of pepper seedlings with 5µM melatonin through soil drench could be used to improve antioxidant enzyme defence mechanism, plant growth, as well as fruit yield under cadmium stress.



## **KAOLIN MODULATES PHYSIOLOGICAL AND PHYSIOCHEMICAL ATTRIBUTES OF POMEGRANATE UNDER SUMMER STRESS BY REFLECTING SUN RADIATIONS.**

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### **Abstract**

Spraying with kaolin is becoming a feasible and cheap treatment to attenuate the destructive effects of sunlight and heat stresses. Here, the impact of spraying with kaolin was investigated on leaf temperature, fruit temperature, photosynthesis and gas exchange rate, sunburn and physiochemical attributes of pomegranate arils. The four spraying levels of kaolin (Control, 3%, 5% and 7%) were used in 4 replicates for two consecutive years on three cultivars. The four kaolin treatments were applied three times with 30 days of intervals. Results indicate that the kaolin treatments reduced the plant canopy temperature, sunburn %, fruit cracking%, bacterial blight disease severity, transpiration rate and polyphenol oxidase activity significantly compared to control. Kaolin application also improved cosmetic look, fruit weight, fruit firmness, lightness, redness, and rate of photosynthesis. However, kaolin application also reduced disease incidence %, fruit fly incidence % yellowness, stomatal conductance, total peel weight, maturity index and titratable acidity by improving 100 arils weight, pH, total phenolic contents, antioxidants, anthocyanin, catalase, and super oxidase dismutase non significantly at the highest level of kaolin. There was a significant difference between the results of applying kaolin at concentrations of 3%, 5% and 7% in almost all the measured characteristics. Considering global warming, using kaolin application can be recommended as a suitable and cheap method for the acclimation of pomegranate to high temperatures and solar radiation.



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## THE IMPACT OF SALT STRESS ON THE ATTRIBUTES OF SELECTED OKRA (*Abelmoschus esculentus* L.) CULTIVARS

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### Abstract

The saline of the underground water supply is a main problem that adds to setting agricultural productivity. The salt-stressed plants have shown inhibited growth patterns with a slight lifespan of leaves and remaining productivity. By looking at these landscapes, an experiment was led to calculate the salt stress results of selected okra cultivars on seedling traits i.e., shoot and root length, shoot and root weight, number of leaves, flowers and chlorophylls 'a' and 'b' contents. The okra cultivars Green Star, Sabaz Pari, and Pahuja Seed improved Bhindi, and White Radish was used for this study. Sodium chloride (100 mM) was used to create the salinity while distilled water was used as the control. Salt stress expressively shorter the shoot and root length of all the tested okra cultivars. The lowest Shoot length 6 cm and root length 10.6 cm was found in 'Sabaz pari cultivar in salt stress condition while White Radish showed the highest shoot and rot length 7.5 and 12.4 cm respectively. The weight of roots and shoots was also decreased under salt stress with respect to controlled condition. White Radish showed also the highest weight under salt stress. Salt stress also expressively reduced the quantities of chlorophylls 'a' and 'b' contents of okra cultivars. From these clarifications it was arrived that 'White Reddish' cultivar of okra was able to sustain the physiological attributes moderately better than the other tested cultivars under salinity situation. White Radish, therefore, could be selected as the most salt-tolerant okra cultivar which could boom and make it successful in the salt-affected areas of the sandy region.





## **EVALUATION OF EXTOTIC SOLANACEOUS ROOTSTOCKS FOR SALT TOLERANCE IN TOMATO THROUGH GRAFTING**

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### **Abstract**

Salinity stress negatively affects the crop production. Tomato is one of the most significant vegetables crops in Pakistan, but its yield is declining due to various biotic and abiotic stresses. Salinity negatively affects the growth and productivity of tomato. In this context, a study is planned to explore the potential of Solanaceae plants as rootstocks, to prevent salinity stress in tomato. In this study, one scion (1359-tomato scion) will be grafted on three exotic rootstocks (101-eggplant rootstock, 104-eggplant rootstock, 614-tomato rootstock) for the induction of salinity tolerance. The seeds will be sown in plug trays followed by grafting in the healing chamber of plant propagation and Physiology Lab, Graduate Block MNS University of Agriculture, Multan. Grafted and non-grafted tomatoes will be grown under four salinity concentrations: T0 (Non-saline, Control), T1 (4 dSm-1), T2 (6 dSm-1) and T3 (8 dSm-1), containing growing media (garden soil, silt and farmyard manure in equal proportion). The morphological, physio-chemical nutritional and yield related parameters of grafted tomato plants in comparison to non-grafted plants would be analyzed. The study will be laid out according to completely randomized design (CRD). The data will be analyzed by using appropriate statistical software.



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## **GERMINATION OF TOMATOES UNDER PEG-INDUCED DROUGHT STRESS**

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### **Abstract**

Globally, abiotic stresses especially drought has emerged as one of the most severe threats to sustainable crop production leading to jeopardizing the food and nutritional security of rapidly increasing population. Tomato is an important vegetable crop and land area under its cultivation is persistently on decline due to water scant conditions. Polyethylene glycol (PEG) is a compound entailing a series of polymers that vary from viscous liquids to waxy solids and have potential to induce drought artificially. However, testing of different PEG levels for morphological and biochemical traits of tomato continues to remain an unexpected aspect, which has necessitated conducting fresh studies. The aims of this study were to assess the effects of drought stress on germination percentage, germination energy and number of days to complete germination in fifteen tomato populations; to distinguish the treatment that is the most suitable for classifying the tomatoes for their response to early-imposed drought; as well as to distinguish populations which could be used for breeding tolerant varieties. The experiment included control germination assay (distilled water) and the increasing (4, 8, and 12%, w/v) polyethylene glycol (PEG) treatments. Both germination percentage and energy considerably decreased with the increasing PEG treatments, while the observed average increase in the number of days required to complete germination remained statistically insignificant. The differences in germination among the populations were most pronounced in 12% PEG treatment, which is therefore recommended for further research. Several populations are indicated as tolerant; however, tomato drought tolerance exhibited as early as at the germination stage does not necessarily indicate the tolerance in later phases of plant development.



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## **NUTRITIONAL ENHANCEMENT OF ZINC AND IRON IN MANGO C.V. SUFAID CHAUNSA THROUGH FOLIAR APPLICATION OF CYSYTEIN IN CHANGING CLIMATE SCENARIO**

Fatma Bibi<sup>1\*</sup>, Abdul Ghaffar Grewal<sup>1</sup>, Khurram Shahzad<sup>1</sup>, Sidra Kiran<sup>1</sup> and Beenish Butt<sup>1</sup>

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### **Abstract**

Changing climate scenario have started to shake the agricultural system of Pakistan. Although Pakistan is amongst the top ten mango producing countries of the world but unfortunately we are still struggling with yield, quality and nutritional deficiency (Zn and Fe) issues and the world standards for all these are yet to achieve. In last ten years early rise in temperature during February and March had serious flower shedding and fruit drop losses at very early stage of fruit setting. Also due to high pH of our soils the Zn and Fe deficiencies are commonly observed in commercial cultivars of mango. Sufaid chaunsa is the most exported cultivar in world markets. To meet International nutritional standards in fruit a two-year study (2018-2020) on Sufaid Chaunsa was conducted at experimental farm Multan, Pakistan at Mango Research Station Shujabad, Multan, Pakistan to enhance the existing nutritional levels of mangoes (Zn, Fe) through use of various levels and combinations of Zn, Fe along with foliar application of cysteine. The experiment was laid out in randomized complete block design with three replications. Zn, Fe and cysteine each with two levels in twelve possible combinations were applied to mango plants of same age and health. The soil application of Zn and Fe in the form of zinc and iron sulphate along with NPK was done just after fruit harvest and before fruit setting. Foliar application of cysteine was made at egg stage of fruit. Basic analyses of soil for EC, pH, P, K, OM, Zn and Fe was conducted where Zn and Fe were present in 1.0 and 4.39 mg kg<sup>-1</sup> respectively. Initial levels of Zn and Fe by 2018 in fruit were recorded as 1.02 and 4.07 mg kg<sup>-1</sup> respectively. Fe (350) +Zn (300) + Cysteine (200ppm) combination enhanced Zn and Fe levels in mangoes with significantly high (Zn=1.19 and Fe= 4.51 mg kg<sup>-1</sup>) against Fe (350) +Zn (300) + no Cysteine and other treatments. From the findings of the study significant interaction of amino acid (cysteine) was concluded with nutritional enhancement of Zn and Fe and chemical nutrients in Sufaid Chaunsa in mango of Punjab, Pakistan.



## **SIMULTANEOUS USE OF PHOSPHATE SOLUBILIZING BACTERIA AND PHOSPHORUS SOURCE TO INCREASE THE GROWTH AND YIELD OF OKRA UNDER CALCAREOUS SOIL**

Muhammad Anwar-ul-Haq<sup>1</sup>, Muhammad Akbar Anjum<sup>1\*</sup>, Yasir Ahmad<sup>1</sup>, Sana Mudassar<sup>1</sup> and Yaqoob Sultan<sup>1,2</sup>

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### **Abstract**

Globally, agriculture is affected by climate change, breeding food scarcity, food insecurity and influencing the production of crops. Besides, the demand for food is increasing with the rapidly growing world population but production is low due to nutritional imbalances in plants that affect greatly plants' performance and their response to the surrounding environment. To alleviate these issues, cost-effective, eco-friendly and sustainable solutions are required for crop production. Okra (*Abelmoschus esculentus* L.) is the national vegetable of Pakistan and has a lot of nutritional value as well as medicinal benefits. In Pakistan, soils are calcareous and generally lacking in the available form of phosphorus (P) for plants. To mitigate this challenge, *Pseudomonas* sp. is used as phosphate solubilizing bacteria (PSB) to increase the solubility of non-available soil P and enhance the production of various crops. The study was directed to investigate the effect of the simultaneous use of *Pseudomonas* sp. and P fertilizer for okra (cv. Sabz Pari) crop performance under calcareous soil. The trial was performed in a randomized complete block design (RCBD) with five treatments and three replications during 2019-2020. Five treatments were assigned as T0 (distilled water), T1 (*Pseudomonas* sp.), T2 (*Pseudomonas* sp. + 100% P), T3 (*Pseudomonas* sp. + 75% P) and T4 (*Pseudomonas* sp. + 50% P). However, recommended doses (RD) of N and K were applied in each treatment combination. Results revealed that simultaneous application of *Pseudomonas* sp. + 100% P significantly ( $p \leq 0.05$ ) increased the plant height at 60 and 120 DAS, stem diameter at 60 and 120 DAS, relative chlorophyll content at 60 and 120 DAS, number of branches/ plants, number of leaves/ plants, number of flowers/ plants, number of pods/ plants, fruit set (%), pod length, pod diameter and pod yield/ ha. The minimum results of growth and yield parameters were observed in the control treatment. It is concluded that the interactive effect of *Pseudomonas* sp. and RD of P may be the most efficacious method to increase the growth and yield of okra and may have the potential for sustainable crop production under calcareous soil.



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## **NUTRIPRIMING AFFECTS PLANT GROWTH PERFORMANCE, YIELD AND QUALITY PARAMETERS OF DIFFERENT OKRA CULTIVARS**

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### **Abstract**

Okra, a member of family Malvaceae is a summer vegetable crop produced all over the country, is a rich source of vitamins A, B and minerals like calcium, phosphorus and iron. Okra production faces many problems i.e., lower yield and poor quality due to many biotic and abiotic factors. The present study was conducted to check the efficiency of seed priming with Thiamine (vit. B), to improve growth, yield and quality parameters of okra plant. The Experiment was laid out under Randomized Complete Block Design (RCBD) with three replications of each treatment. Results revealed that seed priming with thiamine at various concentrations caused the maximum plant height, number of fruits, number of leaves, leaf color, fruit weight, number of seeds, fresh seed weight, dry seed weight, root length, fresh and dry root weight and chlorophyll contents. Keeping in view the above results it is concluded that seed priming with thiamine not only increases seed germination but also helps to improve plant height, weight, yield and quality of fruit.



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## **STEM EXTRACT OF CHENOPODIUM MURALE AS A SOURCE OF NATURAL FUNGICIDAL COMPOUNDS AGAINST PATHOGEN OF FUSARIUM WILT OF TOMATO**

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### **Abstract**

*Fusarium oxysporum* f. sp. *lycopersici* (FOL) is a highly destructive pathogen of tomato causing wilt disease in this crop. In search of an alternative strategy to synthetic fungicides for the control of this pathogen, methanolic stem extract of an annual winter weed *Chenopodium murale* L. was investigated against this pathogen. The extract (1 to 5%) significantly ( $P \leq 0.05$ ) suppressed fungal growth by 39–74%. This extract was partitioned using three organic solvents of different polarities. Bioassays with different concentrations (1.562 to 200 mg mL<sup>-1</sup>) showed the best antifungal activity by chloroform followed by n-hexane and ethyl acetate sub-fraction causing 51–100%, 52–98% and 29–98% reduction in biomass of FOL, respectively. GC-MS analysis of chloroform and ethyl acetate fractions showed 20 and 8 compounds, respectively. Acetic acid, butyl ester (22.72%), cyclopentanol (20.15%), 2-hexanol (21.36%), oleic acid (13.92%), morphine (12.97%) and  $\beta$ -sitosterol (11.79%) were the abundantly occurring compounds in the two sub-fractions. Literature survey showed that many identified compounds namely oleic acid; morphine;  $\beta$ -sitosterol; palmitic acid; hentriacontane; acetic acid, butyl ester; 2-hexanol and cyclopentanol possess antifungal properties and could be responsible for control of FOL in the present study.



## **IN VITRO PROFILING OF ASSOCIATED MYCOFLORA WITH ANTHRACNOSE AFFECTED PLANTS AND MANAGEMENT OF ANTHRACNOSE OF MANGO INCITED BY COLLE-TOTRICHUM SPP.**

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### **Abstract**

Mango (*Mangifera indica* L.) is a sweet and delicious fruit with an impressive nutritional profile, making it known as the "king of fruits." However, mango cultivation can be hampered by various biotic and abiotic problems, particularly post-harvest diseases such as anthracnose. This disease limits the shelf life and exports of fresh mango, leading to serious economic losses. The symptoms of anthracnose include necrotic spots on leaves, panicles, and fruit, with the fungus potentially causing die-back on twigs. In this research, orchards in the Multan division, a recognized mango cultivation area, were surveyed to evaluate the severity and incidence of the disease. The study found that the disease was most prevalent in the northern region and used potato dextrose agar for in vitro isolation. Five chemical fungicides were tested, with Score being found to be the most effective, followed by Topsin-M and Bavistin. A regression prototype was also designed to forecast the prevalence of the disease during the season and to better manage the disease. The research concludes that an integrated strategy is needed to control mango anthracnose, utilizing the evidence from the regression model by studying meteorological variables.



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## **CHARACTERIZATION, MODELLING AND IN-VITRO MANAGEMENT OF MANGO MALFORMATION DISEASE CAUSED BY *Fusarium spp.***

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### **Abstract**

Mango malformation is a significant disease-causing economic loss for mango growers worldwide. It is characterized by stunted and bunched seedlings and vegetative or floral malformation in trees. The etiology of the disease is complex and involves various organisms, including *Fusarium spp.* A survey of mango orchards in the Multan region of Pakistan identified the highest intensity of the disease in the northern region. In vitro isolation and identification of the fungal pathogen responsible for the disease were performed using the potato dextrose agar medium. Chemical-based fungicides, including Score and Topsin-M, were found to be effective in inhibiting the growth of *Fusarium sp.* at a minimum concentration of 25 ppm. An epidemiological study was conducted to develop a regression model for forecasting the progression of mango malformation and design a management strategy based on meteorological variables. The research concludes that an integrated approach, including the use of predicted forecast data and appropriate cultural practices such as pruning, is necessary to effectively control mango malformation.





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## **THE STUDY OF VARIOUS HERBAL PLANTS TO CONTROL THE JASSID (*Amarasca biguttula*) AND APHID (*Aphis gossypii*) PEST OF OKRA (*Abelmoschus esculentus* L.).**

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### **Abstract**

This experiment was conducted on different plant extracts materials against the sucking pest jassid and aphid on Okra crop. The present experiment was conducted at the experimental area of Institute of Agricultural Sciences University of the Punjab, Lahore. The plants extracts were applied with three replications. Randomized Complete Block Design (RCBD) was used to lay out the experiment. The present study was aimed to evaluate the efficacy of different plant extracts such as Lemon leaves extract, Neem leaf Extract, Clove extract, Onion leaf extract, Garlic leaf extract, Ginger leaf extract and Moringa leaf extract against aphid and jassid infestation with the dosage of 22 percentage. The data were collected at weekly base. The results concluded that garlic leaf extract gave the highest percent reduction among all the treatments followed by Clove, ginger, neem leaf extract, onion and moringa after 48 hrs of application against aphid while Lemon leaves extract gave least control. Same as on the other pest jassid, Ginger gave the highest percent reduction among all the treatments followed by neem leaf extract, garlic extract, clove extract, onion extract, lemon and moringa after 48 hrs of application.



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## **LINKING ARTHROPODS ABUNDANCE TO SOIL QUALITY OF DIFFERENT LAND USE TYPES OF SARGODHA (PUNJAB) PAKISTAN**

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### **Abstract**

Soil health is an important factor that plays an important role in the existence of animals and humans on earth. Soil health and productivity are affected by the presence of arthropods in the soil. For this factor, an experiment was conducted to resolve this problem. Soil arthropods have been proposed as physical, chemical, and microbiological indicators for soil quality evaluation. Soil arthropods have been shown the sensitivity to variations in soil management and have a good correlation with beneficial soil functions. In the Sargodha district, a new approach (QBS index) based on the types of soil arthropods was proposed to assess soil biological quality. The QBS index is based on arthropod communities present in a soil sample. Soil micro-arthropods were extracted in the laboratory using a Berlese Funnel apparatus. This quality index was also correlated with other biological and physico-chemical properties of soil to better understand the environmental determinants explaining the dynamics of soil arthropods under different land-use-system. The results revealed that arthropods improve soil health and productivity by influencing the Physicochemical and biological properties of soil. The maximum number of soil arthropods was noted when the soil temperature was optimum, ranging from 21.97°C to 28.83°C. Further, an increase or decrease in these values showed a negative effect on the arthropods population. The arthropods' density was also increased when there was the highest amount of organic matter (5.1 g kg<sup>-1</sup> soil) and moisture contents (up to 14%) in the soil. The arthropod population showed a positive correlation to the microbial respiration rate and a negative correlation to the bulk density of soil. The lowest value of bulk density (0.39 g cm<sup>-3</sup>) and maximum microbial respiration rate (0.11 mg CO<sub>2</sub> g<sup>-1</sup> soil) was recorded in soil when there were a maximum number of arthropods. Soil arthropods also showed sensitivity to the acidic and alkaline conditions of the soil. Arthropods abundance was decreased when the pH of the soil was greater than 9.00 or less than 4.00. Soil arthropods also influenced the activities of enzymes. Maximum activities of enzymes were observed when there was the highest number of arthropods in the soil system. Keywords: Soil, arthropods, QBS index, enzymes, quality.



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## **CHARACTERIZATION OF FIPRONIL RESISTANCE, INHERITANCE IN *Aedes aegypti* (L.); THE MOST DANGEROUS AND MEDICALLY IMPORTANT PEST**

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### **Abstract**

The study was conducted to determine the characterization of fipronil resistance and its inheritance in *Aedes aegypti*. The purpose of the study was to assess the effective dominance of fipronil resistance on different concentration of fipronil in *A. aegypti* and response of fipronil to susceptible, fipronil selected, two reciprocal crosses and two back cross population of *A. aegypti*. Larval stages of dengue mosquito were collected from local health department Multan. Five concentrations in each bioassay were prepared by the serial dilution method and each concentration including control were replicated three times. The results showed that fipronil selected when compared to susceptible, the resistance ratio increases from 1-fold to 9.54-fold. The median lethal concentration LC<sub>50</sub> (95% fiducial limits) both of the reciprocal crosses were similar; therefore, it is suggested that fipronil inheritance was autosomal. Results of the effective dominance indicated that resistance to fipronil in *A. aegypti* was incompletely recessive at the highest concentration i.e., 6 ppm, while incompletely dominant at the lowest concentration, i.e., 0.38 ppm. In the case of dominant type of resistance, epistatic interactions may occur between major and minor genes and contribute to maintain susceptible genes in the population. The basic reasons for development of resistance could be affected by detoxification mechanisms, geographical distribution, diversity and physical morphological characteristics of the insect species.



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## **DIVERSITY AND RECOMBINATIONAL ANALYSIS OF COTTON LEAF CURL VIRUS IN CHILI AS AN ALTERNATIVE HOST**

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### **Abstract**

Cotton leaf curl virus (CLCuV) is an important viral disease of cotton in Pakistan. In the absence of cotton crop, the CLCuV species harbors several weeds, vegetables and ornamentals plants surrounding the cotton field thus enhancing the chance of virus survival, multiplication as well as the establishment of new viral strain due to new recombination. So, this research was designed to explore the diversity of cotton leaf curl viral species in chilies. All the reported be gomo viruses in chilies were retrieved from NCBI and sequence similarity demarcation tool was applied to find the number of viral species infecting chili. Recombinational analysis was performed between CLCuV strains, and chili leaf curl virus to find out the possible new recombinants. Virus infected leaf samples was collected from chili plants from the MNS university of Agriculture, Multan's research fields to find the occurrence of most prevalent strains of cotton leaf curl virus. Total DNA was extracted from infected and healthy leaf samples and rolling circle amplification was performed. CLCuV strain specific primers was used to for the PCR amplification. All these findings will help to identify the most viral CLCuV strain and presence of new viral recombinant in alternative host chili.



## **EFFICACY OF SUSTAINABLE HORTICULTURAL PRACTICES IN MANGO ORCHARD AGAINST FRUIT FLY MANAGEMENT**

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### **Abstract**

Mango is the second-largest fruit crop in Pakistan after citrus and is grown on an area of over 167,000 hectares. According to the Pakistan Bureau of Statistics, the total mango production in Pakistan in 2020-2021 was 1.8 million metric tons, which accounts for around 8.6% of the World's total mango production. The management of fruit flies is a major challenge faced by mango farmers worldwide. The use of synthetic pesticides in controlling these pests has led to several negative consequences such as pesticide resistance, environmental pollution, and human health hazards. Sustainable horticulture practices, including cultural, biological, and physical control methods, have been proposed as an alternative approach to managing fruit flies. This study aimed to evaluate the efficacy of sustainable horticulture practices in managing fruit flies in mango orchards. The study was conducted in a mango orchard located in a tropical region of Pakistan. The experimental design was a randomized complete block design with three treatments: cultural control, physical control, and a combination of cultural and physical control. The cultural control involved sanitation practices, pruning, and orchard floor management. The physical control involved the use of trapping and netting. The treatments were applied following standard procedures, and data were collected on fruit fly infestation, fruit damage, and yield. The results showed that all the treatments significantly reduced fruit fly infestation and fruit damage compared to the control. The combination of cultural and physical control was the most effective in managing fruit flies, reducing infestation by 83% and fruit damage by 87% compared to the control. The yield was also significantly higher in the treatments than in the control. The study demonstrates the efficacy of sustainable horticulture practices in managing fruit flies in mango orchards, providing an environmentally friendly and sustainable alternative to synthetic pesticides. The sustainable horticulture practices used in this study were effective in managing fruit fly infestation and improving fruit quality in mango orchards. These practices can reduce the use of synthetic insecticides, minimize negative impacts on the environment, and improve the sustainability of mango production.



## **PRE-HARVEST SPRAY OF BORON (B), ZINC (ZN), AND POTASSIUM NITRATE (KNO<sub>3</sub>) TO IMPROVE THE FRUIT QUALITY OF GUAVA CV. GOLA**

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### **Abstract**

The fruit of guava, botanically named *Psidium guajava* L., belongs to the family Myrtaceae. It can be grown on poor alkaline and poor drained soil. Guava is a hardy fruit of tropical to subtropical regions having a good source of vitamin C and have a high nutritional value. Guava bears the fruit twice a year. Most of the time winter crop prefer because of its high-quality traits also summer crop have profitable outcome when we care properly. A trial was conducted to improve the fruit's quality and its quality traits. This trial was laid out at PARS, UAF, and had 4 treatments with different levels that were replicated 3 times per treatment. The treatments were T0 (Control), T1 (ZnSO<sub>4</sub> 2%), T2 (H<sub>3</sub>BO<sub>3</sub> 3%), and T3 (KNO<sub>3</sub> 3.5%). The results showed that treated fruits showed better results than untreated (Control). Among all the treatments, T3 (KNO<sub>3</sub> 3.5%) showed better results, i.e., firmness (86.7%), and minimum results were recorded in the control. Physical data regarding fruit length, width, and weight were determined to be 4.27 cm, 4.5 cm, and 183.60 g, respectively, by 3.5 % KNO<sub>3</sub>. Biochemical parameters including total soluble solids (TSS) were higher in T3, as were ascorbic acid content, reducing sugar, total sugar, and pH in fruit treated with T3, and their values were 432.90, 10.97%, 8.47%, and 8.47%, respectively, of 2% ZnSO<sub>4</sub>. T2 (H<sub>3</sub>BO<sub>3</sub> 3%) performed well in context on non-reducing sugar having value of 19.40%. Organoleptic parameters like color, taste, aroma, visual quality and overall acceptance were better in 3.5% KNO<sub>3</sub> than others.



## EFFECT OF VARIOUS PRE-SOWING SEED TREATMENTS ON GERMINATION OF *Delonix regia*

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### Abstract

*Delonix regia* (Gold mohar) is a member of Fabaceae family used as an ornamental tree. The study was conducted to estimate the germination of Gold mohar under various types of seed treatments. The experiment was laid out in Complete Randomized design (CRD) with five plants in each treatment with three replications. Statistical analysis of the computed data was analyzed using analysis of variance (ANOVA) technique and treatment means were compared using Tuckey's test at 5% probability. The pre-sowing seed treatments used in this experiment were as follow., To: Control, T1: Hot water treatment (For 3 mins at 100°C), T2: Hot water treatment (For 6 mins at 100°C), T3: Hot water treatment (For 9 mins at 100°C), T4: Cold water treatment (For 12 hours at 4°C), T5: Cold water treatment (For 24 hours at 4°C), T6: Cold water treatment (For 36 hours at 4°C), T7: Conc. H<sub>2</sub>SO<sub>4</sub> (For 2 mins), T8: Conc. H<sub>2</sub>SO<sub>4</sub> (For 4 mins), T9: Conc. H<sub>2</sub>SO<sub>4</sub> (For 6 mins), T10: Scarified seed. The seeds of *D. regia* were sown in polythene bags. Among the seed treatments, T7 (conc. H<sub>2</sub>SO<sub>4</sub> for 2 mins) performed best in all the parameters viz., number of days to germination (6 days), germination percentage (87.44%), number of branches/plant (6.14 branches), number of leaves/plant (27.66 leaves), plant height (12.50 cm), stem diameter (3.73 mm), followed by T1 (hot water treatment for 3 mins at 100°C) and T10 (scarified seed). This study concluded that treating Gold mohar seeds by dipping in conc. H<sub>2</sub>SO<sub>4</sub> for 2 mins is the best method to break the seed dormancy and enhance the germination.



## INDIGENOUS *Lilium* L. HYBRIDS BULBLETS PRODUCTION THROUGH EXOGENOUS APPLICATION OF PLANT GROWTH REGULATORS

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### Abstract

Lilium, a member of family Liliaceae, is one of the prime bulbous crops cultivated throughout the world as cut flower and potted plant. Production of cut flowers in Pakistan is increasing day by day and majority of flowering bulbs are imported from Netherlands at high price by spending a lot of foreign exchange. A study was conducted at Commercial Floriculture Laboratory, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan, to evaluate the effects of exogenous application of various plant growth regulators on growth and development of bulblets of *Lilium* L. hybrids. Two cultivars of *Lilium* L. LA hybrids, viz. 'Indian Summerset' and 'Batch' were used for indigenous bulb production and evaluation of flower yield and quality. Treatments included no application of plant growth regulators, naphthalene acetic acid (NAA), indole butyric acid (IBA), 6-benzyl aminopurine (BAP) and gibberellic acid (GA) each @ 150, 200 and 300 mg L<sup>-1</sup>. Scales were detached from bulb basal plates and dipped in above mentioned PGRs solutions. After air drying under shade, these scales were packed in punctured zip lock polythene bags in moist coco coir and kept in lab. at 25±2 °C. After 90 days, data were collected on bulblets produced on scales followed by plantation of these bulblets in the field. Lab. experiment was laid out according to completely randomized design (CRD), while field experiment was laid out according to randomized complete block design (RCBD) with factorial arrangements. Application of different plant growth regulators exhibited significantly improved bulb production. Application of NAA @ 200 mg L<sup>-1</sup> produced highest number of bulblets per scale (5.20 and 2.73) in *Lilium* cv. 'Indian Summerset' and 'Batch', respectively, and induced heaviest bulblets after scaling, during growth period I (planted in crates) and growth period II (planted in field) in *Lilium* cv. 'Indian Summerset' (7.35, 31.33 and 37.60 g, respectively), with longest shoots (18.62 cm) and in cv. 'Batch' (4.01, 20.36 and 30.29 g, respectively), with longest shoots (8.94 cm). Application of Gibberellin hindered shooting in both cultivars. Longest roots were recorded in 'Indian Summerset' (8.61 cm) when treated with IBA @ 200 mg L<sup>-1</sup>, while in 'Batch' *Lilium* (8.31 cm) with IBA @ 150 mg L<sup>-1</sup>. Application of GA @ 150 and 200 mg L<sup>-1</sup> produced largest bulblets after scaling in 'Indian Summerset' (15.03 mm) and 'Batch' *Lilium* (14.22 mm). *Lilium* cv. 'Indian Summerset' treated with GA @ 150 mg L<sup>-1</sup> developed bulblets having highest diameter (31.11 mm) after growth period I (planted in crates). While cv. 'Batch' treated with NAA @ 200 mg L<sup>-1</sup> developed largest bulblets (26.07 mm) after growth period I (planted in crates). 'Indian Summerset' and 'Batch' *Lilium*, when treated with NAA @ 200 mg L<sup>-1</sup> exhibited highest catalase, superoxide dismutase, peroxidase and total antioxidants activity. 'Indian Summerset' and 'Batch' *Lilium*, when treated with GA @ 200 mg L<sup>-1</sup> exhibited highest concentration of GA and lowest concentration of ABA in bulblets. Application of NAA improved bulblets growth and development. Application of GA decreased bulblets production and delayed shoot emergence and sprouting. Growers and nurserymen may use NAA @ 200 mg L<sup>-1</sup> for high quality indigenous *Lilium* bulb production.





## ASSESSMENT OF INDOLE BUTYRIC ACID (IBA) EFFECT ON ROOTING OF *Petrea volubilis* CUTTINGS

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### Abstract

*Petrea volubilis*, commonly known as purple wreath, queen's wreath and sandpaper vine, is an evergreen flowering vine in the family Verbenaceae, that is valued especially for its display of violet flowers. Indole butyric acid (IBA) is a plant hormone in the auxin family and is an ingredient in horticultural plant rooting products. IBA is a viable source of auxin hormone which promotes rooting in stem cuttings. *Petrea volubilis* through semi-hardwood cuttings using different concentrations of Indole 3-butyric acid (IBA) in agro-climatic conditions of Faisalabad. The quick dip method was used to IBA solutions for cuttings of purple wreath. The following treatments were used for dipping of cuttings in IBA, viz. T0 (control), T1 IBA (100 mg.L<sup>-1</sup>), T2 IBA (200 mg.L<sup>-1</sup>), T3 IBA (300 mg.L<sup>-1</sup>), T4 IBA (400 mg.L<sup>-1</sup>) and T5 IBA (500 mg.L<sup>-1</sup>) along with no dip as control. The experiment was conducted under CRD with three replications and fifty cuttings per replication for each treatment. Results showed that treatment containing 500 mg.L<sup>-1</sup> of IBA performed better than all other treatments sprout length (41.6 cm), leaf area (9.2 cm<sup>2</sup>), total leaf chlorophyll contents (3.6 nmol/cm), photosynthetic rate (2.3  $\mu\text{mol m}^2 \text{s}^{-1}$ ), transpiration rate (0.7  $\mu\text{mol m}^2 \text{s}^{-1}$ ), stomatal conductance (0.2 mol m<sup>2</sup>s<sup>-1</sup>), epidermal cell area (0.3  $\mu\text{m}^2$ ), cortical thickness (6.5  $\mu\text{m}$ ), stele thickness (3.8  $\mu\text{m}$ ), xylem thickness (1.4  $\mu\text{m}$ ), metaxylem cell area (0.2  $\mu\text{m}^2$ ) attained maximum results and less number of mortality percentage (22.6%) was obtained. The study suggested that indole butyric acid (IBA) at 500 mg.L<sup>-1</sup> application proved to be best treatment and a promising dose for improvement of growth and sprouting of cuttings.



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## **EFFECT OF IAA, IBA, NAA AND CUTTING TYPES ON ROOTING INITIATION OF PHALSA (*Grewia asiatica*)**

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### **Abstract**

Phalsa (*Grewia asiatica* L.) is an important minor fruit crop of Pakistan with an area of 1241 hectares producing 4209 ton. The homogeneity of phalsa germplasm is generally not achieved in most of the orchards being sexually propagated, where true to type plants are not expected leading in to lack of uniformity in shrub characters and fruit traits grown in the field. Vegetative propagation in commercial phalsa nurseries is generally not adopted being more laborious and time consuming apart from other technical obstacles. Further, the germination of cuttings of phalsa has been very poor in various nursery conditions along with wide range of variation in seedling characteristics. This study was aimed to check the impact of different type of cuttings and plant growth regulators to attain the maximum sprouting and rooting percentage in vegetative propagation of phalsa through cutting. Phalsa cuttings were collected from reliable sources. The cuttings were treated with 250ppm and 500ppm IAA, IBA and NAA solutions and planted in the media comprising of equal proportions of Bhal, Bagas (Sugar Mill biproduct) and compost. Phalsa cuttings were planted in polythene bag of suitable sizes. Rooting and sprouting success of cuttings was recorded in the fruit plants nursery at the UAF Sub-Campus Burewala. Parameters like days to sprouting, sprouting success percentage, leaves and shoots physical responses; and rooting success in relevance to root physical characters was studied using suitable statistical approaches. Experiment was conducted in CRD under two factors factorial layout and data was analyzed using standard statistical procedures. These studies revealed that T5 (IBA - 500 ppm) produced the best results among all parameters in hardwood cuttings.



## VEGETATIVE GROWTH AND ROOT DEVELOPMENT OF EXOTIC CULTIVAR (WHITENSPIRE) OF *Euonymus japonica* CUTTINGS AS INFLUENCED BY VARIOUS LEVELS OF INDOLE-3-ACETIC ACID (IAA)

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### Abstract

The most pragmatic way to proliferate the number of nursery plants is through cuttings, so a pronounced success in this regard is obtained if plant growth regulators are used for the root initiation in cuttings of *Euonymus japonica*. Plant growth regulators like IAA accelerates cell division, cell elongation, root initiation in stem cuttings. IAA stimulates differentiation of xylem and phloem and lateral root development at the site of the cut, all of which lead to root initiation. This study looked at the effects of utilizing silt as a potting media and varying IAA concentrations (0, 500, 1000, 1500, and 2000 mgL<sup>-1</sup>) on vegetative growth and root development of exotic cultivar (White Spire) of *Euonymus japonica* under a Complete Randomized Design (CRD) experiment in a greenhouse with 35 cuttings per treatment. Semi hardwood cuttings treated with IAA @ 500 mg-l attained minimum days to sprouting and root initiation, It was noted that morphological and physiological characteristics such as leaf area, number of leaves, fresh and dry weight of the plant, the number and length of roots, the number and length of shoots, and the number of buds. For vegetative growth and better root development, the interaction effects showed the highest results at an IAA level of 500 mgL<sup>-1</sup>. According to the findings, certain morphological traits of an exotic cultivar of *Euonymus* may significantly be influenced by IAA concentration.



**ROOT DEVELOPMENT AND SOME VEGETATIVE GROWTH  
PARAMETERS ARE IMPROVED WHEN SEMI HARDWOOD  
CUTTINGS OF *Trachelospermum jasminoides* (STAR JASMINE) ARE  
TREATED WITH LOW LEVELS OF NAPHTHALENE ACETIC-ACID  
(NAA)**

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## Abstract

Studies have indicated that plant growth regulators can enhance the speed and quality of root initiation and development in semi hardwood cuttings of *Trachelospermum jasminoides*. This can result in a higher success rate of rooting compared to untreated cuttings, which can lead to better survival and growth of plant. Plant growth regulators like NAA stimulates the cell division and elongation in the root meristem, leading to an increase in root initiation and development. This study observed the effects of using silt as a potting media and varying NAA concentrations (0, 250, 500, 750 and 1000 mgL<sup>-1</sup>) on root development and vegetative growth of *Trachelospermum jasminoides* under a Complete Randomized Design (CRD) experiment in a greenhouse with 40 cuttings per treatment. The study found that (750 mgL<sup>-1</sup> NAA) significantly enhanced root initiation and development, resulting in a higher success rate of sprouting leaves compared to other treatments. Additionally, this concentration of NAA led to improved shoot length, stem diameter, number of leaves, leaf area, fresh and dry weight of the plant, and the number of buds. While NAA treatments at other concentrations (250, 500 and 1000 mgL<sup>-1</sup>) also showed positive results on root development and vegetative growth, the results were not as pronounced as those achieved @ 750 mgL<sup>-1</sup> NAA. In conclusion, certain physiological and morphological traits of *Trachelospermum jasminoides* may significantly improve by NAA treatment.



## **EFFICACY OF VARIOUS PGRS ON SOME MORPHOLOGICAL TRAITS OF STEM CUTTINGS OF DRAGON FRUIT (*Hylocereus undatus*)**

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### **Abstract**

Dragon fruit is a tropical plant that is grown for its edible fruit and an ornamental pot plant. Plant growth regulators, such as auxins and gibberellins, can have an effect on the stem growth of dragon fruit plants. Auxins promote stem elongation and thickening, while gibberellins promote cell division and stem elongation. So the study objective was to check the efficacy of various plant growth regulators like IAA, NAA and their combination on some morphological traits of dragon fruit cuttings. To check out the effect of different plant growth regulators on the growth of dragon fruit cuttings, Complete Randomized Design was laid out and the stem cuttings were treated with multiple growth regulators of different concentrations. The study shows that the cutting that were treated with IBA 7000 ppm, took the least number of days for root initiation (14.45 d), along with the length of the longest root (23.07) was also seen in this case. In addition to this the, IBA also showed some effect on other morphological trait of dragon fruit cuttings including the maximum dry and fresh weight (11.12 g and 56.66 g respectively), number of sprouts per cutting (2.43) and the least number of days for first sprouting were also scene in this case.



## **RESPONSE OF *Beaumontia grandiflora* CUTTINGS TO VARIOUS CONCENTRATIONS OF IBA**

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### **Abstract**

The role of auxins in root promotion is well documented. Indole Butyric Acid (IBA) is the most effective of them all. The experimental trial was executed to examine the impact of IBA on the root enhancement of *Beaumontia grandiflora*. Six treatments viz. T0 (control), T1 IBA (100 mg. L-1), T2 IBA (200 mg. L-1), T3 IBA (300 mg. L-1), T4 IBA (400 mg. L-1) and T5 (500 mg. L-1) was employed for dipping semi hard wood cuttings of *Beaumontia grandiflora*. To determine the response of cuttings various morphological (sprout length, leaf area, plant quality, no. of leaves, root length, no. of roots per plant etc.) and physiological parameter like root anatomy was observed. To conduct the experiment, Completely Randomized Design (CRD) was used. There were three replications and five cuttings per replication for each treatment. Analysis of Variance (ANOVA) technique was used to determine the overall significance of the proposed research trial and treatment means was compared by Least Significant Difference (LSD) test at 5% level of probability. It was observed that the cuttings showed positive response to the application of IBA. The best results were recorded for the cuttings which were treated with 500 mg. L-1 IBA. The cuttings treated with 500 mg.L-1 IBA displayed less number of days to sprout (11) and mortality percentage (22%), better leaf area (25.8 cm<sup>2</sup>), plant quality (4.67/5), number of leaves/cutting (10.33), shoot fresh weight (11.33 g), shoot dry weight (2.13 g), root fresh weight (4.73 g), root dry weight (1.33 g), root/shoot ratio (0.87 g), number of roots/cutting (6.66), number of lateral shoots (1.8), root length (4.76 cm) and stem girth (0.9 cm). It is concluded from the results that T5 (500 mg. L-1) can be used for the production of better quality plants of *Beaumontia grandiflora* as cuttings treated with 500 mg. L-1 IBA were best among all the treatments. Keywords: Root enhancement and IBA



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## **IMPORTED SOILLESS SUBSTRATES CRISIS AND POTENTIAL INDIGENOUS AGRO INDUSTRIAL WASTES AS ALTERNATIVE SOILLESS SUBSTRATE FOR HIGH QUALITY CONTAINERIZED PLANT PRODUCTION**

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### **Abstract**

Peat moss is a commercial soilless substrate used for containerized plant production throughout the world, however, its harvesting is causing serious damage to the ecosystem. Therefore, countries having peat lands have decided to reduce its harvesting for horticultural uses. Moreover, peat prices are not affordable for containerized plant production, particularly for export quality production and is also not readily available throughout the year. Therefore, it is need of the day to explore alternative soilless substrates having low cost and comparable physico-chemical properties with peat moss and other imported soilless substrates. For this purpose, agro-industrial wastes, viz., sesame straws, sesbania straws, sugarcane press mud, rice hulls ash and pine bark were collected, cleaned, crushed and composted where required. Among different attributes, pH, electrical conductivity (dS m<sup>-1</sup>) and water holding capacity (%) are more important, which were considered before substrate combinations formulation. Physico-chemical characteristics of sesame straws (pH 6.9, EC 0.8 dS m<sup>-1</sup>, WHC 25%), sesbania straws (pH 6.8, EC 0.6 dS m<sup>-1</sup>, WHC 27%) and pine bark (pH 6.7, EC 0.62 dS m<sup>-1</sup>, WHC 30%) were comparable with peat moss (pH 5.9, EC 0.53 dS m<sup>-1</sup> WHC 55%), while EC of raw sugarcane press mud (7.2 dS m<sup>-1</sup>) and rice hulls ash (5.4 dS m<sup>-1</sup>) was very high which was not suitable to be used individually, however, after treatment for lowering EC, may be combined in small proportions with other indigenous agricultural wastes to be used as soilless substrate. Therefore, it can be concluded that sesame straws, sesbania straws and pine bark may be combined with other suitable agricultural wastes to develop an indigenous soilless substrate for high quality containerized plant production for local and export markets. During evaluation of indigenous soilless substrate combinations, use of sesame straw, sugarcane press mud and pine bark (4:4:2; v/v/v) produced best quality market-able *Pelargonium* plants and performed at par with imported peat moss and coco coir.



## **EFFECT OF POTTING SUBSTRATES ON MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF (*Ranunculus asiaticus* L.)**

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### **Abstract**

*Ranunculus asiaticus* L. is an important cut flower native to Turkey and its flowers are prized for their colorful petals such as yellow, red, white and orange. Potting substrates is becoming increasingly popular among florists, gardeners and other horticultural professionals. This type of potting substrates provides numerous advantages when it comes to growing flowers. The purpose of this study was to check the effect of different potting substrates on morpho-physiological characteristics of ranunculus. Experiment was conducted at Gardening Wing, Estate Management Department, University of Agriculture, Faisalabad. Different growth substrates were used for soil amendments including the farmyard manure (FYM) + silt, leaf compost (LC) + silt, poultry manure (PM) + silt and coconut coir + silt were used to enhanced morpho-physiological characteristics of ranunculus. Each treatment was replicated three times and having 15 plants in each. The experiment was arranged according to randomized complete block design (RCBD). Data were analyzed using Fisher's analysis of variance (ANOVA) technique and treatment means were compared using Tukey's test at 5% probability level. Leaf compost (LC) + silt showed the maximum stem diameter (6.1 mm), number of roots (120), flower duration on plant (7.30 days) leaf area (9.4 cm<sup>2</sup>), total leaf chlorophyll content (22.4), photosynthetic rate (12.49  $\mu\text{mol m}^{-2} \text{sec}^{-1}$ ), percentage of carbohydrates in leaves (0.52 %) and flower diameter (6.9 cm) respectively. Farmyard manure + silt showed the maximum values for plant height (28.8 cm), number of leaves (34.5), number of flowers (10), stem fresh weight (40.4 g), stem dry weight (18.9 g) and petal width and leaf width showed non-significant results among the treatments. It is concluded that leaf compost (LC) + silt significantly enhanced most of the floral and physiological parameters of *Ranunculus* plant.





## **EFFECT OF VARIOUS GROWING SUBSTRATES ON GROWTH AND DEVELOPMENT OF FOXTAIL PALM (*Wodyetia bifurcata*)**

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### **Abstract**

A typical landscape palm, *Wodyetia bifurcata* (the foxtail palm) can withstand dryness and thrive in a variety of climates. For potted plants, there were an increased interest for biodegradable substrates such as peat moss, leaf compost, and sugarcane press mud. Foxtail palms was tested for growth and quality performance utilized growth-promoting substrates at the "Lalazar Nursery, University of Agriculture, Faisalabad". A total of four substrates were utilized, including garden soil, leaf compost, sugarcane press mud (S.C.P.M.), and peat moss. Each of the eight treatments were three replications, each with three plants, in accordance with the CRD design. "For this study, Fisher's analysis of variance and Tukey's test was used to compare the treatment means at the 5% confidence level. Results regarding maximum plant height (87.19 cm), number of leaves (52.00), leaf fresh weight (0.71 g), leaf dry weight (0.08 g), photosynthetic rate (0.26  $\mu\text{mol m}^{-2}\text{s}^{-1}$ ) and transpirational rate (0.26  $\text{mmol m}^{-2}\text{s}^{-1}$ ), stomatal conductance (0.03  $\text{mmol m}^{-2}\text{s}^{-1}$ ) were recorded in T5 treatment 50-50 % of leaf compost + peat moss while leaf temperature (29.70  $\mu\text{mol m}^{-2}\text{s}^{-1}$ ), epidermal cell area (0.36  $\mu\text{m}^2$ ), were recorded in 50-50 % leaf compost + S.C.P.M. Maximum results shows cortical thick- ness (7.50 $\mu\text{m}$ ), stele thickness (4.30 $\mu\text{m}$ ), xylem thickness (3.10  $\mu\text{m}$ ), meta xylem thickness (0.40  $\mu\text{m}^2$ ) was obtained in T6 treatment (50-50 % S.C.P.M + peat moss) while chlorophyll contents (242.73  $\text{nmol/cm}$ ) was obtained in T3 treatment peat moss. Maximum results in EC (9.03  $\text{dSm}^{-1}$ ), pH (14.3), nitrogen contents (11.85%), phosphorous content (33.4 %) , potassium content (450%) were recorded in T7. It is concluded that T5 treatment 50-50 % leaf compost +peat moss shows best results in vegetative growth and quality of *Wodyetia bifurcata*.



## **EFFECT OF VARIOUS GROWING SUBSTRATES ON GROWTH AND DEVELOPMENT OF PONYTAIL PALM (*Beaucarnea recurvata*)**

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### **Abstract**

The ponytail palm (*Beaucarnea recurvata*) is a member of asparagaceae family used as an indoor and outdoor ornamental plant. The use of sustainable growing substrate in horticulture is an appropriate method of environment management and providing nutrients to the plants. The objective of this study is to utilize plant-based substrate as a component of growing media for ponytail palm production. The research was conducted at Lalazar Nursery, Gardening Wing Estate Management, University of Agriculture, Faisalabad. There were total eight treatments. Each treatment were replicated three times, having three plants each. Different plant-based materials; leaf compost, coco peat and peat moss were used for quality growth and development of ponytail palm. Selected physico-chemical analysis (N, P, K, pH, EC) of growing media were done. The experiment was arranged according to Completely Randomized Design (CRD). Collected data was analyzed using Fisher's analysis of variance technique and treatment means were compared using Tukey's test at 5% probability level. The result regarding maximum plant height (86.05 cm), number of leaves per plant (58.33), leaf length (120.70 cm), leaf width (0.97 cm), caudex diameter (105.45 mm), fresh leaf weight (0.91 g), leaf total chlorophyll content (136.40 SPAD), photosynthetic rate (118.33  $\mu\text{mol m}^{-2}\text{s}^{-1}$ ), transpiration rate (0.33  $\text{mmol m}^{-2}\text{s}^{-1}$ ), epidermal cell area (1.00  $\mu\text{m}^2$ ), metaxylem cell area (0.45  $\mu\text{m}^2$ ), cortical thickness (7.50  $\mu\text{m}$ ) and xylem thickness (7.40  $\mu\text{m}$ ) were recorded in T5 coco peat 50% + leaf compost 50% and T6 peat moss 50% + leaf compost 50% showed maximum dry leaf weight (0.09 g) and stele thickness (7.36  $\mu\text{m}$ ). Maximum EC (16.6 dS/m), pH (48.5), N (2.15 %), P (23.3 ppm), K (285.10 ppm) were observed in T4 coco peat 50% + peat moss 50%. Minimum values regarding mostly parameters were studied in control treatment due to poor chemical properties and less availability of nutrients.



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## **GROWING OF PALM SEEDLING IN VARIOUS SOIL AMENDMENTS AND ESTIMATION OF ITS BENEFITS COST RATIO**

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### **Abstract**

Growth media is one the most noticeable and significant input of pot grown ornamental. In present study, we used various growing media with different soil amendments to identify the best growing media for palm seedlings along with its benefits cost ratio (BCR). Seedlings of three palm species (Phoenix palm, Lady palm and Alexandria palm) were grown in different soil amendments i.e. Control (Gardens Soil + Sand + Silt), soil amended with peat moss (50% Peat moss + 25% Garden soil + 25% Silt), soil amended with leaf mould (50% Leaf mould + 25% Garden soil + 25% Silt) and soil amended with bagasse (50% Bagasse + 25% Garden soil + 25% Silt). Among different soil amendments, the best growth and developments of palm species were observed in in soil amendment with 50% peat moss as compared with other soil amendments while lesser development was observed in control. Furthermore, BCR results showed that the palm plants grown in the peat moss is having a greater number of BCR as compared with the BCR of leaf mould and bagasse. Based on findings of the current study, it can be concluded that soil amended with peat moss (50%) has positive effect on growth and development of palm species and is more economical.



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## **GROWTH AND FLOWERING OF SALVIA SPLENDENS CV. 'FARAO' AS AFFECTED BY VARIOUS POTTING MIXES**

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### **Abstract**

Different potting mixes are commercially available in the market and are being widely used for ornamental plants. The present study was initiated to check the performance of various potting mixes prepared by using different inorganic and organic materials viz., sand, silt, coconut coir, leaf mold on growth and flowering of *Salvia splendens* CV. 'Farao'. For the purpose a pot experiment was conducted with nine treatments including control and ten plants in each replication according to Completely Randomized Design. Experiment was conducted at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, during year 2021-2022. Analysis of variance technique was used to determine any difference among treatments while means were compared by applying least significant difference (LSD) test at 5% level of probability. Before filling the pots analysis of each potting media was done to know its composition such as pH, EC, N, P, K, and organic matter. Results showed that Treatment T5 (combination of Coconut coir + Leaf mold) performed better in majority of growth, flowering and physiological attributes viz., plant height, number of leaves per plant, number of branches per plant, leaf area index, stem diameter, plant spread, fresh weight of plant, dry weight of plant, number of days to 1<sup>st</sup> inflorescence emergence, number of whorls per inflorescence, number of florets per inflorescence, number of inflorescence per plant, length of inflorescence, weight of inflorescence, vase life, leaf total chlorophyll content, leaf temperature, photosynthetic rate, stomatal conductance, and transpiration rate. Therefore, potting mix comprised of coconut coir + leaf mold is recommended for better vegetative growth and flower production of *Salvia splendens* CV. 'Farao'.



## OPTIMIZATION OF GRAFTING HEIGHT FOR GROWTH AND DEVELOPMENT OF MANGO (*Mangifera indica* L.) NURSERY PLANTS

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### Abstract

Grafting height has a significant impact on plant growth and development of many fruits plant including mango. Mango varieties in Pakistan are monoembryonic and for true to type seedlings grafting technique is adopted on commercial scale. The present study was planned to standardize the height of mango rootstock for grafting at nursery level. The research was conducted using a Completely Randomized Design (CRD) with a factorial arrangements. There were three different varieties (Sindhri, Saufaid Chaunsa, Chenab Gold) grafted at three different heights (8inch, 12inch and 16inch) using cleft/wedge grafting technique on desi mango nursery seedlings placed at Mango Research Institute Multan (MRI). Different parameters were examined such as grafting survival percentage (%), number of flushes (No.), days to first bud sprouting (days.), leaf area (m<sup>2</sup>), stem girth (mm), scion length (cm), plant height (cm), fresh leaves biomass (g), dry leaves biomass (g), chlorophyll &quot;a&quot; (g/kg), chlorophyll *a* (g/kg), catalase (mg -1 protein), peroxidase (mg -1 protein), superoxide dismutase (mg -1 protein) and water use efficiency (μmol mol<sup>-1</sup>), stomatal conductance (mmolH<sub>2</sub>O/m<sup>2</sup>/S), substomatal conductance CO<sub>2</sub> (μmol/mol), photosynthesis rate (μmolCO<sub>2</sub>/m<sup>2</sup>/S), and transpiration rate (mmolH<sub>2</sub>O/m<sup>2</sup>/S). It was found that scion Sindhri grafted at 16 inches' height significantly improved, number of flushes (2.62), number of leaves (14.55), stem girth (14.25mm), plant height (56.16cm), scion length (18.62cm), water use efficiency (3.42 μmol mol<sup>-1</sup>), substomatal conductance CO<sub>2</sub> (306.79 μmol/mol), leaf photosynthesis rate ;(13.66 μmolCO<sub>2</sub>/m<sup>2</sup>/S), superoxide dismutase (3.70 U mg<sup>-1</sup> protein), peroxidase (0.96 U mg<sup>-1</sup> protein). However, scion of Chanab Gold grafted at 12 inches, performed best for grafting survival percentage (97.5%), minimum days to first bud sprouting (10), chlorophyll *a* (3.84g/kg). Moreover 16 inches grafting height of Chanab Gold gave the best results for leaf area (221.78m<sup>2</sup>), transpiration rate (2.97 mmolH<sub>2</sub>O/m<sup>2</sup>/S), as compared to other scion as well as grafting height and when desi mango seedlings grafted with Saufaid Chaunsa scion at height of 12-inches performed well in fresh leaves biomass (18.58g), dry leaves biomass (4.66g), and stomatal conductance (89.83 mmolH<sub>2</sub>O/m<sup>2</sup>/S). So it was concluded that in variety Chanab Gold scion best for mango plants growth than other two varieties scion and in grafting height 16 inches' graft height gave the best results in all aspects of plant growth. Furthermore, Sindhri scion performed best when grafted at 16 inches grafting height than other varieties scion and graft heights. Chenab Gold also improve the physical and physiological growth of mango seedlings when grafted at 12 inches' height.



## **PLANT GROWTH PROMOTING RHIZOBACTERIA INCORPORATED SOILLESS SUBSTRATES - A NEW ARENA FOR HIGH QUALITY NURSERY PRODUCTION OF ORNAMENTALS**

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### **Abstract**

Nursery raising of ornamental flowering annuals using soilless substrates is becoming a lucrative industry worldwide. Pakistan, though being an agricultural country, still doesn't have its own cheaper and reliable soilless substrate for high quality nursery production. Therefore, a study was being conducted at University of Agriculture, Faisalabad, Pakistan and Purdue University, West Lafayette, Indiana, USA, for production of a cheaper and year around easily available soilless substrate using agricultural by-products and value added with inoculation of plant growth promoting rhizobacteria. For this purpose, coco-coir, rice hulls ash and composted sugarcane pressmud were combined in ratio of 1:1:1; v/v/v and were inoculated with Bacillus (MN-54), Enterobacter (MN-17) and Trichoderma species in concentrated (108 CFU mL<sup>-1</sup>) and diluted (107 CFU mL<sup>-1</sup>) solutions. These inoculated treatments along with uninoculated treatment and a negative control (sand: silt; 1:1, v/v) were evaluated for their physico-chemical properties and their effects on nursery raising attributes of marigold and zinnia. Physico-chemical analysis revealed that Enterobacter MN-17 (107 CFU mL<sup>-1</sup>) inoculated substrate was enriched with nitrogen (1.22%), phosphorus (91.7 mg L<sup>-1</sup>) and potassium contents (265.9 mg L<sup>-1</sup>) along with highest water holding capacity (72.9%), total porosity (81.04%) and organic matter contents (92.9%). Whereas Trichoderma spp. (108 CFU mL<sup>-1</sup>) inoculated substrate had electrical conductivity (1.59 dS m<sup>-1</sup>) and pH (5.64) values in optimal ranges. Trichoderma spp. (108 CFU mL<sup>-1</sup>) inoculated substrate resulted in highest final germination percentage (93.6%) and took less time for first seed germination (2.1 days), 50% germination (5.1 days) and mean germination (5.4 days), along with greatest seedling vigor index (2195), seedling shoot length (10.2 cm), root length (12.5 cm), leaf total chlorophyll contents (57.4 SPAD), seedling fresh (1.08 g) and dry weight (0.48 g) in marigold. However, in zinnia, Enterobacter MN-17 (107 CFU mL<sup>-1</sup>) inoculated substrate resulted in highest germination percentage (98.3%), whereas same strain having concentrated (108 CFU mL<sup>-1</sup>) application took less time for first seed germination (2.6 days), 50% germination (3.1 days) and mean germination (3.8 days). Enterobacter MN-17 (107 CFU mL<sup>-1</sup>) resulted in greatest seedling vigor index (3302), seedling root length (15.8 cm), leaf total chlorophyll contents (55.8 SPAD), seedling fresh (1.12 g) and dry weight (0.48 g). In conclusion, substrate enriched with Enterobacter MN-17 (107 CFU mL<sup>-1</sup>) or Trichoderma spp. (108 CFU mL<sup>-1</sup>) may be used alone or in combination with both strains to produce high quality ornamental flowering annuals nursery.



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## **BIOCHAR, COMPOST AND COIR AS ALTERNATE SUBSTRATES FOR SOIL BASED MEDIA IN MANGO NURSERY PRODUCTION**

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### **Abstract**

Mango nursery production in orchards is a traditional practice in Pakistan which causes various soil borne diseases. Some public and private nurseries started producing potted mango nursery plants in soil based potting media in Pakistan. However, they are facing different problems due to the high mortality percentage and lack of standard practices. Keeping in view this challenges, present research was designed to screen the best media ingredients and standardize them in suitable combinations for pot media. Media ingredients and their various combinations were screened on the basis of physical properties like air filled porosity and water holding capacity while some other chemical properties like pH and electrical conductivity were also studied. It was found that all the studied media ingredients i.e., Coconut coir, Composts, bagasse and biochar depicted the optimum range of physicochemical properties. However, best performance of biochar and composted bagasse was observed. Four media combinations in varying concentrations of coir, biochar and compost were also screened out on the basis of their studied parameters. In conclusion different agricultural wastes such as bagasse, coconut coir and biochar have the optimum physicochemical properties. Coconut coir, biochar produced from mango wood and corncob and composted bagasse in varying concentration can be used as an alternative growing medium for the establishment of mango nursery and other horticultural crops as well.



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## **EXPLORING THE POTENTIAL OF STRAWBERRY RUNNERS PRODUCTION IN DISTRICT POONCH OF AZAD JAMMU AND KASHMIR**

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### **Abstract**

Strawberry (*Fragaria x ananassa duch.*) is an important temperate berry fruit. This small fruit is commonly consumed all over the world due to its high antioxidant value and phenolic contents. In Pakistan, strawberry is grown in different areas of KPK, Punjab and Sindh. Strawberries are propagated very easily by runners in temperate areas having well moisture soil, fertilizes and proper draining system. Until now, 'Chandler' is the only cultivars commercially cultivated throughout Pakistan. The harvest of strawberry begins in early summer and generates revenue when few other crops are available. Therefore, strawberry is a very demanding enterprise. Its future is very much bright in our country because this fruit fetches maximum economic returns to the farmer. Since, climate of Punjab and Sindh is not suitable for nursery production; runners are mainly sourced from either Mingora or Dir districts. Whereas, climate of district Poonch, Azad Jammu and Kashmir is suitable for nursery runner production. Many studies have shown that runner quality (runner height, runner spread, weight of runner, runner leaf number) is a major factor that affects both productivity and fruit quality. So, there is great need to determine runner's health, fruit nutritional value, yield per plant and their shelf-life. So, this study evaluates field performance of available strawberry cultivars in terms of runner production, yield and fruit quality at various locations in district Poonch. This study will help to increase the business opportunities for local farmers.





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## **MODERN POTTED TUNNEL NURSERY: FUTURE OF MANGO INDUSTRY**

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### **Abstract**

A healthy young mango plant promises a healthy orchard. In Pakistan, mango nursery plants are procured and planted in field through one of the two major sources: field nursery and tunnel nursery. This study was devised in Mango Research Institute, Multan to compare the plant health indicators between open field nursery & modern potted tunnel nursery. The results showed that the plants produced in the potted tunnel nursery system got ready for grafting after 6 months of transplantation in the tunnel, while in open field nursery, it took minimum 12-15 months to become graftable. Similarly, the plants under tunnel produced better fibrous root system to absorb moisture & nutrition efficiently while in the field nursery, tap root remained dominant in growth causing dearth of water and nutrition availability to these plants. In addition, it was found that the plants grown in open field were more susceptible to biotic and abiotic factors; in contrast, tunnel nursery plants got protection against these factors. Rather, covering of tunnels with plastic sheet during winter created microclimate in the tunnels and plants continued to grow due to temperature increase. Likewise, the study revealed that more number of plants can be produced under limited structure in potted nursery system as compared to open field nursery. Moreover, the plants can be arranged more efficiently in beds form according to variety or need and each plant got surplus space during management practices like pest scouting and grafting. In addition, the use of resources like nutrition application, irrigation and protective sprays was found more effective and controlled in potted tunnel nursery. The study clearly depicted that the concept of clean and healthy mango nursery is the only way to produce healthy and disease free mango orchards. In return, the country's exchequer can be refilled by exporting such quality mangoes.



## **NUTRITIONAL FUNCTIONS IN OLIVE LEAVES**

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### **Abstract**

Olive is a miraculous fruit crop having high nutritive and medicinal properties; however, little is known about the nutritional value of olive leaves. Investigations were made to evaluate the biochemical properties, proximate macromolecules, and mineral contents in the leaves of five different olive cultivars (V1: Koroneiki, V2: BARI Zaitoon-1, V3: BARI Zaitoon-2, V4: Arbequina, V5: Gemlik) with respect to two leaf age groups (LA1: Fresh Leaves, LA2: Mature leaves). The biochemical parameters included total phenolic contents (TPC), total flavonoid contents (TFC), total antioxidant capacity (TAC); the proximate parameters comprised of moisture, protein, ash, fiber, fat and nitrogen free extract (NFE); whereas the studied minerals included sodium (Na), calcium (Ca), nitrogen (N), phosphorus (P), potassium (K), zinc (Zn), iron (Fe), copper (Cu) and manganese (Mn). Significant difference was found among various biochemical activities (TPC, TFC), proximate attributes (moisture, protein, ash, fiber, NFE) and mineral contents (Na, Ca, N, P, Zn, Fe, Cu, Mn) in the leaves of studied cultivars. Arbequina (V4) had more nutritional value based upon significantly higher TFC, protein, NFE, Na, N and P. The impact of leaf age was also significant on the various studied attributes of olive including TPC, TFC, TAC, protein, ash, Ca, Fe, Cu and Mn. The fresh leaves had higher TPC, TFC, protein, Fe and Cu; while the mature leaves had higher TAC, ash, Ca, and Mn. Overall, the olive leaves had significant potential for supplementing human nutrition; however, the pharmacological effects need to be investigated before any recommendation.



## **MORPH-BIOCHEMICAL DIVERSITY AND ANTIMICROBIAL ACTIVITY OF DATE PALM SEEDS UNDER CULTIVATED IN DIFFERENT AREAS OF PUNJAB, SINDH, AND BALOCHISTAN, PAKISTAN.**

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### **Abstract**

*Phoenix dactylifera* L. (date palm) is a very important and commercial fruit that is extensively cultivated in parts of Asia, North Africa and the United States of America and Australia. The objective of the study was to identify the bioactive compounds, antioxidant capacity and morphological characterization of date palm seed. For this purpose, an extract of date palm seed was prepared for antioxidant and antimicrobial activity. The morphological data was subjected to multivariate analysis using XLSTAT (2010) and chemical data was laid under CRD for result determination analysis of variance by ANOVA. Significant variation was present in the morphological and biochemical characteristics of different date palm varieties. Deglet noor seed has a maximum seed length 27.14mm and a seed weight (1.37g). Whereas, Neelum has a maximum seed width of 9.58mm. Different date palm varieties showed different qualitative traits such as seed shape, seed surface, seed base, seed apex and frequency of protuberance, furrow nature, micropyle position, micropyle elevation and mucron. The biochemical parameters include phenolic, flavonoid, antioxidant potential, and antimicrobial test activity of date palm seeds. Antioxidant activity was analyzed by DPPH (0.004%) assay radical scavenging activity. The antioxidant activity of date seeds of all examined varieties ranging from 17.66% to 60.56%. The highest activity was shown in kongan (60.56%) and lowest was observed in Peli sundhar (17.66%). Ridag variety revealed the highest content of phenolics (324.03 mg GAE/ 100 g) while, lowest phenolics were showed in Phuphal (68.06 mg GAE/ 100 g). Basro showed that the highest value of flavonoids among all date varieties (708.53 mg CE/100g) while, Naqal kurh (217.06 mg CE/100g) recorded a minimum amount of TFC in date powder. For antimicrobial activity, extracts were prepared in methanol, distilled water and n-hexane and the antimicrobial activity of these extracts was checked against different bacteria. Methanol extracts of date seed powder showed strong antibacterial activity against *Escherichia coli* (26 + 2) while n-hexane and aqueous were observed *E. coli* (23.67 + 2.00), and *B. subtilis* (16.00 + 1.5) respectively. Results were analyzed by mean + standard deviation. Results of this study have shown that date seed extracts have high antioxidants and antibacterial capacity. Therefore, date seed can be utilized in food, pharmaceutical and cosmetic industries for human use.



## IMPACT OF GAMMA IRRADIATION ON LEAF BIOCHEMICAL TRAITS OF GRAPEFRUIT GERMPLASM

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### Abstract

Mutation breeding have played a substantial role in enhancing genetic variability and inducing novel traits in different fruit crops including citrus. Induced mutagenesis have been extensively utilized in grapefruit (*Citrus paradisi* Macf.) for varietal development and many spontaneous and induced mutants have been released as varieties. Gamma irradiated induced mutagenesis was employed in six grapefruit varieties to enhance genetic variability and induce novel traits. Leaf biochemical attributes showed a significant variation in different important traits. Biochemical compounds like Hydrogen peroxide (36.43 to 60.15  $\mu\text{mol/g}$  FWT) and malondialdehyde contents (2.30 to 5.14  $\mu\text{mol/g}$  FWT) significantly increased at higher levels of gamma rays compared with control whereas, total sugars (64.90 to 42.86 mg%) were reduced. Total chlorophyll contents (2.34  $\mu\text{g/ml}$ ), carotenoids (29.99  $\mu\text{g/ml}$ ), total phenolic contents (79.92 mg/g GAE) and total soluble proteins (42.68 mg/g) were increased at lower levels of gamma irradiation (40 Gy) compared to control. While at 80 Gy, activity of POD (50.87 IU/mg of protein), CAT (33.95 IU/mg of protein), total flavonoid contents (37.86 mg/g catechin standard) and antioxidant capacity (124.94 %) were increased. Significant genotypic variability was also noted as Grapefruit varieties also showed significant variability as cv. Star Ruby showed greater amount of total chlorophyll contents (2.90  $\mu\text{g/ml}$ ), CAT (29.54 IU/mg of protein), total soluble proteins (40.08 mg/g) and hydrogen peroxide (57.13  $\mu\text{mol/g}$  FWT) compared with other varieties. While carotenoids (29.33  $\mu\text{g/ml}$ ), antioxidant capacity (114.24 %), total sugars (58.18 mg%) and total phenolic contents (75.29 mg/g GAE) were more in cv. Red Blush. Conclusively, gamma irradiation considerably affected leaf biochemical properties of grapefruit germplasm. Genetic stability analysis and field trials of the selected mutant germplasm for further screening is ongoing. The current study will act as a baseline for future breeding programs and for the development of improved varieties in grapefruit.



## **EFFECT OF MELATONIN ON GROWTH, YIELD, PHYSIOLOGICAL AND BIOCHEMICAL PROPERTIES OF BROCCOLI (*Brassica oleracea* L.) UNDER SALT STRESS.**

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### **Abstract**

Salinization of farming soils is a major abiotic stress hampering crop growth and productivity globally. Broccoli is moderately tolerant to salinity. Melatonin is an important molecule with a diverse role in planting abiotic stresses. In this study, we studied the role of exogenously applied melatonin in alleviating salt stress in broccoli cultivars. For this experiment, two popular cultivars (Marathon and Greenport) were selected. Three levels of melatonin, control (0 $\mu$ M), 50 $\mu$ M and 100 $\mu$ M were applied on broccoli plants subjected to salt stress (0mM, 40mM, 80mM, 120mM) and under non-stressed conditions. The results showed that exogenous melatonin application could improve morphological characteristics of broccoli i.e., plant height, the number of florets, head weight, head diameter, root length, shoot length, the number of leaves, relative water content, shoot fresh weight, root fresh and dry weight. The application of 50 $\mu$ M melatonin as foliar spray increased TSS, acidity, vitamin C,  $\beta$ -carotene, Total phenolics and Antioxidants in the broccoli head. Additionally, the foliar spray of melatonin improved chlorophyll a, b and total chlorophyll (head and leaves) and reduced antioxidant damage under salinity stress by enhancing the activity of antioxidant enzymes such as superoxide dismutase (SOD), peroxidase (POD), catalase CAT. Lower malondialdehyde (MDA), H<sub>2</sub>O<sub>2</sub>, and Proline content were observed in exogenously applied melatonin than in controlled plants under salinity stress in both cultivars of broccoli. The exposure to NaCl salinity determined an increase in Na<sup>+</sup> and K<sup>+</sup> concentrations in plant tissues. However, exogenously applied melatonin reduced the uptake of Na<sup>+</sup> from the soil. Among the cultivars, Marathon showed more tolerance against salt stress than Greenport. Collectively, our data provide evidence that exogenous application of melatonin may ameliorate the salt-induced damage to broccoli plants.



## **IDENTIFICATION OF POMEGRANATE (*Punica granatum*) HYBRIDS BASED ON MORPHOLOGICAL, BIOCHEMICAL AND GENETIC MARKERS**

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### **Abstract**

Pomegranate (*Punica granatum*) belonging to Lythraceae family is a fruit-bearing deciduous shrub. To enhance and manage genetic capital, new cultivars must be developed and almost all pomegranate cultivars have been produced from local pomegranate cultivars through selective breeding. Identification of parent types with better agronomic traits is important for increasing production and to produce better cultivated forms. Therefore, pomegranate hybrids and their parents having enhanced biochemical characteristics were evaluated against morphological, biochemical and genetic variation. Fourteen hybrids were developed by sexual hybridization of eight selected parents at University of Agriculture Faisalabad. The PCA biplot exhibited the highest morphological qualitative variability (76%) among F1 hybrid progeny. Leaf quantitative parameters i.e., (leaf area and width) were maximum in hybrid H8 (10.7cm<sup>2</sup> and 1.90 cm, respectively). In most of hybrids, total phenolic content and anthocyanin values were at combined mid-parent values which were the case in direct offspring of two parents. Vitamin C was found maximum in H11. The highest chlorophyll and carotenoids were related to hybrid H3. Genetically four SSR markers were used for the identification of F1 hybrids and parents in which POM\_AAC13 showed the highest polymorphism with Polymorphic Information Content (PIC) value of 0.278 and dendrogram divided all parents and hybrids into five main groups. Maximum number of accessions were clustered in group A including F1 hybrids and parents revealing more genetic similarity. It was concluded that H8 (Khatta Khushab × Ternab Ghulabi) was found to be superior in terms of morphological characters and H11 (Khatta Khushab × Ternab Ghulabi), H3 (Kandhari Red × Qabili) could be promising future pomegranate cultivar with enhanced biochemical and photosynthetic traits. Keyword: Breeding, parent cultivars, biochemical characteristics, SSR markers



## PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF COLCHIPLOID GERmplasm IN ACID LIMES

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### Abstract

Global climate change has diverted breeder's attention to widen germplasm base for greater climate change resilience. Polyploids have shown remarkable success due to their greater heterozygosity, gigantism, less inbreeding depression and enhanced tolerance to biotic and abiotic stresses. Hence, colchiploid germplasm was developed in acid limes including Mexican lime and Eustis limequat and screened for phenotype and cytological studies for ploidy estimation. The putative polyploid germplasm was evaluated for physiological and biochemical responses. Lime tetraploids showed enhanced photosynthetic rate  $A_{max}$  ( $19.46 \mu\text{mol m}^{-2} \text{sec}^{-1}$ ), stomatal conductance ( $0.407 \text{ mmol m}^{-2} \text{sec}^{-1}$ ) and chlorophyll contents (38.70 SPAD units) whereas transpiration rate and water use efficiency were reduced compared with their diploids progenitors. The enzymatic activities i.e., SOD ( $13.19 \text{ IU mg}^{-1} \text{ protein}$ ), POD ( $29.70 \text{ IU mg}^{-1} \text{ protein}$ ), CAT ( $10.27 \text{ IU mg}^{-1} \text{ protein}$ ), antioxidants (100.70 %), oxidative markers i.e.,  $\text{H}_2\text{O}_2$  ( $43.97 \text{ nmol g}^{-1} \text{ FWT}$ ), MDA contents ( $3.07 \mu\text{mol g}^{-1} \text{ FWT}$ ), photosynthetic pigments i.e., chlorophyll 'a' ( $2.15 \mu\text{g ml}^{-1}$ ) and chlorophyll 'b' ( $1.033 \mu\text{g ml}^{-1}$ ) all parameters showed an increasing trend with the increasing level of colchicine application (0.1%). Furthermore, among both cultivars, Mexican lime polyploids showed better responses for most of the physiological and biochemical attributes compared with Eustis limequat. Genetic characterization of the developed polyploid germplasm using SSR markers is ongoing to estimate the allelic polymorphism. The developed heterogenous genetically diverse germplasm will widen the genetic base of the acid lime varieties.



## MITIGATION OF HEAT STRESS IN FENUGREEK (*Trigonella foenum-graecum* L.) BY SALICYLIC ACID AND CHITOSAN APPLICATION

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### Abstract

Fenugreek (*Trigonella foenum-graecum* L.) is an annual leguminous crop, which is widely cultivated for its medicinal importance in different regions of the world. Fenugreek vernacular name is Methi and belongs to Fabaceae family. Fenugreek is a cool season crop and susceptible to heat stress. In this way a research project was carried out in Vegetable Stress Physiology Lab, Institute of Horticultural Sciences, University of Agriculture, Faisalabad (UAF). To evaluate the hypothesis that the chemicals, chitosan and salicylic acid mitigate the stress affect. Optimal levels of both chemicals were sprayed after 60 days of sowing at seedling stage. The experiment was single factor, in which the fenugreek cultivar “kasuri” against heat stress condition was studied. Foliar application of chitosan and salicylic acid was made by following treatments (T1 = Control, T2 = 1.5mM Salicylic acid, T3 = 1.2 mM Chitosan, T4 = Combination of T2 and T3). Data were gathered on the basis of growth (no of leaves / plant, seedling shoot length, seedling fresh weight, seedlings dry weight and shoot / root ratio), chlorophyll contents, electrolyte leakage, photosynthetic rate, transpiration rate, stomatal conductance and water use efficiency. The experiment was performed according to CRD. This was analyzed using standard statistical procedures and techniques. Results indicated that SA significantly increased no. of leaves while chitosan increased shoot length. In addition to this heat stress was controlled in all above mentioned parameters by the application of SA and chitosan.





## **MORPHO-PHYSIO-BIOCHEMICAL AND YIELD EVALUATION OF SOILLESS GROWN CHERRY TOMATO UNDER PARTIALLY CONTROLLED GREENHOUSE**

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### **Abstract**

Sustainability of agriculture is in the transformation of innovative agricultural practices i.e., soilless cultivation to ensure higher productivity with quality attributes. Cherry tomato (*Lycopersicon esculentum* var. *cerasiforme*) is an important vegetable crop; however, its productivity is affected by extreme weather events. Therefore, a study was planned to evaluate the performance of cherry tomato in soilless growing system under partial controlled greenhouse (10,000 ft<sup>2</sup>) equipped with fan and pad evaporative cooling system. Five F1 cherry tomato cultivars (Shugarino, Pareso, Tasterio, Root seed and Premium Ruby) is evaluated for different physical attributes (No. of leaves, inter-nodal distance (inches), plant height (ft), shoot fresh and dry weight (g), root fresh and dry weight (g)), reproductive attributes (no. of clusters/plant), physiological attributes (photosynthetic rate (A), transpiration rate (E), stomatal conductance (gs), sub-stomatal conductance (Ci), water use efficiency (WUE) and yield (fruit size (inches), No of fruit/cluster, yield (kg)) and biochemical attributes (total soluble solids (TSS), titratable acidity (TA), ascorbic acid, total phenolics and antioxidants were carried. The study was laid out under Completely Randomized Design (CRD) by using statistics 8.1 ® software. Collected data revealed a significant difference in the morpho- physio, yield and biochemical attribute. Irrespective to this, the cultivar "Pareso" performed well as compared to other cultivars in improving the plant height, shoot and root fresh and dry weight, photosynthetic rate, stomatal conductance, water use efficiency, total soluble solids and yield attributes.



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## **CALLUS INDUCTION AND REGENERATION IN DATE PALM (*Phoenix dactylifera* L.)**

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### **Abstract**

The date palm is one of the oldest plants and may be found in the Middle East, North Africa, the Sahel, East and South Africa. Due to heterozygosity, its sexual propagation inhibits the propagation of true-to-type genotypes. During the juvenile life of the palm tree, off shoots generated from axillary buds located near the base of the trunk are used for vegetative propagation. Offshoot production is extremely slow; their numbers are low and unable to fulfil the continuously increasing demand for variety. Date palm (*Phoenix dactylifera*) is cultured to increase medicinal and nutritional values also use as edible fruit In vitro culture techniques are being used to enhance date palm genetic development. Today different biotechnological techniques are used for mass production of date palm within short time. It is determined that in-vitro micropropagation by using different explants of date palm is the suitable method to overcome issues of harmful diseases and physiological disorders. Callus induction of date palm has advantages of pathogens free plants, rapid clone production and increased production with more nutritive and beneficial varieties.



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## **BIODIVERSITY OF NATIVE INSECT POLLINATORS IN BOTTLEBRUSH**

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### **Abstract**

Insect pollinators strongly contribute to world's economy, seed production, natural ecosystem and food we eat. Seed plants approximately 90% depends on cross-pollination and fruits and seed produced by pollinated plants are approximately 25% part of diet. Economic importance of pollination services worldwide is 577 billion dollars while it is 1.59 billion dollars in Pakistan. Pollinators are vital for food and nutritional security since many essential nutrients are provided through the pollination services. Visual observations of randomly selected 15 plants were taken across the whole flowering period (October to December 2022) in MNS university of Agriculture, Multan. Initially morpho-typing was done through collection of insect pollinators followed by identification by using standard taxonomic keys. Biodiversity of insect pollinators in bottle brush was composed of 06 bee species, 04 syrphid fly species and 02 butterfly species. Maximum abundance was recorded for *Apis dorsata* and *A. florea* (honey bees) followed by *Ischiodon scutellaris* and *Eristalinus aeneus* (syrphids) while abundance of *Danaus plexippus* and *Papilio demoleus* (butterflies) was lowest. Knowledge of biodiversity and host plant range of different insect pollinators is necessary for their conservation in the current scenario of climate change.



## **EFFECTIVENESS OF NATIVE POLLINATORS IN STRAWBERRY YIELD ENHANCEMENT**

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### **Abstract**

Strawberries are a high-value crop, with a global market value of over \$4 billion. Strawberries are a good source of fiber, vitamin C and antioxidants, which can help prevent chronic diseases such as cancer and heart disease. Native pollinators are essential for crop pollination and yield enhancement by playing a vital role in fruit and seed production. It is estimated that native pollinators are responsible for pollinating about 80% of flowering plants worldwide. This study aimed to evaluate the effectiveness of native pollinators in enhancing strawberry yield. The research methodology involved establishing two treatment groups: a control group without pollinators and an experimental group with the presence of native pollinators such as native bees, butterflies, moths, beetles, and flies. The experimental group was set up by providing suitable habitats for the native pollinators near the strawberry plants. The results showed that the presence of native pollinators significantly increased the strawberry yield compared to the control group. The average weight of the strawberries harvested from the experimental group was 35% higher than that of the control group. Additionally, the strawberries from the experimental group had a higher percentage of well-formed and larger-sized fruits than the control group. The conclusion drawn from this study is that the presence of native pollinators can significantly enhance strawberry yield. Therefore, the conservation and promotion of native pollinators should be encouraged to maximize strawberry production. This finding can also have significant implications for other agricultural crops that rely on pollination by native insects.



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## **THE ROLE OF CAULIFLOWER MOSAIC VIRUS (CAMV) SILENCING SUPPRESSOR PROTEIN 6 (P6) IN MODULATING DEFENSE SIGNALING PATHWAY**

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### **Abstract**

The Cauliflower mosaic virus (CaMV) silencing suppressor P6 protein plays a crucial role in translation of the 35S RNA. Recent research has shown that P6 also functions as a unique pathogenicity effector by modifying a key regulator of plant defense called NPR1, which controls the response to salicylic acid (SA) and jasmonic acid (JA). When P6 is expressed in *Arabidopsis* and *Nicotiana benthamiana* plants, it suppresses the expression of genes that respond to SA and increases the expression of genes that respond to JA. This leads to increased susceptibility to certain types of pathogens, such as the bacterium *Pseudomonas syringae*, while decreasing susceptibility to others, such as the fungus *Botrytis cinerea*. Furthermore, P6 causes NPR1 to mislocalize in the nucleus even in uninduced plants, which contributes to the suppression of SA-dependent defense responses. These findings demonstrate that P6 is a new type of pathogenicity effector protein that enhances susceptibility to biotrophic pathogens by suppressing SA-dependent defense responses and enhancing JA-dependent ones.



## COMPARATIVE FIELD STUDIES OF VARIOUS TRAPS AND AMMONIUM ATTRACTANT OF THE FRUIT FLY, *Bactrocera zonata* (DIPTERA.: TEPHRITIDAE)

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### Abstract

Fruit flies are major pests of several fruit and vegetable crops throughout the tropical and subtropical world. Among various tropical fruits, guava, and mango fruits are nutritive and attractive delicious commodities to eat for man. Mango (*Mangifera indica* Linn.) and Guava (*Psidium guajava* Linn.) both guava and mango are equally attractive to fruit flies. Fruit flies belong to the family Tephritidae which is one of the largest, most diversified, and fascinating families of Diptera. Tephritidae includes about 4000 species arranged in 500 genera. These are commonly called "fruit flies" due to their close association with fruits and vegetables. Out of 4000 species, 392 species have been recorded in the world. Among the various alternative strategies available for the management of fruit flies, the use of traps stands as the most outstanding alternative. Traps have both olfactory as well as phagostimulatory action and are known to attract fruit flies. Attractants, when used together with an insecticide impregnated into a suitable substrate, form the basis of the capture technique. This technique has been successfully used for the eradication and control of several *Bactrocera* species. These traps were baited with a synthetic food-based attractant (protein hydrolysate + jaggery + AA + TMA + Pu + lufenuron) under the field. A triplet mixture compound at pH 6.82 for both sexes outperformed either ammonium alone or unbaited traps. Yellow was the most attractive color for capturing adults *B. zonata* baited with ammonium-based proteinaceous food baits placed at 5 feet under the canopy followed by green and transparent in combination with cylindrical window plastic bottle traps (Trap 2). According to the results, the cylindrical window plastic bottle trap captured the highest number of fruit flies per trap during May, June, July, and August having 65.5, 72.47, 76.43, and 52.68, respectively. Irrespective of traps and height, yellow color traps captured the highest numbers of fruit flies during May, June, July, and August (59.35, 74.81, 37.61, and 45.9, respectively), followed by green and transparent, respectively. Furthermore, the optimization of the number of traps was evaluated. The result indicated 12 traps per acre from the 8-meter radius distance lead to the lowest damage per acre during May, June, July, and August, i.e., 8.06, 9.38, 9.31, and 6.06%, respectively. So, the yellow-colored cylindrical window plastic bottles baited with chemosterilant bait at the rate of 12 traps per acre installed in the mango field decreased the infestation and increased the production and income of the farmer.



## **MOLECULAR CHARACTERIZATION OF THE BEGOMOVIRUS CAUSING CHILLI LEAF CURL DISEASE BY TARGETING COAT PROTEIN REGION OF DNA-A COMPONENT**

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### **Abstract**

Chilli (*Capsicum annum*) is one of the major summer cash crops in Pakistan. Several fungal, viral, and bacterial diseases are reported to affect chilli production every year. Among them, chilli leaf curl disease causes significant losses to chilli production in Pakistan. It is caused by one of the viruses belonging to the genus Begomovirus. Symptoms include upward or downward leaf curling, severe stunting, abscission of flower buds, chlorosis and reduced or no fruit production. To devise effective management strategies, correct identification of the causal organism is necessary. Thus, the objective of this study was to identify and analyze the diversity of Begomovirus in different chilli-growing areas of District Okara, Punjab. This study includes the collection of infected leaves and molecular characterization of the isolated pathogen. Genomic DNA was isolated from all collected samples. For molecular studies, nucleotide sequences of the coat protein region (CLCV1 and CLCV2) were targeted. NCBI-BLAST analysis revealed a 99% similarity of the isolated pathogen to the Chili leaf curl virus (ChiLCV). No other Begomovirus was found to be associated with chilli leaf curl disease in District Okara. This preliminary research opens new paths to the development of effective control measures for chilli leaf curl disease in Pakistan.



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## **EFFECT OF IRRIGATION METHODS, SILICON APPLICATION AND MULCHING ON THE ONION GROWTH AND PRODUCTIVITY**

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### **Abstract**

Onion requires frequent irrigation for better yield because of shallow root system and no root hairs. Keeping in view water crisis situation of the world particularly Pakistan, an experiment was conducted at UAF Sub-Campus Burewala during winter 2022 to improve onion water use efficiency by various approaches. Three irrigation methods (Furrow, Alternate Furrow and Fixed Furrow irrigation) along with four levels of Silicon foliar application (0.5mM, 1 mM, 1.5 mM and Control) were tested under mulch as well as non-mulch conditions. Total twenty-four treatments were laid down under RCBD three factorial layout with three replications. All treatments under mulched conditions showed significantly higher plant height, Number of leaves, Bulb diameter, Neck diameter, Neck to Bulb ratio as well as Bulb Yield. Among methods of irrigation, maximum values were observed under furrow irrigation followed by fixed furrow, then alternate furrow irrigation. However, crop water productivity was highest for alternate furrow irrigation (0.4 g/L), followed by fixed furrow (0.31 g/L) then furrow irrigation (0.18 g/L). Silicon foliar application @ 0.5mM improved plant height, number of leaves as well as neck diameter. Further increase in silicon dose did not prove any significant improvement in plant growth and quality attributes. Keeping in view the results it may be concluded that under ample supply of irrigation water, furrow irrigation coupled with mulching while, under limited supply of irrigation water, alternate furrow irrigation method coupled with mulching is best. Foliar application of silicon @ 0.5mM, one-month after transplanting may further improve growth attributes of the crop.





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## **IUB-HORTICULTURE R&D ACTIVITIES: PAST, PRESENT AND FUTURE PROSPECTS**

Muhammad Nafees<sup>1\*</sup>, Muhammad Amin<sup>1</sup>, Khalil Ur Rehman<sup>1</sup> and Ishtiaq Ahmad<sup>1</sup>

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### **Abstract**

Department of Horticultural Sciences is running projects entitled “Establishment of Commercial Multi-story/High Density Orchard and Fruit Research Unit, “Cut-flowers & Vegetables Production, Research and Training Cell” and “Establishment of Citrus and Date Palm Orchard Based on Micro-Irrigation System using the Undulated Barren Land”. Under the 1st project:  $\geq$  17,000 plants including 4000 Mango (cv. Sindhari, Season- al, White, Black, Azeem-Chounsa), 4000 Guava, 5500 Citrus (Kinnow, Future's early, Shukri, Mosambi, Grapefruit, Lemon, Lime), Date palm, Peach, Pear, Lychee, Figs, Olive and Papaya under drip irrigation system on an area of 28 acres during 2020. Modification in apical dominance and establishment of small tree system through disbudding, removal of main and scaffold branches in mango, citrus and guava is in progress with the involvement of students, researchers and growers. Various experiments are in progress on water and nutrient management, mulching and IPM. Frost and heat wave management is in progress through installation of rain-gun in mango block, however, received 15-20% mortality in mango because of frost, termites and heat waves as drip irrigation system was out of order in 2021. There was only 5, 3, 2 and one percent mortality in citrus, dates, peach and guava, respectively. These STS orchards aimed to showcase for regional communities to ensure sustainable quality fruit production and strengthening postharvest science & technology to address food security issues of the world.



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## **EFFECT OF FOLIAR APPLICATION OF BORON ON VEGETATIVE GROWTH AND FLOWER OF SNAPDRAGON**

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### **Abstract**

Snapdragon (*Antirrhinum majus*) is a flowering plant grown in a number of countries worldwide. Effect of foliar application of boron on chlorophyll content, flower appearance, plant length, number of leaves, spike diameter, no of spike, fresh plant and root weight, root length, and dry plant and root weight were determined. Four treatments of boron were T2 = 0.25%, T3 = 0.5%, T4 = 0.75% and T5 = 1% were compared with a control treatment named as T1. Total number of experimental units were 60 including control treatment. Dry plant weight and root weight, fresh plant and root weight, root length, no. of spikes, spike diameter, spike length and number of leaves were decreased significantly when compared with control while chlorophyll content and plant length were increased in treatment 4 and treatment 2 respectively. Results shows that the foliar application of boron on *A. majus* has negative effects.



## **ENDOGENOUS GROWTH HORMONES AND LEAF GASS EXCHANGE PARAMETERS OF KINNOW MANDARIN INFLUENCED BY DIFFERENT ROOTSTOCKS**

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### **Abstract**

Citrus holds the key position in the horticulture sector of Pakistan in terms of area and production. Kinnow is considered as the trademark of Pakistan's citriculture industry. Kinnow share is 95% in total citrus production of Pakistan. An experiment was conducted to evaluate the endogenous plant hormones, leaf gas exchange parameters and photosynthetic pigments of Kinnow mandarin grafted on nine rootstocks (Rough lemon, cox mandarin, Fraser hybrid, Troyer Citrange, Cleopatra mandarin, Poncirus trifoliata, Benton, C-35 and Carrizo Citrange). Endogenous hormones levels, physiological and growth attributes were studied on seven years old trees of the scion stock combination for consecutive two years. Maximum Indole acetic acid (IAA), gibberellic acid (GA3) and zeatin (ZT) levels were recorded in scion and rootstock of Poncirus trifoliata followed by Fraser hybrid. Troyer citrange rootstock depicted maximum amount of abscisic acid in scion and rootstock. Maximum leaf gas exchange in Kinnow mandarin was recorded on Fraser hybrid rootstock followed by Poncirus trifoliata. Kinnow grafted on Troyer citrange rootstock had minimum stomatal conductance and photosynthetic activity because of high ABA level. Photosynthetic pigments of Kinnow mandarin were maximum on Poncirus trifoliata and minimum on Troyer citrange. A positive correlation was observed among levels of IAA, GA, ZT and vegetative growth of Kinnow mandarin. It was concluded that endogenous hormones modulated the growth of Kinnow mandarin. Poncirus trifoliata and Fraser hybrid rootstocks could be an alternate rootstocks of traditional Rough lemon for Kinnow mandarin .



## **VARIETAL DIVERSIFICATION OF VARIOUS POTATO GENOTYPES UNDER AGRO CLIMATIC CONDITION OF OKARA DISTRICT, PAKISTAN**

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### **Abstract**

Potato is a nutritionally enriched garden vegetable which considered as a valuable cash crop of Pakistan due to its remarkable share in national GDP. Potato has been widely cultivated on a commercial scale and has a diverse range of germplasm that needed to be characterized in order to pool the most potential genotypes. Therefore, eight different genotypes of potato were collected from Potato Research Institute (PRI), Sahiwal and evaluated against various morphological traits under the agroclimatic conditions of Okara district. Maximum tuber emergence (%) was noted in FD7430 (77.33). Regarding foliage characters, stem color varied from full green to green with purple streaks while stem cross section was round to angular among all genotypes. Number of stem per plant (7), stem height (64.67 cm) and number of secondary shoots (15) were more in Mozika. Leaf shape varied from undissected to weakly dissected among all genotypes while genotype FD7430 had maximum leaf size i.e. leaf length (8.1 cm) and leaf width (6.62 cm). Furthermore, SL-52 was considered as more environmentally adaptable due to high resistance against frost and more disease resistance against foliar blight. Among red skinned varieties, more tuber weight (113.25 g) and tuber size (112.65 mm, 60.5 mm) was noted in Mozika. While FD7430 showed maximum tuber weight (226.11 g) and tuber size (113.25 mm, 80.9 mm) among all white skinned potato genotypes. Hence, results indicated that, FD7430 and Mozika genotypes performed better in terms of morphological traits of potato plant and tuber under agroclimatic conditions of okara district.



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## **EFFECT OF GROWING MEDIA ON THE GROWTH, YIELD AND QUALITY OF CONTAINERIZED CHILI (*Capsicum Annum L*) PRODUCTION SUPPLEMENTED WITH K<sub>2</sub>SO<sub>4</sub> FOLIAR APPLICATION**

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### **Abstract**

Chili (*capsicum annum L.*) is one of the most important spice crops of Pakistan. Growing media and prevailing soil conditions significantly affect the yield, growth production and quality of chili. The growth of container-grown chili is highly dependent upon the type of media used. A comprehensive study was conducted to optimize the yield, growth and production via using different growing mixtures and foliar applications of potassium sulfate (K<sub>2</sub>SO<sub>4</sub>). The experiment was carried out at UAF Sub-Campus Burewala during the winter season in a walking tunnel. Effect of growing media (Silt + Sand + FYM and Silt + Sand + PM) at equal ratio was studied on yield, growth and quality of containerized chilies supplemented with 0 ppm, 4000 ppm and 6000 ppm K<sub>2</sub>SO<sub>4</sub> application of at flowering stage. The results revealed significant effect of growing media and K<sub>2</sub>SO<sub>4</sub> foliar application. Chilies grown in pots filled with Silt + Sand + FYM resulted significantly improved growth characteristics including plant height, number of leaves, days to flowering (137 days), increased fresh weight (17g) and dry weight of fruit (1.73g), increased number of fruits, fruit length (3.5 cm), root length, and fruit yield. While, biochemical parameters like pH (3.14), total soluble solids (6.7°Brix), vitamin C and titratable acidity were better in chilies grown in Silt + Sand + PM potting media. Among K<sub>2</sub>SO<sub>4</sub> concentration, 4000 ppm was proved to be most effective in combination with potting media comprising of Silt + Sand + FYM. Keeping in view these results, it was concluded that media composition comprising of media Silt + Sand + FYM (1:1:1) ratio with foliar application of 4000ppm K<sub>2</sub>SO<sub>4</sub> at flowering stage was highly effective in increasing growth, yield and quality of chilies.



## **MANIPULATION IN BUNCH COMPACTNESS OF TABLE GRAPES BY AGRONOMIC APPROACHES, ANTITRANSPIRANT APPLICATION AND GIBBERELIC ACID SPRAYING.**

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### **Abstract**

Compact grape bunches have higher susceptibility to infections and more chemicals are needed to protect the fruits. Different experiments were conducted to find out the appropriate strategy for getting desirable compactness level in three grapes cultivars including 'Sultanina-C', 'Flame Seedless' and 'NARC Black'. In first experiment, different cultural or agronomic techniques (Leaf removal, berry thinning and shoulder removal) had been tested to reduce bunch compactness and their impact on fruit physicochemical parameters was evaluated. Second study was carried out to estimate the impact Kaolin antitranspirant chemical at the time of flowering on physical and biochemical attributes of same cultivars. Exogenous application of Kaolin was made with 0, 3, 5, and 7% concentration at flowering stage. In next study, exogenous application of GA3 was applied at pre-bloom and full bloom stage with concentration 5, 10, 20 and 30ppm whereas control plants were sprayed with water. Medium loose bunches were attained by berry thinning treatment in 'Sultanina-C' grapes whereas in 'Flame Seedless', all treatments except leaf removal, resulted in producing medium loose bunches. Although the production had been reduced but the unmarketable berries were also reduced significantly as a result of leaf removal and thinning. The visual quality parameters including L\*, b\* and a\* were improved in less compact bunches in response to treatments. Kaolin 3% produced medium loose bunches which is desirable trait of table grapes that resulted in 1.65-fold less compactness whereas, Vitamin C, total phenolic contents and total antioxidants were reduced significantly. Medium loose bunches were obtained where 10ppm GA3 was applied. Pre-bloom application of GA3 significantly increased the bunch length of Sultanina-C and Flame Seedless. The unmarketable berries percentage was reduced significantly with increasing concentration of GA3 and reduced bunch compactness. TSS of 'Sultanina-C' and 'NARC Black' grapes were increased because of GA3 application during first year experiment while no significant change was recorded in 'Flame Seedless'. Vitamin C, total phenolic contents (TPC) and total antioxidants were decreased with GA3 application.



## **BIOSTIMULANTS IMPROVED THE REPRODUCTIVE GROWTH AND BIOCHEMICAL CHARACTERISTICS OF MANGO (*Mangifera Indica* L.) CV. SAMAR BAHIST CHAUNSA**

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### **Abstract**

Climate change is recognized as one of the most serious challenges affecting agricultural productivity globally. Mango (*Mangifera indica* L.) production has the potential to boost Pakistan's socio-economic growth and development, but its production is declining in recent years due to imbalanced nutrition and rapid increment in temperature at the flowering stage subsequently triggering flower drop and low production. To alleviate this issue, the use of biostimulants on mango cv. Samar Bahist Chaunsa to combat nutrient deficiency and overcome climate change effects at the flowering stage is a sustainable approach in a cost-effective and eco-friendly way. A field experiment was designed according to the Randomized Complete Block Design (RCBD) with four treatments and three replications, performed at Sq.# 9, University of Agriculture, Faisalabad during 2021-2022. This study aimed to assess the reproductive growth and fruits biochemical characteristics by foliar application of different biostimulants. The treatments viz. To (distilled water), T1 Biofoliar (440 ml/100 liters), T2 Seamaxx (330 ml/100 liters) and T4 Orange Amine (400 ml/100 liters) were applied as a foliar application at the pre-bloom stage and fullbloom stage of mango flowers with a boom sprayer. The results revealed that the application of T2 (Seamaxx 330 ml/100) liters on mango flowers at both pre-and fullbloom stages had a significant effect on the reproductive growth and fruit biochemical contents along with the increment of the fruit set percentage as compared to control. The mango fruit analysis disclosed that the maximum fruit length (118.101 mm), fruit width (64.533 mm), fruit weight (271.33 g), and total yield (98.01 kg) were recorded with application of Seamaxx 330 ml/100 liters. Biochemical studies showed that the total soluble solids (27.46 °Brix) and titratable acidity (0.896%) were highest at Seamaxx 330 ml/100 liters. Furthermore, nutritional studies also showed that the application of Seamaxx 330 ml/100 liters had a positive effect on different nutritional contents (N, P, K, Ca, Cu, Mg, Fe, Zn, and Mn) of mango fruit. In conclusion, this study suggests that the application of Seamaxx 330 ml/100 liters as a biostimulant can be used to fulfill the nutrients requirement and reduce the increasing-temperature effects at the flowering stage, thus enhancing the crop yield as well as the quality of fruit.



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## **WILD WATERMELON ROOTSTOCK IMPROVES WATERMELON GROWTH BY ENHANCING BORON UPTAKE UNDER LOW BORON CONDITIONS**

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### **Abstract**

Boron (B) is an essential micronutrient for plant growth and development. The deficiency of boron suppresses root and shoot growth resulting poor plant development. The aim of the present study was to evaluate if water-melon (*Citrullus lanatus* L.) performance can be improved under different B conditions (0.25  $\mu$ M and 75  $\mu$ M- as H<sub>3</sub>BO<sub>3</sub>) by grafting B inefficient genotypes onto wild watermelon rootstock. Shoot dry mass, root mass ratio and root tissue density was significantly higher in wild watermelon rootstock grafted plants compared with self-grafted plants under low B (0.25  $\mu$ M) conditions. Wild watermelon rootstock grafted plants showed reduced H<sub>2</sub>O<sub>2</sub> accumulation and lipid peroxidation, and improved catalase and superoxide dismutase activity. The root and leaves cell wall structural analysis showed less protein structure destruction and wax accumulation in cell wall of wild watermelon rootstock grafted plants evidenced by less cellulose content, and high expression of cell wall related gene (Cla.XTH27) under 0.25 $\mu$ M B supply. Moreover, higher expression of B transporters genes (ClaBOR1, ClaBOR2, ClaNIP5;1, ClaNIP6:1) in wild watermelon rootstock grafted plants helped enhance B uptake and supply to plant tissues and cell wall that improved plant growth. In conclusion, we suggest that grafting can be used to improve the growth and development of watermelon under low boron soil conditions.





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## **ASSESSMENT OF MICRO-NUTRIENTS UPTAKE IN SWEET ORANGE CV. MUSAMBI AND SALUSTIANA UNDER FIELD CONDITION**

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### **Abstract**

Musamabi & Salustiana (*Citrus sinensis* L.) are two commercial varieties of a sweet orange group in Pakistan. In some previous years, there is a rapid decline in bearing age, yield, and fruit quality. The experiment was carried out to evaluate the diagnostic study of micro-nutrients up taken by two citrus cultivars. The purpose of the study was initiated to evaluate the varietal comparison against the uptake of micro-nutrients in a one-year life span of two selected cultivars of sweet orange. Two treatments were selected for this experiment T1= Control (Recommended fertilizer NPK) and T2= T1+ Micro-nutrients (Fe & Zn) foliar spray. Data regarding zinc, Iron, plant height, plant canopy, chlorophyll content, leaf area, fruit weight, fruit size, peel weight, juice weight, peel thickness, number of seeds, titratable acidity, total soluble solids(TSS), and yield were observed and results showed significant impact in their levels. In leaf micro analysis application of T2 on all three stages, Zn & Fe showed a significant increase in the Salustiana. However, T2 treatment on Salusti- ana variety improves their plant height, plant canopy, leaf area, and leaf chlorophyll content. The maximum increase in fruit weight, fruit size, peel weight, peel thickness, juice weight, and yield was founded when T2 treatment was applied to the Salustiana variety. While, the maximum number of seeds was recorded in T2 when applied on Musamabi and the highest titratable acidity was obtained when T1 was applied to the Musam- bi. Similarly, Maximum TSS was recorded when T1 was applied on Salustiana. The results showed that appli- cation of T2 = T1 + micro-nutrients (Fe & Zn) foliar spray to the trees of the Salustiana variety can be used to obtain long-life trees with better quality and maximum yield. Keywords: Nutrients, fertilizer, age of plant, growth, quality, yield.



## **EFFECT OF PRE-HARVEST FRUIT BAGGING ON QUALITY OF MUSKMELON**

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### **Abstract**

Numerous good agricultural practices (GAP) are becoming revered in all over the World to produce high-quality fruit with less dependence on man-made chemicals. Among such practices, pre-harvest fruit bagging has emerged as an effective method. The Golden variety of muskmelon was the subject of the current study at Bahauddin Zakariya University in Multan, Pakistan during 2019-2020. The study's goals were to investigate whether pre-harvest bagging provided physical protection that enhanced fruit quality internally by altering the microenvironment for fruit growth and boosting skin colouration and lowering abnormalities in addition to promoting fruit quality aesthetically. The study included six different kinds of bags and experiments laid out according to a randomized complete block design (RCBD). These bags were i.e., muslin cloth with elastic closing, muslin cloth with zip closing, muslin cloth with magic closing, polythene with zip closing, polythene with staple closing and spun bond fabric bag. The highest fruit weight was found in polythene bags with staple closure, whereas the lowest fruit weight was found in muslin cloth with elastic closure. The findings relating to weight loss in ripe fruit revealed that various types of bags had an extremely significant impact. The rate of ripe fruit weight loss was highest for polythene with zip closure, followed by polythene with staple stoppage. A polythene bag with a staple closure maximized ascorbic acid buildup in mature fruits. Different forms of bagging treatments had little effect on the anti-oxidant capability of ripe fruits, but they significantly reduced it in preserved fruits. Polythene bags with staple fastening produced the highest phenolic contents, while fruits that weren't packed had the lowest levels. Different types of bags had a highly significant impact on organoleptic evaluation (aroma, flavour, taste, texture, and overall acceptability). Thus, these results about fruit bagging technique may help for sustainable fruit production with good quality.



## ASSESSMENT OF FOLIAR APPLICATION OF MICRONUTRIENTS ON GROWTH AND YIELD OF VEGETABLE MARROW UNDER CALCAREOUS SOIL

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### Abstract

Vegetable production has the potential to boost Pakistan's socioeconomic growth and development, but its production is low due to nutritional imbalances in plants that greatly affect plants' performance. In semi-arid and arid regions of the world, deficiency of micronutrients especially iron (Fe) and zinc (Zn) is widespread due to an increase in fixation and decrease in solubility which influences crop productivity. To alleviate this issue and to boost plant's performance; a field experiment was designed according to a randomized complete block design (RCBD) with three replications and performed in the year 2021. The study aimed to assess the impact of foliar application of Fe and Zn on the growth and yield of vegetable marrow (*Cucurbita pepo*) under calcareous soil. Nine different treatments were applied as two levels of Zn (25 and 50mgL<sup>-1</sup>), two levels of Fe (50 and 100mgL<sup>-1</sup>) and four combinations of Fe and Zn viz. 25mgL<sup>-1</sup> Zn+50mgL<sup>-1</sup> Fe; 25mgL<sup>-1</sup> Zn+100mgL<sup>-1</sup> Fe; 50mgL<sup>-1</sup> Fe+50mgL<sup>-1</sup> Zn; 50mgL<sup>-1</sup> Zn+100mgL<sup>-1</sup> Fe and a control treatment at three intervals of time during the growth period. Results showed that foliar application of Fe and Zn put a positive effect on the growth and yield parameters of vegetable marrow. Among all the studied parameters, a significant improvement was observed in leaf greenness (43.6 SPAD values), leaf carotenoid content (0.0339), and leaf number (142.8) by the foliar application of 25mgL<sup>-1</sup> Zn, 100mgL<sup>-1</sup> Fe and 50mgL<sup>-1</sup> each Fe and Zn, respectively. Moreover, average fruit weight (240.33g) and fruit yield per plant (789.83g) were significantly higher by the foliar application of 50mgL<sup>-1</sup> Zn+100mgL<sup>-1</sup> Fe treatment. In conclusion, the foliar application of 50mgL<sup>-1</sup> Zn+100mgL<sup>-1</sup> Fe during the growth period may be a sustainable approach to increase vegetable marrow growth performance and yield under calcareous soil.



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## **EFFECT OF DIFFERENT TRELLISING SYSTEMS ON YIELD AND FRUIT QUALITY OF WILD BLACK RASPBERRIES GROWN AT RAWALAKOT, AZAD JAMMU AND KASHMIR**

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### **Abstract**

Raspberries are the third most popular berries after strawberries and blueberries. Black raspberries are deciduous shrubs of temperate region. Due to the ideal climatic conditions for its growth, black raspberry plants have been found wild under Rawalakot conditions. Therefore, a huge plantation could be found in wild. However, no studies have been conducted so far to exploit their commercial potential. In general, berry crops have better postharvest fruit quality when the plant microclimate is improved by having an open canopy and maximum air circulation. Open canopies and optimum air circulation can be attained by the proper combination of plant spacing, vegetative thinning and training. In this study wildy grown plants from different localities were collected and grown under rain-fed conditions of Rawalakot using three different trellising systems including hedgerow (control), V-trellis and single-sided shift trellis. Rows were planted in an east-west orientation, with approximately 10 feet row-row distance and 3 feet plant-plant distance. After first year growth of wild raspberry plants trained under different trellis systems, data collection is in progress for various parameters related to vegetative, morphological and fruit quality. After studying all the production and postharvest handling protocols, there is a great possibility that the local communities will show some interest in consuming this highly nutritious fruit in fresh form. Moreover, the local farmers can earn additional income after growing this crop on a commercial scale and with the increase in production a small scale industry could be established for developing value added products in future.



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## **PERFORMANCE EVALUATION OF DIFFERENT CULTIVARS OF GLADIOLUS AGAINST DIFFERENT PLANTING DATES AT MULTAN**

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### **Abstract**

Gladiolus is an important floricultural crop commercially grown and is used for decorative purposes especially as cut flower. The present investigation was carried out at Horticultural Research Sub-station for Floriculture and Landscaping, Multan. Four promising varieties of gladiolus viz: V1: White prosperity, V2: Amster dam, V3: Essential and V4: Red Balance were evaluated against different planting dates viz: T1: 15th September, T2: 1th October, T3: 15th October and T4: 1st November. The results of study depicted that the maximum plant height (108.65cm) was recorded in white prosperity in V1: when planted on 1st November. Whereas the days to spike emergence remained minimum in V1: white prosperity followed by V2: Amsterdam on same date of planting. Minimum number days (81.50) and (84.25) to first floret opening were observed in V:1 (White prosperity) and V:2 (Amsterdam) respectively on same date of planting. Overall results revealed that white prosperity and Amsterdam gladiolus cultivars performed better when planted on 15th September and 1st October respectively as compared to other varieties and dates of planting.



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## **ANATOMICAL STUDY OF LEAVES OF RUBUS SPECIES COLLECTED FROM POONCH DIVISION OF AZAD JAMMU AND KASHMIR**

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### **Abstract**

Rubus is a large and diverse genus of flowering plants in the rose family Rosaceae with 250-700 species. Different species in the Rubus genus are native to six continents and are found from mountain tops to coastal locations at sea level. Leaves are among the most important organs of a plant that indicate the plant condition. The anatomy shows adaptations and their functional traits reflect to some extent the constraints of environments where a plant grows. Anatomical study of characteristics of the epidermis of leaves and along with the transverse section includes leaf traits that are leaf area, specific leaf area, leaf thickness, palisade thickness, spongy tissues thickness and stomatal traits include stomatal density, stomatal pore index, stomatal thickness, stomatal length by placing samples in formalin alcohol solution. Due to the ideal climatic conditions for their growth, plants of Rubus species plants have been found wild in Poonch division of Azad Jammu and Kashmir. There is enormous need and scope for the conservation of genetic resources of Rubus species in this area. So far no studies have been conducted for exploring these species for their nutritional and socio-economic benefits of local communities. Therefore, this study has been designed to collect these wildly grown species from Poonch division of Azad Jammu and Kashmir, identify them, document their characteristics and conserve them for future studies and research planning. Promising Rubus species, screened out by morphological characterization will be further investigated through SSR markers to confirm genetic variations.



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## **BIOCHEMICAL EVALUATION OF EUROPEAN PLUM CULTIVARS GRAFTED ON WILD ALMOND ROOTSTOCK**

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### **Abstract**

European plum (*Prunus domestica* L.) is an important temperate fruit belongs to family "Rosaceae" that is comprised of 100 genera and over 300 species. In Pakistan, it is considered a minor fruit crop having most of its production in Balochistan followed by KPK and northern areas of Punjab. In these areas, plum is grafted on Swat local and Desi peach rootstock. However, while using these rootstock, plum growers faces certain issues such as scion compatibility issues, low precocity, lack of uniformity, fruit quality and adaptability to regional soil and climatic conditions. Therefore, to fill such gaps wild almond was used as rootstock to check its influence on five promising cultivars growing in Punjab such as "Fazal-e-manani", "Red beaut", "Methaley", "Red ruby", and "Gurdalu". The results exhibited that wild almond rootstock has a significant impact on plum biochemical attributes. Highest. Ascorbic acid contents (3.39 mg 100 g<sup>-1</sup>), were noted in "Red Beaut". While maximum total phenolic contents (0.619 mg GAE 100 g<sup>-1</sup>) and total soluble solids (21.5 °Brix) were recorded in "Gurdalu". However, the highest titratable acidity (6.5%) was observed in "Methaley. The study revealed that wild almond rootstock may be used as a rootstock for plum growers and may be used in future for crop improvement programs.



## INVITRO CALLUS INDUCTION AND ASSESSMENT OF PHYSICO-CHEMICAL ATTRIBUTES IN MEDICINAL PLANTS OF CHOLISTAN THROUGH STANDARDIZING MS MEDIA

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### Abstract

The study optimized sterilization protocols, culture media, and enzyme sources for three medicinal plants of Cholistan dessert. *Withania coagulans*, *Melothria scabra*, and *Datura stramonium* were sterilized to optimize contamination control. In term of sterilization 0.4% NaOCl required minimum days (15.56d) for seed germination, highest germination percentage and lowest contamination percentage in 70% Ethanol with Tween-20. In term of medicinal plant, statistically least days (6.67) were required to germinate and highest germination percentage were recorded in *M. Scabra* seeds while least contamination percentage were found in *D. stramonium*. In interaction of medicinal plant species and sterilization, *M. Scabra* seeds treated with 70% Ethanol with Tween-20 required least days (3.67) for germination. Highest germination percentage were found in *M. Scabra*, *W. coagulans* and *D. stramonium* seeds treated with 70% Ethanol with Tween-20 and *M. scabra* seeds when treated with sterilized distilled water. Statistically, least contamination percentage were found in *M. scabra* seeds when treated with 70% Ethanol with Tween-20. Statistically, highest callus induction percentage were found in *M. scabra* and overall 2,4-D (2mg/liter of MS Media) showed highest callus induction percentage. In interaction of medicinal plant species with concentration of 2,4-D *M. scabra* and *W. coagulans* showed highest callus induction percentage. Least days (8.0) for callus induction were found in *M. scabra* with 2,4-D 2mg/l. Sterilization of seeds with ethanol was best in term of contamination control, germination percentage and time to germinate seeds. MS media having 2,4-D 2.0mg/l showed best result in term of days for callus initiation and callus induction percentage while 1.5mg/l in term of fresh weight of callus.





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## COMPARATIVE PLANT GROWTH AND YIELD OF FOUR GRAPEFRUIT CULTIVARS AT HORTICULTURAL RESEARCH STATION SAHIWAL

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### Abstract

Comparative plant growth and yield of four grapefruit cultivars at Horticultural Research Station Sahiwal Asif-ur-Rehman<sup>1</sup>, Mudassir Naseer<sup>1</sup> and Sana Asghar<sup>1</sup> 1-Horticultural Research station, Sahiwal ABSTRACT A comparative study on performance evaluation pertaining to the four grapefruit cultivars was carried out for bringing diversification of this important group of citrus. The grapefruit (*Citrus paradise mac.*) varieties were Red Blush, Marsh seedless, Duncan and Shamber evaluated for plant growth and yield attributes for two consecutive seasons. The age of the plants was 20 years receiving uniform application of management and cultural practices cultivated at 6.1 m space in square system, experimental layout was RCBD with four plants per replication. Significant difference for plant growth and yield attributes was observed among four grapefruit varieties. Conclusively, Red blush plants exhibited significantly higher canopy volume (57 m<sup>3</sup>), plant height (360 cm), stem girth (55.9 cm), average fruit weight (464 g) and yield (422 fruit/ plant) than other contestant varieties Duncan, Marsh seedless and Shamber. The studies confirm that all the grapefruit varieties can be successfully grown in Sahiwal region. Moreover, the studies on growth and yield are stood confirmative of the successful acclimation of seedless Red blush and Shamber grape fruit varieties besides Duncan and Marsh seedless in Sahiwal division.



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## **EFFECT OF FOLIAR SPRAYS OF KNO<sub>3</sub> ON THE YIELD AND FRUIT QUALITY OF KINNOW**

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### **Abstract**

Kinnow is a high value crop and contains a unique characteristic fruit value among all other citrus varieties. In Sahiwal zone fruit gets affected by the severe fruit drop and greening issues due to high temperature and nutrient unavailability. In pursuit of that foliar sprays of KNO<sub>3</sub> were applied to kinnow trees with concentrations of control, 2%, 4% and 6%. Aim of the experiment was to find out the optimum dose of KNO<sub>3</sub> for enhancement in quality and yield of kinnow. The experiment laid out according to Randomized Complete Block Design (RCBD), with four replication and two plants per treatment for the consecutive three years. Data regarding yield per plant, fruit weight, fruit size, peel thickness, peel weight, juice weight, juice percent- age, rag weight, TSS, leaf area, chlorophyll content total sugars and vit. C was evaluated. Data revealed that T3 (KNO<sub>3</sub>-4%) showed comparatively higher fruit number (654), fruit weight (193 g), fruit size (6.4/7.0 mm), juice weight (87.1 ml), juice percentage (45.1), TSS (12.1), chlorophyll content (0.4 mg-1Fw), total sugars (8.12 %) and vit. C (74.16 mg/100g). In the future, it will be an effective protocol for the quality produce of kinnow on commercial basis.



## **PERFORMANCE OF DIFFERENT PEACH VARIETIES AT LOWER ALTITUDE (4000 FT) OF MURREE HILLS**

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### **Abstract**

Peach is unique stone fruit belongs to subtropical zones. It is getting high in demand due to its immense nutritional importance and dessert quality. High quality peach produce is dependent of various factors such as variety, rootstock, climate and soil etc. In pursuit of that the performance of eight different cherry varieties namely Florida King, Peach 8, Mario Delicizia, Peach 3, Early Grand, A-669, Nectarine and Spring Crest were evaluated in the climatic conditions of Tret (4000 ft). The experiment laid out according to randomized complete block design (RCBD), with four replications and one plant per treatment for the consecutive three years. Data regarding Flowering time, Fruit setting, Color break stage, Date of maturity, Ripening Stage, Fruit Weight (g), Fruit Length (cm), Fruit Width (cm), Yield per plant (kg), TSS % and Firmness. Peach 8 is the early maturity variety followed by Florida king. The Highest TSS value was shown by Florida King (13 oBrix) followed by Peach 8 (12 oBrix). Regarding the firmness (15) Florida king surpasses all other varieties. Regarding yield per plant Early Grand exhibited better results (15 kg/plant). In the long run, it will be an effective protocol for production of peach on commercial scale and development of market as well as storage on sound basis.



## **INTERACTIVE EFFECTS OF SCION AND ROOTSTOCK GENOTYPES COMPATIBILITY AND FRUIT QUALITY**

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### **Abstract**

Different rootstocks were imported by Agriculture Research System from University of California, USA under Project for Horticulture Promotion (PHP) project during 1999-2000 and were planted at GPU, Sherkhana for evaluation. The experiment was laid out in Randomized completely block design and each treatment had three replications. Sweet orange (*C. sinensis*) variety Blood Red budded on Carrizo Citrange (*Citrus insitorum*), Australian Bigarade (*C. aurantium* L.) and Sour Orange (*Citrus aurantium*) rootstock and data were recorded on compatibility and nursery plant parameters. However the same parameters were also examined for tree and fruit traits. The parameters recorded during propagation stages are days to bud sprouting, percent sprouting, survival percentage, scion length, scion diameter, root volume, while the parameters recorded for tree characteristics were plant height, tree girth and tree canopy. The traits that were recorded for fruit characteristics were TSS (Total Soluble Solids), acidity, reducing sugars, nonreducing sugars, total sugars, sugar acid ratio, peel diameter and fruit size. Most of the studied parameters were found non-significant except fruit size and TSS. Carrizo citrange gained maximum values in days to sprouting (58), sprouting percentage (80.5 %) and survival percentage (93.75 %) during propagation, while resulted minimum values in tree traits such as tree girth (1.12 ft), tree canopy (10.46 ft) and plant height (5.98 ft). Blood red on Australian bigarade rootstock resulted maximum scion length (52.3 cm), scion diameter (0.68 cm), root volume (23.54 cm<sup>3</sup>) and yield (265 fruits/tree), while maximum tree girth (1.45 ft), tree canopy (13.12 ft) and tree height (8.24) was recorded in plants budded in sour orange. Regarding fruit quality parameters most of the values are maximum in fruits produced on sour orange rootstock viz., acidity (1.22 %), reducing sugars (0.53%), non-reducing sugars (1.19 %), total sugars (1.69 %) and sugar acid ratio (1.50). However maximum TSS (12.00 Brix), peel diameter (5.15 mm) resulted by Australian bigarade.



## **EVALUATION OF LOCAL CHILI ROOTSTOCKS FOR GRAFT COMPATIBILITY, GROWTH RESPONSE AND PRODUCTIVITY OF HOT PEPPER HYBRID SKYLINE II**

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### **Abstract**

Pepper belongs to family Solanaceae, is one of the important vegetables in the world. Chili production is mainly affected by soil borne and viral diseases. Although fungicides are available for many diseases, but they don't impart complete resistant in many case. In such conditions, use of resistant varieties/hybrids is the only option but resistance has been reported mostly in wild types and landraces. In such situation, grafting on resistance rootstock can help to gain benefits of rootstocks (wild types and landraces) as well as hybrids. We evaluated six local chili landraces i.e., Shinghri, Kot Sultan, Kashmiri, Hasilpur, Lodhran and Qundri, as rootstocks for grafting of hot pepper hybrid (Skyline II) as scion stock along with control (self-grafted). Experiment was laid out on a Randomized complete block design along with three replications. Results revealed that graft compatibility was significant among chili rootstocks. Kashmiri and Lodhran showed the highest compatibility (84.6 and 78.6 % respectively). However, field survival percentage, fruit pedicel length, total soluble solids, fruit juice pH, titratable acidity, and ascorbic acid contents of Skyline II were not affected by different rootstocks. While, maximum plant height (52.7 cm), number of secondary branches (29.3), number of leaves (358.5), number of nodes (150.7), stem diameter above (18.3 mm) and below the union (24.6 mm), chlorophyll contents (26.9 SPAD), total plant yield (1187.6 g), average fruit fresh weight (10.8 g), average fruit length (75.6 mm) and dry weight percentage (16.5 %) were recorded in Kashmiri rootstock. In addition, minimum days to first flowering (54.3 days) was recorded in Kashmiri rootstock but maximum (78.9) was noted in Shinghri rootstock. It was concluded that Kashmiri rootstock had excellent graft compatibility and also improved the growth and fruit yield of hot pepper hybrid Skyline II.



## **ESTIMATION OF CROP PERFORMANCE AND ECONOMIC FEASIBILITY OF PEA-POTATO INTERCROPPING SYSTEM**

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### **Abstract**

Food insecurity is the foremost issue globally as the demand for food is increasing with the rapidly growing world population. Agriculture provides the largest share of food supplies and ensures a critical number of ecosystem services. So, there is a dire need to utilize the cultivable land as well as increase the crop productivity per unit area such as the intercropping system that results in the effective use of land and other resources and a reduction in the cost of production. A study was initiated to assess the relationship and productivity of intercropped leguminous crop (pea) and exhaustive crop (potato). A field experiment was designed according to the randomized complete blocks design (RCBD) with three replications and performed at the Vegetable Research Area of the Department of Horticulture, Bahauddin Zakariya University, Multan 60800, Pakistan during 2019-2020. The three levels of a variable viz. T1 (pea) T2 (potato) and T3 (pea and potato intercropped) were pursued and all recommended agronomic practices were ensued according to crop requirements. Observed data of pea crop were plant height, number of branches, fresh weight of pod, pod length, pod diameter, number of grains per pod, 100 seeds fresh weight and days of flowering and observed data of potato crop were plant height, plant spread, number of stems, number of leaves, number of tubers, the weight of marketable yield, weight of non-marketable yield and total yield per plant. The results revealed that there is no significant difference between the individual performance of pea and potato crops and pea-potato intercropping. However, the pea-potato intercropping system upsurges the per unit area productivity and economic feasibility as compared to individual cultivation. It is suggested that the intercropping of the leguminous crop (pea) in an exhaustive crop (potato) may be helpful for cost-effective and sustainable crop production.



## **IMPACT OF CANOPY DIRECTIONS AND POSITIONS ON FRUIT QUALITY OF FEUTRELL'S EARLY MANDARIN**

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### **Abstract**

Citrus fruit quality is determined by canopy direction as well as its position. Therefore, this work was planned to evaluate the quality of Feutrell's Early fruit harvested from different canopy directions and positions. Fruit was harvested from four different directions (E, W, N, S) and two positions (upper & lower) and subjected to various fruit physio-chemical analysis. The results revealed that fruit harvested from North direction exhibited higher average fruit weight (123.85 g), average rag weight (40.47 g) and average peel weight (24.93 g), average juice weight (57.21 g), average peel thickness (1.17 mm) with maximum SOD (67.13 U mg protein-1) and POD (0.74 U mg protein-1) activity than others directions. Moreover, highest average fruit diameter (63.23 mm), average fruit length (51.55 mm) with more ethylene production (2.96 nmol C<sub>2</sub>H<sub>4</sub> kg<sup>-1</sup>hr<sup>-1</sup>), TSS (13.70oBrix), TSS: TA ratio (25.27), anthocyanin (0.156 mg -1 100 g FW) and carotenoids (0.076 ug/100 mL) was observed in fruits harvested from the South direction. Fruit harvested from west direction exhibited maximum blemishes (2.93score) while higher average seed weight (1.68 g), average number of seeds(11), TA (0.57%), ascorbic acid contents (27.17 mg/100ml of juice), total antioxidants (84.54% Inhibition) and CAT (10.28Umg protein-1)was found in fruit from East direction. As far canopy position was concerned, fruit harvested from upper canopy position exhibited higher average fruit weight (106.82 g), average rag weight (34.21 g), average seed weight (1.34 g), average juice weight (49.39 g), average no. of seed (13), average peel thickness (1.058 mm) with maximum TSS (12.73oBrix), TA (0.56%), ascorbic acid (26.82 mg/100ml of juice), total phenolic contents (67.692 mg -1 100 g GAE), anthocyanin (0.1325mg -1 100 g Fw) and POD activities (0.61 U mg protein-1), while ethylene production (2.49 nmol C<sub>2</sub>H<sub>4</sub> kg<sup>-1</sup> hr<sup>-1</sup>) and blemishes (1.74 scores) were found to be higher in fruits harvested from lower canopy. Conclusively, fruit harvested from North direction and upper position exhibited better fruit quality attributes in Feutrell's Early mandarin fruit.



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## **EFFECT OF ASCORBIC ACID ON GROWTH OF ROUGH LEMON (*Citrus jambhiri*) UNDER SALINE**

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### **Abstract**

Rough lemon (*Citrus jambhiri*) is important for rootstock purposes in the whole world. Salinity stress drastically affects its growth and nutrient accumulation. Several recent studies have shown that ascorbic acid (Asc) can confer abiotic stress tolerance to plants. Exogenous application of ascorbic acid leads to improved growth under saline conditions. Therefore this experiment was conducted to investigate the influence of ascorbic acid (0ppm, 50ppm, 100ppm) spray on rough lemon plants. The pot experiment was conducted according to the complete block design with three replications at the citrus research area in the Department of Horticulture, Bahauddin Zakariya University Multan. Plants were treated with three salinity levels (0ppm, 50ppm, 100ppm). The plants were given saline water after one day and a spray of ascorbic acid on each fortnight. The main effect of the high concentration of ascorbic acid was significant on the majority of plant characteristics but a higher concentration of salt inhibits the growth of the plant. Results showed that 100 ppm ascorbic acid significantly affected the studied parameters as compared to the control. Regarding different concentrations of ascorbic acid, 100 ppm performed the best for plant height, stem diameter, no. of leaves, fresh leave weight, dry leave weight, fresh root weight, and dry root weight. Not all effects of salinity were negative but rough lemon plants can tolerate the saline condition at a specific level. It is suggested that ascorbic acid can improve the tolerance of rough lemon rootstock under saline conditions.





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## **PHYSICO-CHEMICAL AND SENSORY CHARACTERISTICS OF THREE DATE PALM CULTIVARS OF MAKRAN DIVISION, BALOCHISTAN**

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### **Abstract**

Date palm (*Phoenix dactylifera* L.) is valuable and highly nutritive fruit crop. Makran is famous for production of best date cultivars and best source of income for most of the farmers. However, the quality of them is not up to the mark due to lack of post-harvest management. This study was planned to evaluate fruit quality at khalal stage of three dates palm cultivars (Mozathi, Begum jangi, and Haleeni) harvested from Makran division, Balochistan. The physico-chemical and organoleptic analysis were performed under ambient condition (23-27°C and 55-65% R.H) on daily basis upto day-2. As the shelf period progressed, all the date palm cultivars exhibited significant loss in fruit weight, titratable acidity (TA), and vitamin C contents up to day-2 of shelf. However, irrespective to days at shelf, Mozathi exhibited significantly lower weight loss, higher Vitamin C content, total soluble solids (TSS) and sensory attributes with best aroma, taste, texture, and flavor as compared to other cultivars. While Haleeni exhibited significantly higher titratable acidity, and juice pH. Conclusively, Mozathi showed best fruit quality attributes while begum jangi showed more fruit quality losses during shelf period.



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## **INFLUENCE OF NUTRIENTS FOLIAR SPRAY ON YIELD AND QUALITY ATTRIBUTES OF KINNOW MANDARIN**

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### **Abstract**

Citrus (*Citrus sinensis* L.) is one of the world's most significant fruit crops, 3rd among subtropical fruits. Kinnow is considered as the trademark of Pakistan's citriculture industry, dominates the major citrus growing areas of the country. Macro and micronutrients have the capacity to regulate and manipulate the growth and fruit quality of Kinnow mandarin. The present study was initiated to evaluate the influence of foliar sprays of nutrients on yield and fruit quality of Kinnow mandarin. For this purpose, foliar sprays of different nutrients (nitrogen, iron and zinc) were applied on plants. The trial was carried out using a randomized complete block design (RCBD). The parameters such as reducing sugars (%), acidity (pH), TSS (brix)0, total sugars (%), total fruits per plant, fruit set (%), yield per tree (Kg), length of fruit (cm), fruit width (mm), total number of seeds per fruit and peel thickness (mm) were studied. The collected data was analyzed statistically by using the proper software. According to results, T6 (Nitrogen @1.5%) gave best results in terms of reducing sugars, TSS/Brix (0), total sugars (%), fruit set (%), yield per tree (Kg), fruit length (cm), fruit width (mm), number of seeds per fruit and peel thickness (mm). The minimum acidity (pH) was recorded in T5 (Nitrogen @1%) and T4 (FeSO<sub>4</sub> @0.5%). While the maximum number of fruits per plant were recorded in T4 (FeSO<sub>4</sub> @0.5%) then in T2 (ZnSO<sub>4</sub> @0.5%). All the treatments give good result as compare to T0 (control / no treatment) while T6 (Nitrogen @1.5%) gave best results in maximum parameters observation.



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## **MORPHOLOGICAL AND ANATOMICAL STUDY OF RUBUS SPECIES COLLECTED FROM MUZAFFARABAD DIVISION OF AZAD JAMMU AND KASHMIR**

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### **Abstract**

Rubus is a large and diverse genus of flowering plants in the rose family Rosaceae with 250-700 species. Different species in the Rubus genus are native to six continents and are found from mountain tops to coastal locations at sea level. Due to the ideal climatic conditions for their growth, plants of Rubus species have been found wild in Muzaffarabad division of Azad Jammu and Kashmir. There is enormous need and scope for the conservation of genetic resources of Rubus species in this area. So far no studies have been conducted for exploring these species for their nutritional and socio-economic benefits of local communities. Therefore, this study has been designed to collect these wildy grown species from Muzaffarabad division of Azad Jammu and Kashmir, identify them, document their characteristics and conserve them for future studies and research planning. Promising Rubus species, screened out by morphological (e.g. leaf area and shoot dry weight) and anatomical (e.g. Increase in leaf blade thickness, reduction in epidermal cell area, evolution of small sized vessels, and extensive sclerenchyma tissues) characterization will be further investigated through SSR markers to confirm genetic variations.



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## **ANATOMICAL STUDY OF LEAVES OF RUBUS SPECIES COLLECTED FROM POONCH DIVISION OF AZAD JAMMU AND KASHMIR**

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### **Abstract**

Rubus is a large and diverse genus of flowering plants in the rose family Rosaceae with 250-700 species. Different species in the Rubus genus are native to six continents and are found from mountain tops to coastal locations at sea level. Leaves are among the most important organ of a plant that indicates the plant condition. The anatomy shows adaptations and their functional traits reflect to some extent the constraints of environments where a plant grows. Anatomical study of characteristics of the epidermis of leaves and along with the transverse section includes leaf traits that are leaf area, specific leaf area, leaf thickness, palisade thickness, spongy tissues thickness and stomatal traits include stomatal density, stomatal pore index, stomatal thickness, stomatal length by placing samples in formalin alcohol solution. Due to the ideal climatic conditions for their growth, plants of Rubus species plants have been found wild in Poonch division of Azad Jammu and Kashmir. There is enormous need and scope for the conservation of genetic resources of Rubus species in this area. So far no studies have been conducted for exploring these species for their nutritional and socio-economic benefits of local communities. Therefore, this study has been designed to collect these wildly grown species from Poonch division of Azad Jammu and Kashmir, identify them, document their characteristics and conserve them for future studies and research planning. Promising Rubus species, screened out by morphological characterization will be further investigated through SSR markers to confirm genetic variations.



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## **EFFECT OF MORINGA LEAF EXTRACT DURING SEED PRIMING ON THE QUALITY OF RIDGE GOURD (*Luffa actangula*) SEED**

Sana Mudassar<sup>1\*</sup>, Safina Naz<sup>1</sup>, Shaghef Ejaz<sup>1</sup>, Sajid Ali<sup>1</sup>, Sakeena tul Ain<sup>1</sup>, Anam Noor<sup>1</sup> and Hassan Sardar<sup>1</sup>

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### **Abstract**

The ridge gourd (*Luffa acutangula* L.) is an important green vegetable among cucurbitaceous crops. It has a very low germination rate and poor seedling establishment due to the hard outer seed coat. Seed priming is a useful technique for enhancing seed vigor, thereby, improving overall germination and seedling development in crop species. Recently, different extracts have been found to improve the seed germination of various vegetables. Therefore, the present study was conducted to study the effect of moringa leaf extract on the germination and quality attributes of ridge gourd. In order to improve the germination quality of the ridge gourd, its seeds were primed with different concentrations of moringa leaf extract 0, 1, 2, 3, 4, and 5%. The experiment was conducted in a completely randomized design with 6 treatments and each treatment contained three replications. Results showed that moringa leaf extract significantly affected the studied parameters as compared to the control. Regarding different concentrations of moringa leaf extract, seed primed with 4% moringa extract performed the best for germination rates, germination index, mean germination time, number of leaves, stem diameter, shoot fresh weight, and root fresh weight. Germination %, vigor index, shoot length, the number of leaves, leaf area, chlorophyll and shoot dry weight were also increased with 3 % moringa extract. From the results of this study, it was confirmed that moringa leaf extract could be an effective extract to improve seed germination.



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## **EFFECT OF DIFFERENT SOIL AMENDMENTS ON GROWTH AND YIELD OF CAULIFLOWER (*Brassica Oleracea L.*)**

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### **Abstract**

Cauliflower (*Brassica oleracea L.*) is a very nutritious vegetable having lower amount of carbs but having antioxidants, vitamins, minerals and choline in it. The problems related to cauliflower production are their yield and growth. Different types of soil amendments are used to increase the growth and yield of cauliflower. In our study, we used biochar, leaf manure, farmyard manure and accelerator to observe their effects on growth and yield of cauliflower. The results indicated that leaf manure performed best in root length, total plant length and relative leaf chlorophyll content. Farmyard manure performed best in curd diameter, curd fresh weight and total plant fresh weight and dry weight. Accelerator showed significant results in total plant length, plant moisture content and leaf chlorophyll content, whereas biochar didn't show any significant results.



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## INVESTIGATION THE ROLE OF SODIUM NITROPRUSSIDE AND SALICYLIC ACID THROUGH SEED PRIMING ON LETTUCE

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### Abstract

Lettuce is an important salad crop that is grown year-round in the United States from either direct seeding or transplants. In both cases, lettuce seeds are often exposed to higher than optimal temperatures, which results in poor and nonuniform germination, affecting stand establishment. Seed priming induces faster and more uniform germination over a broader temperature range when the primed seeds are subsequently planted. Therefore, this study was conducted to investigate role of sodium nitroprusside and salicylic acid through seed priming on lettuce. sodium nitroprusside and salicylic acid were applied with different concentrations i.e T1 = hydropriming for 24 hrs, T2 = SA priming for 24 hrs, T3 = sodium nitroprusside + salicylic acid priming for 24 hrs, T4 = hydropriming for 12 hrs, T5 = SA priming for 12 hrs, T6 = sodium nitroprusside + salicylic acid priming for 12 hrs. Seeds of lettuce were primed and then sown in pots. The experiment was conducted in a completely randomized design with six treatments, and each treatment contained four replications. Results showed that sodium nitroprusside + salicylic acid priming for 24 hrs significantly affected the studied parameters as compared to control. Regarding different concentrations of sodium nitroprusside and salicylic acid, sodium nitroprusside + salicylic acid priming for 24 hrs performed the best for germination rate, leaf length, total soluble solids, leaf area, chlorophyll content, lettuce fresh weight, and lettuce dry weight. From the results of this study, it was confirmed that sodium nitroprusside and salicylic acid can improve seed germination.



## **POMEGRANATE SHOOT PROLIFERATION THROUGH NODAL SEGMENTS**

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### **Abstract**

Pomegranate (*Punica granatum* L.) has a paramount significance due to its nutritional and medicinal value as it has been used in maintaining a level of blood cholesterol and treating cancer and many other chronic diseases i.e. Diabetes Mellitus, bronchitis and gastro-intestinal ailments. ). In past years, ancient methods like cutting and layering were used for the propagation of pome but it was difficult to proliferate and it required more time (minimum of 1-2 years for culture preparation), labour, and area. Due to the problems like hetero-zygosity, variation, and non-uniformity caused by cross-pollination, pome seeds are not highly demanded. Hence, pome varieties are not cultivated through vegetative propagation as uniform products of plants are not obtained from the seeds and, the quality and yield of these fruits are not up to the mark, thus the reproduction of plants via seeds are not much preferred. Pomegranates were traditionally vegetatively propagated but (with the advancement in technology) nowadays, tissue culture is used for their cultivation. Production of true-to-type plants with mass multiplication achieved through micropropagation by overcoming insects, pest and viral/fungal diseases. The use of nodal segments, a safe and effective micro-propagated true to type technique for pomegranates. In vitro-culture technique is applied by using different auxin and cytokinin ratio and is now employed in their production.





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## **IMPACT OF ZINC OXIDE (ZNO) NANOPARTICLES ON GRAPES (*Vitis vinifera* L.) CV.VITRO BLACK COLOR DEVELOPMENT**

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### **Abstract**

Grapes (*Vitis vinifera* L.) are one of the world's oldest and most widely grown fruit crops. It includes sixty interfertile species with over 1000 cultivars that occur in nature and are preferred by consumers because to its nutritious content and delightful taste. Vitro Black is an intense blueish-purple color grape variety that is frequently planted in Pakistan's Pothohar region because of its early maturity. Yet, it is incapable of producing the appropriate intense blueish-purple or black colour, resulting in an impact on its economic market worth and quality. Nanotechnology is an emerging discipline in agricultural sciences that can assist in improving grape production and quality. Therefore, research was designed to evaluate the impact of zinc oxide nanoparticles in improving "Vitro Black" color and quality attributes. Vitro Black vines grown over T-bar trellis system were treated with four different doses of zinc oxide nanoparticles @ (0ppm, 30ppm, 60ppm and 90ppm). The results indicated that Zinc oxide nanoparticles at 60ppm enhanced the color pigmentation as well as other fruit qualities such total phenolics, total soluble solids total antioxidants, vitamin c and total antioxidants.



## **EFFECT OF PLANT GROWTH REGULATORS ON VEGETATIVE, REPRODUCTIVE, AND BIO-CHEMICAL ATTRIBUTES OF CAULIFLOWER (*Brassica oleraceae* L.)**

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### **Abstract**

Pakistan is one of the top ten cauliflower producing countries in the world, having approximately 11420 hectares of harvested area, approximately 183340 hectograms per hectare of yield, and approximately 209010 tones of production in 2013. From the year 2014 to year 2021, the market growth rate remained low. The use of plant growth regulators on different plant parts in various ways has been proven to be favorable and useful. Plant growth regulators are synthetic organic compounds that are similar to natural plant hormones but they are not nutrients. Plant growth regulators alter the physiological functions of the plant. This study is especially planned to examine the application of GA3 and Rely foliar spray impact at various concentrations on the vegetative, reproductive, and biochemical attributes of the cauliflower crop under RCBD (Randomized Complete Block Design) with three replications. The important parameters which studied are: plant height (cm), curd breadth (cm), curd diameter (cm), curd length (cm), curd weight (g), leaf length (cm), marketable curd weight (cm), no. of leaves per plant, days from transplantation to curd formation, days taken from curd initiation to maturity, yield per acre (kg), yield per plant (g), chlorophyll contents (SPAD units), vitamin C (mg/g), and TSS (Borix0). The data related to crop yield and quality parameters were recorded by using standard procedures. The mean values for various treatments were compared by using the LSD test at a 5% probability level.



## **EFFECT OF PLANT GROWTH REGULATOR ON THE GROWTH, YIELD AND BIO-CHEMICAL PARAMETERS OF CHILIES (*Capsicum frutescens*)**

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### **Abstract**

Chilies, which belong to the *Capsicum* genus, are the most important spices in the world. All types of chilies are grown as annuals. Plant growth regulators have been reported to increase the yield, growth, and quality of many crops. This study was carried out to evaluate the effect of different plant growth regulators (PGRs) on Chilies. Experiment conducted at Vegetable Research Area, Institute of Horticultural Sciences, University of Agriculture Faisalabad. The following treatments were studied in this experiment: T1 Gibrax (10%) 5g/acre, T2 GA3 (10%) 5g/acre, T3 Gibrax (10%) 10g/acre, T4 GA3 (10%) 10g/acre, T5 Gibrax (10%) 15g/acre, and T6 GA3 (10%) 15g/acre. The experiment was laid out according to the Random Complete Block Design (RCBD). All the treatments were replicated four times. Data was collected for growth parameters like plant height, plant stem diameter, leaf diameter (mm), number of leaves per plant, number of branches per plant, number of flowers per plant, number of marketable fruit sizes per plant, stem thickness, fruit length (cm), fruit weight (g), fruit diameter (cm), and biochemical parameters like total soluble solids (TSS), firmness, and vitamin C measured using standard procedures. The data analysed by ANOVA and treatments were compared by the Least Significant Difference (LSD) test at 5% probability.



## **AGRONOMIC BIOFORTIFICATION WITH IRON ENHANCES GROWTH, YIELD AND QUALITY OF TOMATOES**

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### **Abstract**

Iron (Fe) is one of the most important micronutrients required for healthy human life and serves as a vital source for the normal growth and development of crops. In this study, greenhouse experiment was conducted to investigate the impact of Fe foliar application to tomato cultivars viz. Sandal and Sahel at different concentrations (0, 1, 3, 6 and 9 mM Fe/Plant) on physiological, gas exchange, yield linked and quality traits. The results depicted that foliar application with 6 mM Fe solution significantly improved the tomato growth, yield, quality with a significant increment in fruit Fe contents to 3.07 and 3.41 ppm which are very much higher as compared to control having Fe contents of 1.47 and 1.50 ppm respectively. Moreover, increased Fe foliar application with more than 6 mM Fe/Plant could have negative impact on growth, yield, quality, and fruit Fe contents. In conclusion, foliar application of Iron sulfate heptahydrate is an effective, economical and easy approach to biofortify tomato with Fe. This strategy may be easily implemented in commercial tomato cultivation as a routine method and will enable farmers to grow Fe bio-fortified tomatoes in order to address malnutrition linked with Fe deficiency.



## ENHANCEMENT OF COMPOST NUTRIENT QUALITY USING COMPOST WINDROW TURNER

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### Abstract

Solid waste management is the most significant issue from an environmental and agricultural perspective. Composting of the waste is a process to turn the trash into organic fertilizer. As an agriculture base country, better production of the soil is our key goal with improving soil health. Due to the onsite burning of crop residue, the agricultural soil of Pakistan doesn't have enough organic matter which supports good crop productivity. Currently, the adoption of intensive agriculture gives a boost to agriculture production as well as increases the residue quantity. In Pakistan, the local farmers don't have the mechanized solution to incorporate the crop remnants into the soil. Therefore, to sow the next crop within the time they directly burn the trash into the field which badly affects the environment, damages the soil microbes, and increases the emissions of Greenhouse gas. Composting is the better solution to use crop residue as organic fertilizer in the soil. Three essential ingredients are required for composting, including browns, greens, and water. Brown material has carbon concentration, green has nitrogen, and water is an important element in the decomposition material. Moreover, during the composting process turning of material is a significant process to maintain the CN ratio, temperature, moisture, and aeration for good quality compost. The conventional turning method takes time, increases the composting period, and affects the compost quality. This study used the mechanically operated windrow turner to mix the composting material. The developed turner turns the waste with properly mixing the carbon-to-nitrogen ratio (C/N), temperature, and organic content. The nutrient concentration of the compost enriches by turning with the windrow turner machine up to 70% as compared to the developed with conventional method. The nitrogen concentration increases from 75.1 to 2075 ppm, phosphorus from 1.5 to 12.9, and the same as for potassium. The composting time of the material was reduced up to half of the conventional turning method. The results of the study concluded that good quality compost could be produced by adopting the mechanically operated compost windrow turner. The study will be helpful for farmers, academia, and industrialists to improve the organic fertilizer quality and quantity according to crop requirements.



## **APPLE (*Malus domestica* CV GAJA) FRUIT PHYSICO CHEMICAL AND ORCHARD SOIL ATTRIBUTES DYNAMICS OF VARIOUS LOCATIONS OF NORTHERN BALOCHISTAN**

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### **Abstract**

Apples are mostly farmed in hilly locations of Pakistan, with Balochistan and Khyber Pakhtunkhwa provinces contributing the most. The quality of Apple differs from location to location depending upon management practices soil fertility and agroclimatic conditions. Keeping in a view these facts, a study was executed to investigate the effect of growing location and relation of orchard soil nutrient status with fruit quality of Apple (*Malus spp*) in Northern Balochistan. For this purpose, total of 8 orchards of 'Gaja' apple orchards (two orchards per district) were selected in four Districts (Ziarat, Killasaifullah, Loralai and Zhob) of Northern Balochistan. From these orchards, apple fruits samples and orchard soil were collected for quantification of fruit physiochemical and soil physical and chemical attributes quantification. The results indicated a significant difference for fruit physical and biochemical attributes as well as orchard soil physical and chemical attributes among the locations. The apple fruit harvested from orchard-8 (Kach Amaqzai, Loralai) exhibited highest fruit size [fruit width (6.51cm), length (6.17cm) and volume (193.54 ml)] as compared to other locations. The better fruit biochemical attributes were observed in fruit harvested from orchards located at Ziarat with highest ripening index (TSS:TA ratio of 92.54) and higher juice pH (7.54) as compared to other locations. Apple fruit of Sarai zhob and and loralai orchard exhibited highest Vitamin C (48.98 mg/100ml). Apple fruit of Murgha Kibzai, Zhob location exhibited significant higher TSS value (21.80 °Brix), while, fruit orchard of Loralai exhibited higher fruit TA (0.41%). The Soil texture of all the orchard was loamy soil, however, significant differences for soil EC values were observed being highest for Saira, Zhob location with highest soil EC (6.54mScm1) as compared to other orchard soil. Orchard located at Murgha Kibzai, Zhob had high soil pH (8.5), while. Mekhtar, Loralai soil orchard had higher organic matter (0.68 %), Sarai, Zhob soil had available P (15.1mg kg), and K (224 mg kg). Moreover, the better fruit quality attributes fruit TSS and vitamin C contents was positively correlated with Zhob and Loralai locations available soil P and K. In a nutshell, the better apple fruit quality of location was noted with high soil nutrients in Northern Balochistan.



## **EFFECT OF PACLOBUTRAZOL ON GROWTH AND FRUIT PRODUCTION OF ORNAMENTAL PEPPER**

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### **Abstract**

Ornamental Pepper is one of the important heat and drought tolerant plant. It is popular due to diversity in fruit shape. Its market and aesthetic value reduce due to its long stem which behave like wild plants unlike hybrids, reduced plant life cycle, greater incidence of misshapen fruits and high labor requirement for pinching. In this connection, a study was conducted to see the effect of Paclobutrazol on growth and fruit production of ornamental pepper at the nursery of the Department of Horticulture, The University of Agriculture Peshawar, during 2021-2022. Five Paclobutrazol concentrations (1000, 2000, 3000, 4000 ppml-1) along with control and two ornamental pepper cultivars (Medusa and Treasure Red) were investigated. The experiment was laid out in a randomized complete block design with two factors, replicated three times. Paclobutrazol e concentrations significantly affected all the studied parameters. Maximum number of branches (8.71), chlorophyll content (65.62 SPAD), number of flowers (39.49), number of fruits (26.52), fruit weight plant-1 (82.01), days to fruiting (81.00) and number of seeds plant-1 (61.52) were observed at 4000 ppm of Paclobutrazole, while it took minimum (13.82 cm) plant height, number of leaves (95.63), leaf area (3.71 cm<sup>2</sup>), stem diameter (5.49 mm) and fruit size plant-1 (4.80). In case of ornamental pepper cultivars, maximum plant height (13.62 cm), number of leaves (88.88), number of branches (7.56), leaf area (3.64 cm<sup>2</sup>), stem diameter (6.82 mm), number of flowers (41.78), number of fruits (23.58), fruit weight plant-1 (55.68), days to fruiting (76.46) and number of seeds plant-1 (63.26), were observed in cultivar Treasure Red while it took maximum leaf chlorophyll content (53.79) and fruit size plant-1 (4.50) in medusa cultivar. It is concluded from the experiment that the application of Paclobutrazole at a concentration of 4000 ppm showed the best results and cultivar Treasure Red performed well under agroclimatic conditions of Peshawar. Therefore, cultivar Treasure Red is recommended for cultivation under Peshawar conditions, and Paclobutrazole at 4000 ppm concentration is recommended for better growth and yield of ornamental pepper cultivars.



## CHEMICALLY ENHANCED PHYTOEXTRACTION OF LEAD BY MARIGOLD (*Tagetes erecta*) FROM CONTAMINATED SOIL

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### Abstract

Heavy metal contamination of agricultural lands cause serious problems to the ecosystem as well as harmful to plants. Among toxic elements, lead (Pb) is recognized as the most harmful in phyto-environment. Various approaches have been used to overcome the detrimental impacts of Pb and other heavy metals on plants. Among numerous techniques, the use of hyperaccumulator plants along with chemically enhanced phytoextraction of contaminated sites is of exceptional importance. Marigold (*Tagetes erecta*) plants can grow rapidly by developing a robust root system which supports them to survive under metal contaminated soil. Marigold be plants ornamental plant can be used to decontaminate the contaminated sites while providing ornamental value and can serve as a source of commercially valuable products extracting metal from biomass by way of incineration. Therefore, the present study provided a unique opportunity to investigate the effect of various chemical amendments on metal accumulation efficacy of marigold under Pb contaminated. The pot experiment was conducted to assess the effect of Pb @ 0, 500 and 1000 mg kg<sup>-1</sup> on the growth and yield of marigold assisted with amendments i.e., EDTA and Citric Acid @ 0, 1 and 5 mg kg<sup>-1</sup>. At harvest maturity, growth, yield and physiological parameters such as total chlorophyll contents, relative water contents, membrane stability index, root and shoot lengths and weights, Pb contents, and yields of marigold by using standard protocols. The experimental design was completely randomized design with factorial arrangements having three replications. Obtained data was statistically analyzed for significance by using appropriate computer-based software.





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## **MODERN FLORICULTURAL TECHNOLOGIES & OPPORTUNITIES FOR SOUTH PUNJAB, PAKISTAN**

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### **Abstract**

Floriculture, a potential horticultural enterprise- offers higher returns to the growers and stakeholders to fulfill local demands and earn foreign exchange along with generating year-round employment opportunities. There are several modern technologies and interventions being used in producing high quality ornamentals and rapid shift is being witnessed towards floricultural crop production both locally and internationally. This talk describes some of the modern technologies and practices which are being practices in different parts of the world, developments in local floriculture particularly at University of Agriculture, Faisalabad, Pakistan, and opportunities for floriculture stakeholders in Southern Punjab region to fetch higher returns from their floricultural enterprises using these interventions. These interventions include but not limited to cut foliage production, high quality containerized ornamental plant production for local and export markets, flower seed production, flower dehydration and value-added product development from flower crops etc. Use of these modern and agro-climatically best suited species and technologies would not only help improve floricultural production in South Punjab but also improve socio-economic livelihood of local farmers by growing comparatively low cost but high value floricultural crops compared to other horticultural or agronomic crops grown in this region.



**EXOGENOUS APPLICATION OF GIBBERELLIC ACID AND  
BENZYL ADENINE IMPROVE VEGETATIVE GROWTH  
ATTRIBUTES IN PERSIAN SHIELD (*Strobilanthes dyerianus* L.)**

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## Abstract

*Strobilanthes dyerianus* (Persian Shield) is a member of Acanthaceae family. It is an illustrious ornamental plant that is grown for its attractive, iridescent purple foliage. Plant growth regulators like GA3 and BA are used to alter the growth and development of plants in context to stem elongation, cell division, lateral stem growth and foliage growth. The study was aimed to utilize plant growth regulators as a component of growth hormones for hastened vegetative growth in Persian Shield. In this research, exogenous applications of different concentrations were tested to observe their effect on vegetative growth. The experiment was enacted according to Completely Randomized Design (CRD) with 9 plants per treatment. Treatment combinations were as follows viz. T0: Control, T1: 100 mg l<sup>-1</sup> GA3, T2: 200 mg l<sup>-1</sup> GA3, T3: 300 mg l<sup>-1</sup> GA3, T4: 400 mg l<sup>-1</sup> GA3, T5: 100 mg l<sup>-1</sup> BA, T6: 200 mg l<sup>-1</sup> BA, T7: 300 mg l<sup>-1</sup> BA, T8: 400 mg l<sup>-1</sup> BA. Data was collected on various parameters, viz., plant height (cm), number of leaves per plant, leaf area (cm<sup>2</sup>), root length (cm), leaf total chlorophyll contents (SPAD), photosynthetic rate ( $\mu\text{mol m}^{-2}\text{s}^{-1}$ ), transpiration rate ( $\text{mmol m}^{-2}\text{s}^{-1}$ ) and stomatal conductance ( $\text{mol m}^{-2}\text{s}^{-1}$ ). Collected data was analyzed using Fisher's analysis of variance technique and treatment means were compared using Tukey's test at 5% probability level. Results showed that 200 mg l<sup>-1</sup> GA3, 400 mg l<sup>-1</sup> BA, 400 mg l<sup>-1</sup> BA and 200 mg l<sup>-1</sup> GA3 increased length of side branches, length of main branch, increased leaf length as compared to T0: Control. Hence, the result suggested that the application of GA3 and BA improved the vegetative growth attributes of this ornamental pot plant.



## **ESTABLISHMENT OF PROFICIENT IN VITRO REGENERATION SYSTEM FOR NIGHT JASMINE (*Nyctanthes arboristis* L.)**

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### **Abstract**

Night Jasmine (*Nyctanthes arboristis* L.) or Harsinghar is a significant curative plant from the Oleaceae family. Various parts of Night Jasmine are used to treat many diseases and possess antibacterial, antipyretic, anti-inflammatory, antimalarial, anticancer, and antifungal pharmacological properties. Under field condition, Harsinghar suffers from low seed germination and seedling death due to phenolics. However, plant tissue culture offers a viable solution for proliferation and preservation of this medicinal plant. Micropropagation has routine applications of regenerating large number of plants for species with recalcitrant seeds. Present study involves establishment of callus-to-plant regeneration and adventitious regeneration response of Night Jasmine. The leaf and nodal stem sections were cultured on MS media supplemented with 2, 4, 6 and 8 mg/L 2,4-D for callogenesis. Overall, MS+ 4 mg/L 2,4-D with 91% callus induction percentage proved the best medium for callogenesis from both the explants followed by MS+6 mg/L 2,4-D (85.33%) and MS+8 mg/L 2,4-D (77.33%). The leaves exhibited higher collagenic potential than stem explants. Visual observations were recorded for callus color, morphology, and quantity. The leaves produced higher quantity of off white and compact calli, while stem explants produced light brown and soft calli for adventitious regeneration, leaf and nodal stem segments were cultured on MS medium fortified with 1, 3, 5 and 7 mg/L Thidiazuron (TDZ). Leaf explants produced only callus instead of shoot formation on all MS+TDZ media. However, nodal segments produced maximum shoots on MS + 3 mg/L TDZ (92.33%) followed by MS + 5 mg/L TDZ (78.66%) and MS + 7 mg/L TDZ (65.66%). This is the pioneer study on tissue culture response of Night Jasmine and will provide the baseline for future industrial exploitation of this plant.



## **SYNTHETIC AND CHEMICAL PRESERVATIVE-BASED IMPROVEMENT IN VASE LIFE OF GLADIOLUS CUT FLOWERS**

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### **Abstract**

Preservatives are highly important to increase the relatively short vase life of commercial cut flowers hence, seeking natural, inexpensive and effective strategies to extend longevity is essential. Application of Caltrop leaf extract (CLE) as preservative is still elusive. Here we reported the impact of CLE, Sodium nitroprusside and silver nitrate on vase life, physiological processes and antioxidant activity of cut gladiolus spikes. The experiment was conducted under complete randomized design (CRD) under seven treatments. Data of different vase life, physiological and biochemical attributes was recorded. All levels of chemical preservatives and CLE extract showed encouraging results. Among all the treatments, CLE showed most prominent results and increased the florets life along with number of opened florets, relative fresh weight, net photosynthetic rate, sub stomatal conductance, transpiration rate, stomatal conductance, water use efficiency. CLE decreased the bacterial proliferation and ethylene production. In the case of photosynthetic pigments, CLE considerably attained the photosynthetic pigments and antioxidant activities while reduced the production of malondialdehyde and hydrogen peroxide. In conclusion, CPE extended maximum vase life of cut gladiolus through maintaining water relations, controlling bacterial growth, and increasing enzymes activity therefore proved a novel preservative for cut flower induction.



## **NITROGEN APPLICATION ENHANCES GROWTH, YIELD, QUALITY AND SEED PRODUCTION OF CELOSIA, MARIGOLD, AND ZINNIA**

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### **Abstract**

Cock's comb (*Celosia cristata* L.), marigold (*Tagetes erecta* L.) and zinnia (*Zinnia elegans* Jacq.), are popular ornamentals, which are extensively grown as specialty cut flowers, potted plants and bedding adornments. A study was conducted to scrutinize the influence of nitrogen fertilizer on plant growth attributes and quality seed production of celosia, marigold, and zinnia. In all experiments, there were four treatments having different nitrogen levels, applied at 10, 20, and 30 g m<sup>-2</sup>, along with one control treatment (no nitrogen application), and applied individually on each tested species. Phosphorus and potash at 10 g m<sup>-2</sup> was applied to all treatments uniformly. Data were collected from flower initiation to seed setting and comparison of means revealed that plants supplied with 30:10:10 g m<sup>-2</sup> N improved all plant growth attributes, viz. as plant height, leaf area, total leaf chlorophyll contents, vase life, seed yield per plant and leaf NPK contents in leaves. Whereas (0:10:10 g m<sup>-2</sup>) exhibited poor results in all growth and plant quality attributes, seed yield and leaf NPK contents. Regarding plant growth attributes, highest flower diameter (74.1, 82.5 and 104.9 mm were recorded for celosia, zinnia, and marigold, respectively, with best quality blooms when N was applied @ 30 g m<sup>-2</sup>. Seed yield per plant was also highest (0.51 g in celosia, 0.98 g in zinnia and 6.1 g in 'orange' and 8.1 g in 'yellow' marigold) and highest nitrogen uptake (0.68, 0.53 and 1.27%) was recorded in celosia, zinnia, and marigold, respectively. Leaf phosphorus contents (1.95, 0.42, and 0.62% in celosia, zinnia, and marigold, respectively) were recorded. Highest potassium contents (1.96, 3.3 and 1.15%) were recorded in celosia, zinnia, and marigold, respectively. It was concluded that NPK application @ 30:10:10 g m<sup>-2</sup> proved best regarding vegetative & reproductive flower attributes, flower quality and seed yield attributes in tested annual cut flower species/cultivars grown in agroclimatic conditions of Faisalabad and may be used for high quality flower and seed production.



## **EFFECT OF RHIZOBACTERIAL STRAINS ON GROWTH AND FLOWER CHARACTERISTICS OF POTTED *Calendula Officinalis* L**

Ayesha<sup>1\*</sup>, Abdullah Ma'Arij<sup>1</sup>, Hunzala Ashfaq<sup>1</sup>, Nasir Javaid<sup>1</sup>, Hassan bin Munir<sup>1</sup>, Hifza Safdar<sup>1</sup> and Nadeem Akram<sup>1</sup>

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### **Abstract**

*Calendula officinalis* L. is a herbaceous perennial flower, which belongs to the family Asteraceae. The aim of the study was to evaluate the quality of *Calendula officinalis* L. affected by the application of different RBS. In the research, various strains of rhizobacteria were used to observe their effect on potted *Calendula*. Treatments were as followed viz. T0: Control, T1: *Pseudomonas* sp. (MN9), T2: *Bacillus* sp. (AS-53), T3: *Burkholderia* sp. (PsJN), T4: *Pseudomonas* sp. + *Bacillus* sp. (MN9 + AS-53), T5: *Pseudomonas* sp. + *Burkholderia* sp. (MN9 + PsJN), T6: *Bacillus* sp. + *Burkholderia* sp. (AS-53 + PsJN), T7: *Pseudomonas* sp. + *Bacillus* sp. + *Burkholderia* sp. (MN9 + AS-53 + PsJN). The experiment was laid out according to Completely Randomized Design (CRD) with three replications and there were 10 plants in each replication. Various parameters were studied such as number of leaves per plant, number of branches per plant, plant height, leaf area index, stem diameter, plant fresh weight, plant dry weight, number of days to 1<sup>st</sup> bud initiation, number of flowers per plant, flower diameter, flower weight, and leaf total chlorophyll content. Analysis of variance (ANOVA) technique was used to determine the overall significance of the proposed research trial and treatment means were compared by least significant difference (LSD) test at 5% level of probability. The treatment T7 having a combination of three RBS (*Pseudomonas* sp. + *Bacillus* sp. + *Burkholderia* sp.) showed best results in all parameters viz. number of leaves per plant (46.20), number of branches per plant (11.8), plant height (58.60 cm), leaf area index (19.5 cm<sup>2</sup>), stem diameter (11.03 mm), plant fresh weight (74.6 g), plant dry weight (18.35 g), days to 1<sup>st</sup> bud initiation (76.39), number of flowers per plant (10.8), flower diameter (75.62 mm), and flower weight (11.3 g) of *Calendula officinalis* L. as compared to all treatments. Results of all parameters in T7 were followed by T5 in which combination of two RBS was applied (*Pseudomonas* sp. + *Burkholderia* sp.). Results of all parameters were less in treatment T0 in which no strains were applied (control). It can be concluded that the application of different rhizobacteria strains improved the growth and flowering of *Calendula officinalis* L.



**COMPARATIVE EFFECT OF DIFFERENT LEVELS OF IBA ON  
MORPHOLOGICAL TRAITS OF SEMI HARDWOOD CUTTINGS OF  
*Ficus triangularis* L. (BUTTERFLY FICUS)**

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## Abstract

*Ficus triangularis* is a species of fig tree native to South Asia, which is grown as a houseplant for its attractive leaves and air-purifying qualities. It is known for its triangular shaped leaves and can grow up to 2 meters tall. Indole butyric acid (IBA) is a plant hormone used as a rooting hormone in horticulture and agriculture. It stimulates root growth and development by cutting of various plant species, including herbs, shrubs and trees. IBA is applied directly to the cut end of the cutting or can be dissolved in water and used as a dip. Semi hardwood cuttings were treated with five different concentrations of IBA (200,400,600,800, and 1000 mgL<sup>-1</sup>) and observed for root growth development and vegetative growth of *Ficus triangularis* under a Complete Randomized Design (CRD) experiment in a greenhouse with 30 cuttings per treatment. The study resulted that treating the cuttings at a concentration of 600 mgL<sup>-1</sup> of IBA is the optimal concentration for promoting root growth and other vegetative growth parameters. At this level of IBA, improved shoot length, stem diameter, number of leaves, leaf area, fresh and dry weight of the plant, and the number of buds is observed. The result suggests that IBA promote different physiological and morphological traits of *Ficus triangularis* and could be useful in plant propagation.



## **EFFECT OF VARIOUS GROWING SUBSTRATES ON GROWTH AND DEVELOPMENT OF PONYTAIL PALM (*BEAUCARNEA RECURVATA*)**

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### **Abstract**

The ponytail palm (*Beaucarnea recurvata*) is a member of the Asparagaceae family and is used as an indoor and outdoor ornamental plant. Sustainable growing substrates in horticulture are used to alter the growth and development of plants by providing plant anchorage and nutrients, reducing the incidence of soil-borne diseases, and providing oxygen to roots. The study was aimed at utilizing plant-based substrate as a component of growing media for ponytail palm production. The experiment was enacted according to a completely random design (CRD) with nine plants per treatment. Different plant-based materials, such as leaf compost, coco peat, and peat moss, were used for the quality growth and development of ponytail palms. Selected physicochemical analyses (N, P, K, pH, EC) of growing media were done. Collected data was analyzed using Fisher's analysis of variance technique, and treatment means were compared using Tukey's test at a 5% probability level. The result regarding maximum plant height (86.05 cm), number of leaves per plant (58.33), leaf length (120.70 cm), leaf width (0.97 cm), caudex diameter (105.45 mm), fresh leaf weight (0.91 g), leaf total chlorophyll content (136.40 SPAD), photosynthetic rate (118.33  $\mu\text{mol m}^{-2}\text{s}^{-1}$ ), transpiration rate (0.33  $\text{mmol m}^{-2}\text{s}^{-1}$ ), epidermal cell area (1.00  $\mu\text{m}^2$ ), metaxylem cell area (0.45  $\mu\text{m}^2$ ), cortical thickness (7.50  $\mu\text{m}$ ) and xylem thickness (7.40  $\mu\text{m}$ ) were recorded in T5 coco peat 50% + leaf compost 50% and T6 peat moss 50% + leaf compost 50% showed maximum dry leaf weight (0.09 g) and stele thickness (7.36  $\mu\text{m}$ ). Maximum EC (16.6 dS/m), pH (48.5), N (2.15 %), P (23.3 ppm), K (285.10 ppm) were observed in T4 coco peat 50% + peat moss 50%. Minimum values regarding most parameters were studied in control treatment due to poor chemical properties and less availability of nutrients.





## **DRENCHING OF PLANT GROWTH PROMOTING RHIZOBACTERIA IMPROVES VEGETATIVE AND FLORAL CHARACTERISTICS OF DAHLIA ×HYBRIDA**

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### **Abstract**

Dahlia, a member of family Asteraceae, is a popular ornamental plant which has high market demand on account of its diversity in colors, sizes, shapes, forms, and profusion of flowering. A study was conducted to find out the best suited strain of PGPRs to improve growth, production, and flower quality of pot grown Dahlia ×hybrida. Eight treatments, viz., T0: Control, T1: Pseudomonas sp. (MN9), T2: Bacillus sp. (AS-53), T3: Burkholderia sp. (PsJN), T4: Pseudomonas sp. + Bacillus sp. (MN9 + AS-53), T5: Pseudomonas sp. + Burkholderia sp. (MN9 + PsJN), T6: Bacillus sp. + Burkholderia sp. (AS-53 + PsJN), T7: Pseudomonas sp. + Bacillus sp. + Burkholderia sp. (MN9 + AS-53 + PsJN) were compared in this trial, which was laid out in Completely Randomized Design (CRD) having five plants in each treatment with three replications. The best results were recorded in T7 (Pseudomonas sp. + Bacillus sp. + Burkholderia sp.) for all parameters, viz., days to 1st bud initiation (105.9 days), number of leaves per plant (60.40 leaves), number of branches per plant (11.80 branches), plant height (71.50 cm), leaf area index (52.24 cm<sup>2</sup>), stem diameter (14.72 mm), plant fresh weight (54.9 g), plant dry weight (17.8 g), number of flowers per plant (9.4), flower diameter (132.5 mm), flower weight (34.2 g), vase life (8 days), tuber yield per plant (8.6 tubers), average tuber weight (45.6 g), tuber diameter (38.5 mm), leaf total chlorophyll content (58.47 SPAD), leaf photosynthetic rate (23.51 μmol m<sup>-2</sup> s<sup>-1</sup>), stomatal conductance (0.0306 μmol m<sup>-2</sup> s<sup>-1</sup>), and leaf transpiration rate (0.512 mmol m<sup>-2</sup> s<sup>-1</sup>). It can be concluded that the application of combination of rhizobacterial strains T7 (Pseudomonas sp. + Bacillus sp. + Burkholderia sp.) improved the growth and flowering of Dahlia ×hybrida and therefore PGPRs are highly recommended for better growth of dahlia plants and may be used by growers and nurserymen for high quality dahlia production.



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## **OPTIMIZING PLANTING TIME FOR CUT CELOSIA - A NEW PROMISING SPECIALTY CUTFLOWER FOR SOUTH PUNJAB FLOWER MARKETS**

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### **Abstract**

Cock's comb (*Celosia Argentea* var. *crisitata* L.), a member of family Amaranthaceae, is a popular specialty cut flower grown in various countries and getting popularity in local markets as well. Optimal production protocols are required to develop quality cut stems. Therefore, a study aimed to evaluate various planting times for cut celosia was conducted at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, during 2022. Treatments included four sowing dates, viz. July 15, August 01, August 15 and September 01. Data were collected on plant height (cm), stem length (cm), stem diameter (mm), leaf area (cm)<sup>2</sup>, leaf total chlorophyll contents (SPAD), flower diameter (mm), flower quality, production time (days), number of marketable stems per plant, stem fresh weight (g), stem dry weight (g) and vase life (days). Highest plant height (67.3 cm) was recorded when sowing was done on August 01 with greatest flower diameter (53.3 mm), while shortest plant height (46.9 cm) was recorded for July 15 sowing. Least production time (41.5 d) was recorded for July 15 sowing, while September 01 sowing took longest production time (44.9 d). Highest number of marketable stems (7.8) was recorded for August 01 sowing. It is concluded that August 01 is the best planting time for cut celosia production, however, reasonably good quality stems were produced in early sowings during July and early August.



## **IMPACT OF SUCROSE AND SALICYLIC ACID ON VASE LIFE OF ROSE (*Rosa hybrida* L.) CUT FLOWERS**

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### **Abstract**

Short vase life and post-harvest losses of cut flowers are major threats to the floriculture industry. Roses are of foremost commercial importance and cut roses have the highest demand throughout the world and year-round. The natural limitation of the rose (*Rosa hybrida* L.) cut flowers' vase life, leading to complications in marketing and long-distance transportation. Different chemical preservatives and growth regulators are currently in use to extend the vase and postharvest life of cut flowers. This study aimed to evaluate the impacts of sucrose and salicylic acid (SA) on the vase life of rose cut flowers. A laboratory experiment was planned according to a completely randomized design (CRD) with three replications and performed at the Postgraduate Research Laboratory of the Department of Horticulture, Bahauddin Zakariya University, Multan 60800, Pakistan during 2019-2020. The treatments viz. T0 = control (distilled water), T1 = 4% sucrose + 100 mg/L SA, T2 = 4% sucrose + 200 mg/L SA, T3 = 4% sucrose = 300 mg/L SA were applied under controlled conditions and 15 cut flowers per treatment were evaluated. The results indicated a significant difference among the treatments vis-à-vis flower drop, dry weight per flower and vase life of cut flowers was observed as compared to the control. Moreover, the different preservation treatments affect the longevity of rose cut flowers as stems treated with 4% sucrose + 200 mg/L SA have the longest vase life (16 days) as compared to other treatments including control. However, there was a reduction in vase life observed when the SA concentration increased to 300 mg/L with 4% sucrose. It is suggested that the 4% sucrose with 200 mg/L SA may be propitious for extending the vase life of rose cut flowers and sustainable production. Keywords: floriculture industry, vase life, cut flower, *Rosa hybrida*, chemical preservatives, salicylic acid, sustainable production



## **ORGANIC COMPOUNDS LIKE CHITOSAN, THYMOL AND EUGENOL AT DIFFERENT LEVELS IN VASE WATER, IMPROVES THE DISPLAY LIFE OF CUT STEMS OF GLADIOLUS (*Gladiolus grandiflorus* L.)**

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### **Abstract**

*Gladiolus* (*Gladiolus grandiflorus* L.) is a perennial flowering plant cultivated as a relishing spring cut flower in the plains of Pakistan. The cut stems of gladiolus remain metabolically active by utilizing the stored tissue substrate but that is not enough to keep them alive and fresh for more than 3-4 days and they start dying. In this regard, an experiment was enacted to assess the comparative effect of three organic preservatives namely chitosan, thymol, and eugenol to extend the vase life of cut stems of gladiolus. Cut stems of gladiolus of the same age and stage of maturity of variety "White Prosperity" at the point when the lowermost floret shows color, were purchased from Zarkhaiz Farm, Qasoor. The treatment combinations in vase solution were kept 20, 40, 60, 80, 100 and 120 mg L<sup>-1</sup> of three organic chemicals in same concentration compared with the control (distilled water). Data was collected regarding various parameters including vase life of spike, average life of flower, flower quality, relative fresh weight, dry weight % age, solution uptake, time to start wilting, petal browning, change in solution pH, floret diameter, water loss of gladiolus flower and number of florets open. All these parameters were improved at 60 mg L<sup>-1</sup> of chitosan and 80 mg L<sup>-1</sup> of eugenol in vase water that improved the display life to 8 and 10 days respectively.



## **CUT *Helianthus annuus* A NEW PROMISING SPECIALTY CUT FLOWER FOR PAKISTANI MARKETS**

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### **Abstract**

Sunflower (*Helianthus annuus* L.), a member of Asteraceae (Compositae) family, is extensively cultivated as specialty cut flower in different parts of the world and is also getting popularity as specialty cut flower in Pakistan. Therefore, a study was conducted at Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, Pakistan, during 2022, to optimize the production protocols for Cut *Helianthus annuus* in agro-climatic conditions of Faisalabad, Punjab, Pakistan. Four production experiments were conducted to optimize planting time, planting method, planting density, and optimal macro & micronutrients along with biostimulants for best quality cut stem production. Experiments were laid out individually according to randomized complete block design (RCBD) with four replications. Data were analyzed using Fisher's analysis of variance technique and treatment means were compared using LSD test at  $P < 0.05$ . For planting time, five planting/sowing times were compared, viz. March 19, April 3, April 19, May 3 and May 19. Tallest plants (122.2 cm) were recorded when plants were sown on May 19, followed by May 3 (116.9 cm) as well as highest fresh weight (680.5 g) and dry weight (120.4 g) were also recorded on May 19. Least production time was recorded for April 19 sowing (42.8 d), followed by May 3 sowing (43.8 days). For planting method, three planting methods were compared, viz. ridges, flat beds and raised beds. Tallest plants (104.8 cm) and greatest stem fresh weight (494.6 g) were recorded when plants were sown on ridges, followed by raised beds as well as greatest stem diameter (17.4 mm) and flower diameter (16.2 cm) was also recorded in raised beds followed by flat beds with least production time (44.3 days) in flat beds. In planting density, five treatments were compared, viz. 15×15 cm, 15×22.5 cm, 22.5×22.5 cm, 22.5×30 cm, or 30×30 cm. Plants transplanted on density of 15×15 cm demonstrated tallest plants (119.7 cm) with greatest stem diameter (15.6 mm). Highest flower diameter (21.9 cm) and least production time (41.05 days) was recorded when grown at 30×30 cm spacing. For nutritional regimes experiment, six treatments were compared, viz. control, N @ 90 kg ha<sup>-1</sup>, NPK @ 90:45:45 kg ha<sup>-1</sup>, NPK @ 90:45:45 kg + micronutrients (B, Zn, Fe) (1%, 1% & 1%), NPK @ 90:45:45 kg ha<sup>-1</sup> + Isabion @ 0.4% ml L<sup>-1</sup>, NPK @ 90:45:45 kg ha<sup>-1</sup> + Humic acid @ 0.4 ml L<sup>-1</sup>. NPK+ Isabion (0.4%) performed best with tallest plant height (81.8 cm), and flower diameter (16.5 g) followed by NPK+ Humic acid (0.4%) with plant height (71.06 g) and greatest flower diameter (14.6 cm). Highest stem diameter was recorded in NPK (15.3 mm) followed by NPK+ 0.4% Humic acid (15.1 mm). Least production time (41.6 days) was also recorded in NPK+ 0.4% Isabion. In summary, May proved optimal planting time for sunflower production, while plantation in ridges or raised beds spaced at 15×15 cm and use of NPK along with 0.4% Isabion proven best for optimal plant height and flower diameter with least production time and may be used for high quality cut sunflower production for fulfilling aesthetic needs in local markets particularly during summers



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## **EXOGENOUS APPLICATION OF SEAWEED EXTRACT AUGMENTS PRODUCTION AND NUTRITIONAL PROFILE OF OYSTER AND KING OYSTER MUSHROOMS**

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### **Abstract**

A research trial was conducted to check the growth and reproductive behavior of oyster mushrooms with exogenous application of seaweed extract (*Ascophyllum Nodosum*) including treatments (T<sub>0</sub>= distilled water, T<sub>1</sub>=2 mM, T<sub>2</sub> 6 mM, and T<sub>3</sub> 10 mM). Overall results showed that T<sub>1</sub> and T<sub>2</sub>, responded better for yield of oyster mushrooms, Whereas T<sub>1</sub> performed best in physiological parameters. While T<sub>3</sub>, and T<sub>0</sub> showed minimum performance respectively. Maximum fresh weight of mushroom, and highest yield was obtained from T<sub>1</sub> (2mM seaweed extract). Seaweed extract concentration did not influenced the total number of flush- es and days taken to complete flushes. While, total soluble solids, titrate able acidity, ascorbic acid level, total sugars level, reducing sugar level and non-reducing sugars level were positively influenced by all seaweed treatments. It can be suggested that cotton waste with foliar application supplementation (T<sub>1</sub>) 2mM seaweed extract can be used for enhancement of growth and nutritional profile of oyster and king oyster mushrooms.



## **SAFFRON CULTIVATION IN MAIDAN VALLEY, TIRAH: ADOPTION AND PROBLEMS**

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### **Abstract**

Saffron is one of the most precious and expensive spice of the world. The purpose of the present study was to scrutinize the status of the precious spice Saffron cultivation in the study area, with main focus on the adoption and constraining factor and problems in the way of smooth adoption process. Maidan Valley Tirah, Tribal District Khyber was selected as the area is the most appropriate one for Saffron cultivation in the province Khyber Pakhtunkhwa. Five major tribes Akka Khel, Malik Din Khel, Shalobar, Adam Khel and Kamber Khel were purposely selected. Using Sekkaran table total of 150 sample size was selected from five major tribes of the Maidan Valley using systematic probability technique from the 245 beneficiary/farmers list provided by the Agriculture Extension Department of the concerned Tribal District. The respondents were interviewed through an interview schedule. The collected primary data was investigated through statistical analysis and generated results were incidental and proved the dependency status of various variables. It was found that main constraints and problems in the way of smooth adoption of Saffron cultivation in the area were major pre-harvest problems such as non-availability of quality corms in the local markets, lack of technical knowledge, issues of soil fertility, poor plant protection measures and lack of proper irrigation system and some major post-harvest problems such as problems related to picking and sorting, drying, packaging, and marketing. Majority of the farmers were small land holders, illiterate and own cultivators. The role of extension worker in the process of adoption was satisfactory to some extent in problems solution according to the respondents. Majority of the farmers' source of information was relatives, and government was the only intervening agency. The assistance and services provided by the extension department through various Saffron promotion interventions were satisfactory to some extent but need to be improved further.



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## **EXOGENOUS PROLINE APPLICATION AFFECTS GROWTH AND QUALITY TRAITS OF OYSTER AND KING OYSTER MUSHROOMS**

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### **Abstract**

The purpose of the present research work was to study the effect of foliar application of proline on two cultivars of mushrooms "Oyster" and "King Oyster". Various concentrations of proline (To-distilled water T1= 2mM, T2= 6mM and T3 10mM) were used. The response of mushrooms was evaluated based on different physical, physiological, and biochemical parameters. Results depicted that there was a decreasing trend from T1 to T3. Proline in all treatments affected the weight, flushes, pinheads, at first, second and third. Earliness was also seen in pinhead development and flush completion. The prolines in all treatments also affected TSS, TA, Total sugars, non-reducing and reducing sugars. T<sub>1</sub> was the best among other treatments.





## EVALUATION OF THE EFFECT OF ASCORBIC ACID ON GROWTH OF OYSTER MUSHROOMS

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### Abstract

Various concentrations of ascorbic acid (T0= distilled water, T1-2mM, T2- 6m M and T3 10 mM) were applied exogenously after completion of mycelia stage to study the possibility of ascorbic acid utilization in combination with cotton waste for the production of oyster and king oyster mushrooms and to find the optimum dose and assess the impact of foliar application of ascorbic acid for a better physical, chemical quality and yield of mushrooms. Result showed that minimum days were taken to initiate pinhead and completion of flush and maximum number of flush, pinheads, weight and yield in white and blue oyster mushroom were recorded. The better result among of oyster mushroom Whereas, T3 performed best in physiological parameters while T0 and T1, showed minimum performance respectively. Maximum reducing sugar and total soluble solids were recorded at T1 and T2 and most biochemical properties of oyster and blue oyster mushroom were affected by all doses. Maximum vitamin C, reducing sugar, total sugar, moisture and titratable acidity were recorded at T3. It is suggested that cotton waste supplemented with various concentration of ascorbic acid gave significant result as compared to control. Overall results showed that by increasing the concentration of ascorbic acid the effect of ascorbic acid also increased for oyster and blue oyster mushroom. As compared to blue oyster mushrooms ascorbic acid effect on white oyster mushroom showed higher results.



## **EFFECT OF CHITOSAN ON THE GROWTH AND PRODUCTION OF OYSTER AND KING OYSTER MUSHROOMS**

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### **Abstract**

Exogenous spray with Chitosan (T0= control, T1= 2 mM chitosan, T2= 6 Mm chitosan and T3= 10 mM chitosan) was used to assess oyster mushroom vegetative development, reproductive activity, and overall quality. The fresh weight of 1st, 2nd and 3rd flush (g) recorded more weight at T3 for both strains. Yield perbag (g) was more in T3 for both strains. TSS (Brix) showed the best result at T1 for white oysters and T3 is best for king oysters. Moisture (%) showed the best results in T1 for both strains of an oyster. Total sugar (%) showed the best result in T2 for white oysters and T3 for king oysters. Reducing sugars (%) showed the best result at T1, for white oysters and T3 for king oysters, and non-Reducing sugars (%) showed the best result at T3 for both the strains of the mushrooms. Titratable Acidity (%) showed the best results at T1 for both strains. Vit. C contents showed the best results at T1 for both the strains (mg/100ml).



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## **FISH CUM HORTICULTURE APPROACH TO IMPROVE ECONOMY**

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### **Abstract**

Considerable area of an aquaculture farm is available in the form of dykes some of which is used for normal farm activities, the rest remaining fallow round the year infested with deep-rooted terrestrial weeds. The menacing growth of these weeds causes inconvenience in routine farm activities besides necessitating recurring expenditure on weed control. This adversely affects the economy of aquafarming which could be considerably improved through judicious use of dykes for production of vegetables and fish feed. An integrated hortiagri aquaculture farming approach leads to better management of resources with higher returns. Several varieties of winter vegetables (cabbage, cauliflower, tomato, brinjal, coriander, turnip, radish, beans, spinach, fenugreek, bottle gourd, potato and onion) and summer vegetables (amaranth, water bind weed, papaya, okra, bitter gourd, sponge gourd, sweet gourd, ridge gourd, chilly, ginger and turmeric) can be cultivated depending upon the size, shape and condition of the dykes. A huge quantity of cabbage, cauliflower, turnip and radish leaves are thrown away during harvest. These can be profitably utilized as supplementary feed for grass carp. During winter, grass carp can be fed with turnip, cabbage and cauliflower leaves, while in summer, amaranth and water-bind weed through fortnightly clipping may be fed as supplementary feed for rearing of grass carp. Monoculture of grass carp, at stocking density of 1000 fish/ha, fed on vegetable leaves alone fetches an average production of about 2 t/ha/yr. While mixed culture of grass carp along with rohu, catla and mrigal (50:15:20:15) at a density 5000 fish/ha yields an average production of 3 t/ha/yr.



## **IMPACT OF TREE AGE ON FRUIT QUALITY OF POMEGRANATE CVS. SAWA AND KALHAR**

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### **Abstract**

Tree age groups and cultivars have a significant impact on the post-harvest fruit quality of many fruits including pomegranate. Therefore, present study was planned to evaluate the post-harvest fruit quality of pomegranate cultivars harvested from different tree age groups. Commercially mature fruit of two pomegranate cultivars (Sawa and Kalehar) were harvested from Liaquat Pur city District Raheem Yar Khan from three different tree age groups, i.e., 5-7 years group, 8-10 years group and 12-14 years and used for further analysis on harvest day. Results showed significant influence of cultivars and tree age groups on fruit quality of pomegranate. Among physical fruit quality parameters, maximum fruit weight (261.33/fruit) in 8-10 years tree age group, fruit firmness (39.4233 N), fruit color lightness (67.06 L\*), fruit yellowness (37.51 b\*) in 5-7 years tree age group and fruit redness (17.80 a\*) in 12-14 years was recorded in fruits harvested from 'Kalehar' cultivar. Whereas, maximum peel thickness (0.34mm) from 12-14 years tree age group in fruits harvested from 'Kalehar' cultivar. Among biochemical fruit quality parameters, higher total soluble solids (19.88 °Brix) and TSS/TA ratio (50.88) in 5-7 years tree age group in fruits harvested from 'Kalehar' cultivar. However, maximum TA (0.78 %), juice pH (4.86 %) in 5-7 years tree age group and vitamin C (418.60 mg/100ml of juice) in 8-10 years tree age group was recorded in 'Sawa' cultivar. Results regarding physiological fruit quality attributes including transit fruit weight loss (4.96%) in 12-14 years tree age group in fruits harvested from 'Sawa' cultivar. Results regarding phytochemicals maximum including anthocyanin contents (0.14 ΔAg-1FW) in 5-7 years tree, total phenolics contents (298.04 μg, g<sup>-1</sup> FW) in 5-7 years tree age group and total antioxidant (82.98 % inhibition) in 12-14 years tree age group fruits harvested from 'Sawa' where maximum carotenoids (0.74 μg, g<sup>-1</sup> FW) in 5-7 years tree age group in fruits harvested from 'Kalehar' cultivar. As for as enzymes including superoxide dismutase (51.89 U mg<sup>-1</sup> protein) in 12-14 years tree age group, peroxidase (2.32 U mg<sup>-1</sup> protein) in 12-14 years tree age group and catalase activity (24.00U mg<sup>-1</sup> protein) was found higher in arils of 'Kalehar' cultivar. .



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### **PROTECTED HORTICULTURE: A SUSTAINABLE WAY TO ENHANCE ECONOMIC YIELD UNDER URBAN ENVIRONMENT**

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### Abstract

Protected horticulture is the process of cultivating crops under controlled situations by changing the environment through structures and practices to achieve maximum output by increasing yield and enhancing quality. With the increase in population and awareness of in dietary habits, the consumption of fruits and vegetables has improved. People realize the importance of horticulture commodities as they are highly nutritive and have a vital role in the supply of essential minerals required for body function. In urban areas, there is always a need of regular fresh fruits and vegetables supply. Therefore, to mitigate people's food, there is a need to adopt modern agricultural practices such as protected structures. The use of devices, precision technologies, and greenhouses, tunnels, or row covers are all forms of protected cultivation. The quantity and quality of production under protected cultivation is much better than in the open field. Off-season vegetable, flowers and fruits grown inside protected structures mature earlier as compared to field crops. Further, they are also saved from environmental hazards including biotic and abiotic stresses. The technologies such as drip irrigation save water up to more than 70% as compared to flood systems under these protected structures. It also makes possible a vertical farming system through which less land is required to cultivate fruits and vegetables.



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## **SURVEY AND ANALYSIS OF POSTHARVEST PRACTICES: A CASE STUDY OF FRUITMARKET, ISLAMABAD**

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### **Abstract**

The post-harvest losses of fruits and vegetables in Pakistan range from 20-40% and occasionally even higher. This huge proportion of losses indicates a poor value chain management system and inadequate post-harvest handling practices, resulting in economic losses for each player in the value chain and higher prices of products for consumers as well. This survey analyzed the post-harvest handling and management techniques being employed in the fruit and vegetable market, Islamabad, where local products arrive from all the provinces as well as imported fruits. The survey found that the local fruits were packed in low-grade packaging material, often in substandard cardboard boxes and wooden crates. These boxes were often not specific in shape and size for the type of fruit packed in them. The durability and the presentation of these boxes also had a negative impact on the outlook of the fruit products. Traceability and product information on the label was insufficient. Similarly, the transportation of these fruits was also carried out in vehicles without any cooling facilities and specialized lining to prevent travel injury. Another challenge was the cold storage facilities which had inadequate capacity while being non-specific for the fruit product to be stored. On the other hand, the imported fruits, especially from developed countries like France and New Zealand, had attractive, durable, and customized packaging with complete information and traceability protocols. These imported commodities were being transported in reefer containers. The impact of these measures was clearly observed in the difference between the price values of local and imported fruits. The Granny Smith apples imported from France were being retailed at Rs. 10,000 for 100 apples while prices of local varieties ranged between Rs. 2000-4000 per box (16-18 kg). Imported grapes and citrus from countries like Iran, Egypt, and India were better in quality with higher prices. Elevating the standard of value chain and post-harvest management practices is essential not only to ensure food security but also to increase the competitiveness of local fruit products in the international arena. It will help the country to earn valuable foreign exchange and lower its import bill.



## **IMPACT OF CALCIUM GLUCONATE AND SALICYLIC ACID ON POST-HARVEST QUALITY AND SHELF LIFE OF GUAVA FRUIT (*Psidium guajava*) AT AMBIENT TEMPERATURE**

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### **Abstract**

Horticulturally, guava is an important and major fruit crop in Pakistan. In Pakistan, production of guava fruit ranked 3rd with respect to the area and its production. Fresh guava fruit has a limited shelf life due to its thin peel. The current study was conducted to improve the fruit quality and enhance the shelf life. Fruits were treated with calcium gluconate and salicylic acid in different combinations and stored at ambient temperature for 12 days. Maximum fruit firmness 73 N was recorded in 0.5% calcium gluconate + 0.75 % Salicylic acid, while the lowest value was found in control. Disease incidence was found unaffected in treated fruits than control. 1.5% salicylic acid showed the best results in fruit weight loss, juice weight, and decay. Total phenolic and ascorbic acid in guava fruit of 1% calcium gluconate + 1.5% salicylic acid was maximum after 12 days of storage. Total phenolic in guava fruit reached up to 308.07 µg ml<sup>-1</sup> FW. The minimum increase in TA and ion leakage was 0.03% and 98.91%, respectively. A higher value of total carotenoids (3.45 mg/100 mL) was found in fruits containing 0.5% calcium gluconate and 0.75 salicylic acid, while the lowest value was in the fruit of the control. 0.5% calcium gluconate + 0.75 salicylic acid and 1% calcium gluconate + 1.5% salicylic acid showed significant maintain the quality of fruit and its quality attributes.



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## NUTRITIONAL PROFILE AND POTENTIAL HEALTH-PROMOTING COMPOUNDS IN JUJUBE FRUIT: A REVIEW

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### Abstract

Jujube (*Ziziphus jujuba* Mill. and *Ziziphus mauritiana* Lamk.) is a highly nutritious and functional fruit crop that has been widely grown around the world and is reported to provide a number of health benefits. In terms of dietary supplements, jujube fruit is well known as a super food that contains a wide range of bioactive compounds including polysaccharides, amino acids, polyphenols, fatty acids, alkaloids, dietary fiber, as well as multiple mineral nutrients. Additionally, jujube fruit is regarded as a rich source of ascorbic acid which performs well as storing antioxidants. These phytochemicals, both nutritive and non-nutritive, derived from jujube fruit have physiological effects that include anticancer, anti-inflammatory, anti-hyperglycemic, anti-hyperlipidemic, immunoregulatory, neuroprotective, sedative, and antiviral properties. The objective of this review is to highlight the most recent research on the availability of bioactive compounds in jujube fruit and their biological effects and potential medical applications, notably in the fields of human nutrition, health, and therapeutics.





## **XANTHAN-BASED EDIBLE COATING IMPROVES SHELF LIFE AND MAINTAINS FRUIT QUALITY OF HARVESTED GUAVA FRUITS**

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### **Abstract**

Guava (*Psidium guajava* L.) fruit is often referred to as "apple of the tropics," and is extensively grown across tropical regions of the globe. Due to its limited shelf life after harvest and susceptibility to infections throughout the storage period, it has limits in terms of commercialization. On the other side, edible coatings strengthen the protective activity of the fruit epidermis in avoiding water loss, colour changes, mechanical lesions, and even microbiological degradation, thus increasing fruit shelf life and maintaining its quality. This experiment was laid down to unravel the effects of xanthan gum (XG) on ripened guava fruits to improve their shelf life and quality. Four different concentrations of xanthan gum namely 0, 0.25, 0.5, and 0.75 g/mL XG were used to treat guava fruit for five minutes followed by storage at  $18 \pm 2$  °C and  $\geq 80\%$  relative humidity (RH) for 15 days. Physiological and biochemical changes were studied, together with the specific enzymatic activities for catalase (CAT), superoxide dismutase (SOD), and peroxidase (POD). The results revealed that xanthan gum treatments significantly reduced fruit weight loss, titratable acidity, and ascorbic acid content while increasing total soluble solids than control fruits. Furthermore, total phenolics, flavonoids, and antioxidant capacity were recorded higher in 0.75 g/mL XG-treated fruits and maintained higher eating quality than in control fruits. In addition, electrolyte leakage, malondialdehyde, and H<sub>2</sub>O<sub>2</sub> content were observed higher in 0.75 g/mL XG-treated fruits than in control. The results demonstrate that 0.75 g/mL application has the potential to improve the quality attributes of guava fruit.



## **TOMATOES DEHYDRATION THROUGH VARIOUS DRYING TECHNIQUES**

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### **Abstract**

Tomato (*Solanum Lycopersicon*) member of Solanaceae family is a nutrient-rich commodity. It is a short-du- ration crop but at the highest rank in terms of nutritional involvement in an individual diet. The present study was planned to prepare tomato powder through sun-, oven-, and freeze-drying techniques, to evaluate the most suitable drying technique regarding nutrition maintenance for value-added product preparation. Phytochemical analysis, Proximate composition, mineral profile, antioxidants, total phenolic content (TPC) of fresh, sun-, oven-, and freeze-dried tomatoes was carried out according to the given procedures. Selection of the best treatment was done based on antioxidant profiling and total phenolic content. Total phenolic contents for fresh, sun-dried, oven-dried, and freeze-dried tomato powder were reported to be  $87.07 \pm 0.08$ ,  $53.37 \pm 0.98$ ,  $75.29 \pm 0.27$ ,  $95.69 \pm 0.52$  mg GAE/100 g. Antioxidant % was  $96.07 \pm 0.01$ ,  $94.07 \pm 0.06$ ,  $92.93 \pm 0.02$ , and  $96.10 \pm 0.02$  % inhibition corresponding to fresh, sun-, oven-, and freeze-dried tomato powder. Subsequently, freeze-dried tomato powder was used for the development of value-added products (tomato bread). In the product development segment, four (4) types of treatments were adopted as T1 (5% tomato powder), T2 (10% tomato powder), T3 (15% tomato powder), and T0 (control). Afterward, the developed product was assessed for sensory attributes by following a 9-point hedonic scale. Resultant data were analyzed statistically and each significant effect was compared by using the Tukey test at a 5% probability level. Results from the current study indicate that T2 of tomato-based bread was appreciated by judges during sensory profiling. From the present work, it is concluded that freeze-drying is the best method as compared to sun-drying and oven-drying and the consumption of freeze-dried tomato powder-based innovative products should be prompted in our daily routine. Key words: Tomato, Sun-drying, Oven-drying, Freeze-drying, Total phenolic content, antioxidants.



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## **EFFECT OF CHITOSAN COATING ON QUALITY MANAGEMENT AND SHELF LIFE OF PEACH (*Prunus persica*) FRUITS**

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### **Abstract**

Peach fruit being climacteric, and perishable are highly susceptible to fungal attacks resulting in fruit decay and reduced shelf life. Chitosan can preserve the fruit quality by suppressing decay incidence and increasing antioxidant activity. Therefore, this study was conducted to enhance the shelf life of peach fruit during storage at a temperature (of  $4\pm^{\circ}\text{C}$ ) for 28 days, with good keeping quality. For this purpose various treatments of chitosan (1 % & 2 %) were applied on peach fruit stored at ( $4\pm^{\circ}\text{C}$ ) for 28 days, overall the results described less fruit decay (2.76%) and less weight loss (2.12%) was observed in fruits treated with chitosan 2%. The other quality parameters fruit firmness, total soluble solids, ascorbic acid, and sugars were also maintained in chitosan-treated fruits. Antioxidant enzyme activity like catalase (CAT), Superoxidismutase (SOD), and Peroxidase (POD) in stored peach fruit was more prominent in chitosan (2%) treated fruit during storage as compared to untreated fruits. It can be concluded that a higher dose of chitosan (2%) proved more effective for extending the shelf life up to 28 days by reducing the fruit decay %, maintaining firmness, and increasing antioxidative enzyme activity.



## **GENOTYPES AND POSTHARVEST SHELF AFFECT FRUIT PHYSICO-CHEMICAL, ANTIOXIDATIVE AND SENSORY ATTRIBUTES OF THREE JAMUN GENOTYPE AT AMBIENT CONDITION.**

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### **Abstract**

Jamun (*Syzygium cumini* L.) is one of minor or underutilized fruit crops with plenty of nutrient properties. Jamun fruit is highly perishable. An investigation was carried out to check the physiological, physio-chemical, and organoleptic attributes of three jamun genotypes (Genotype-I 'Jamuni Surahi', Genotype-II 'Jamuni Gola', Genotype-III 'Jamun') at ambient condition (23-27°C and 55-65% R.H). Fruit of three genotypes were harvested. Harvested fruit were evaluated for physio-chemical, antioxidative and nutritional attributes and sensory evaluation at shelf on daily basis upto day-4 of shelf. The data were analyzed statistically, and the comparison between or among treatments were determined using the LSD test with a significance level of 0.05. As the shelf period progressed, all the jamun genotypes exhibited significant loss in fruit weight, titratable acidity (TA), and vitamin C contents up to day-4 of shelf. However, irrespective of the days at shelf, the jamun genotype III (Jamun) exhibited significantly lower weight loss, higher Vit. C, higher titratable acidity, and higher juice pH. as compared to other genotypes. While jamun genotype II (Jamuni Gola) exhibited significantly higher total soluble solids (TSS) and TA: TSS ratio. Moreover, higher sensory attributes with highest aroma, taste, texture, and flavor were recorded in genotype\_I (Jamuni Surahi). Overall, genotype III showed less fruit quality losses and maintained higher antioxidative attributes during shelf period.



## **EFFECT OF LAYER-BY-LAYER EDIBLE COATINGS OF ALBIZIA AND KHERI GUM ON QUALITY OF TOMATO FRUIT**

Shaghef Ejaz<sup>1</sup>, Farwa Fraz<sup>1\*</sup>, Sana Mudassar<sup>1</sup>, Muhammad Anwar-ul-Haq<sup>1</sup>, Laraib Amjad<sup>1</sup> and Isbah Akhtar<sup>1</sup>

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### **Abstract**

Tomato (*Lycopersicon esculentum* Mill.) is one of the most widely consumed fresh vegetables in the world; however, its highly perishable nature limits its postharvest life. Major losses in tomato quality and quantity occur between harvest and consumption. Recently, different edible coatings have been found to extend the postharvest life of commodities. Therefore, this study aimed to evaluate the effect of layer-by-layer coatings on the postharvest life of tomatoes. A laboratory experiment was planned according to a completely randomized design with three replications in the Department of Horticulture, Bahauddin Zakariya University, Multan. Treatments viz. T0 = control (without coatings), T1 = 1st layer kheri gum (10 %) + 2nd layer albizia gum (10%) and T2 = 1st layer albizia gum (10 %) + 2nd layer kheri gum (10%) were applied to tomatoes. Each treatment contained 25 fruits with three replications. Tomatoes were analyzed on the 0, 3rd, 6th and 9th day after applying albizia and kheri gum. Main effect of 1st layer albizia gum (10 %) + 2nd layer kheri gum was significant on majority of qualitative parameters. Results showed that T2 = 1st layer albizia gum (10 %) + 2nd layer kheri gum significantly affected the studied parameters as compared to control. Regarding different treatments, T2 performed the best for total soluble solids, ascorbic acid, weight loss, color, firmness, and titratable acidity. We concluded that edible coatings could be a good alternative to preserve the quality and extend the postharvest life of tomato fruit.



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## **POSTHARVEST AQUEOUS OZONE AND ULTRASOUND APPLICATION INHIBITED FUNGAL DECAY AND MAINTAINED THE QUALITY OF COLD STORED JUJUBE FRUIT**

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### **Abstract**

Jujube is a nutrient-rich tropical and sub-tropical fruit crop. Being highly perishable, the jujube fruit is more susceptible to fungal decay and has a limited shelf life. This study was conducted to investigate the effect of postharvest application of combined aqueous ozone (OZ) and ultrasound (US) to inhibit fungal decay and maintain the quality of jujube during cold storage. Mature green harvested jujube fruit was subjected to combined application of OZ and US for 1, 2 and 3 min following cold storage ( $5 \pm 1^\circ\text{C}$ ) for 20 days with a 5-day interval. Results revealed that fruit treated with OZ + US for 3 min significantly inhibited fungal decay and maintained fruit visual quality during the entire storage period. At end of the experiment after 20 days, fruit treated with OZ + US treatment for 3 min showed a higher marketability index as compared to control fruit via maintaining visual quality, retaining higher firmness, and lowering shriveling and skin defects. The total antioxidants, glutathione, and phenolic content were noted higher in 3 min treatment as compared to other treated and control fruit. Combined application of OZ and US also mitigated oxidative stress by lowering MDA and H<sub>2</sub>O<sub>2</sub> contents in comparison with control fruits. However, the biochemical quality (total soluble solids, acidity, sugar acid ratio) was not affected by the treatments. Overall, the combined application OZ + US for 3 min significantly inhibited fungal decay and maintained the quality of cold-stored jujube fruit.



## **PHYSICOCHEMICAL AND ANTIOXIDATIVE CHANGES IN SWEET ORANGES AND MANDARINS UNDER STORAGE CONDITIONS**

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### **Abstract**

Citrus has accepted exceptional economic significance and export request being recognized for its high juice content, unique flavor, delicious taste and as a rich source of Vitamin-C. Citrus grown all through the world i.e. China, Brazil, India and Spain. Utilization of citrus juice may essentially limit the danger of diabetes and incessant asthma. Citrus is semi perishable fruit and has less shelf life and many changes occur in juice flavor. Many physiochemical and antioxidative changes occur due to ongoing metabolic processes in citrus fruit during storage at ambient condition. This study was conducted to check the physiochemical and antioxidative change in different sweet oranges and mandarins varieties during ambient storage condition. Result of experiment showed that sweet orange cultivars e.g. Washington navel, Pine Apple, Red Blood and Mussambi showed minimum fruit weight loss, while Al, A3 Sanginello, Hamlin, Trocco and Cassa Grandi contained higher weight loss fruit weight loss. However, Honey and Feutrall's early cultivar of mandarin retained higher weight percentage while free mound and fail chl showed higher loss in fruit weight. Moreover, high score for sensorial attributes, vitamin C, acidity, and lower level of total soluble solids were observed in the Washing- ton Navel, Pine Apple, Red Blood and Musambi. Furthermore, high level of SOD, POD and CAT were found in Washington Navel, Pine Apple, and Red Blood and Mussambi cultivar of sweet orange and also in honey and fruiter cultivar of mandarin



## **POSTHARVEST DIPPING IN SALICYLIC ACID IMPROVES STORABILITY AND REDUCES THE DECAY OF KINNOW MANDARIN BY MAINTAINING THE ANTIOXIDATIVE ENZYMATIC ACTIVITIES**

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### **Abstract**

Huge postharvest losses of fruits and vegetables are a devastating and continuous threat to world food security. Like all other fruits, mandarins also face these losses due to many biotic and abiotic factors with a maximum contribution of fungal attack during storage. The present research work was conducted to check the effects of postharvest application of salicylic acid (SA) on the fruit quality of Kinnow mandarin under cold storage. Different concentrations of SA (2, 3, and 4mM) were applied and the fruits were stored for 90 days at 5°C with 90% relative humidity (RH). Results indicated that SA application @ 3mM was found significantly effective to maintain different fruit quality parameters i.e., juice weight, ascorbic acid contents, total phenolic contents (TPC), and total antioxidants with minimum weight loss as well as disease incidence during storage. After 90 days of storage fruit quality enzymes such as catalase (CAT) (22.76 U mg-1protein), peroxidase (POD) (0.63 U mg-1protein) and superoxide dismutase (SOD) (124.54 U mg-1protein) activity were significantly superior at more SA (4mM) treated fruit. We surmise that the pre-storage application of SA can enhance shelf of Kinnow for fruit up to 3 months.





## **PRE-MATURE FRUIT DROP IN APPLES: USE OF MACRO AND MICRO NUTRIENTS TO MINIMIZE THE PROBLEM UNDER THE CLIMATIC CONDITIONS OF AZAD JAMMU AND KASHMIR**

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### **Abstract**

Apple (*Malus domestica* Borkh.) is the most important temperate fruit of Azad Jammu and Kashmir. It is an essential source of minerals and vitamins. It has been found that apple is successfully grown under climatic conditions of Azad Jammu and Kashmir. Pre-mature apple fruit drop is main reason for low yield of apple in this area. The macro and micro nutrients have essential physiological roles in the synthesis of protein, photo-synthesis, chlorophyll synthesis, transport of carbohydrates, reproduction process of plants. Three different apple varieties (Kashmir Amri, Red Delicious, Star Crimson) were selected at three different locations (Rawalakot, Bagh, Dhirkot) of Azad Jammu and Kashmir. In this study two different concentrations of macro nutrient [Magnesium (Mg) (1000 ppm) and (2000 ppm)] and two different concentrations of micro nutrient [Boron (B) (100 ppm) and (200 ppm)] along with water as control were applied before flowering and 2, 4 and 8 weeks before harvest. Results regarding various field parameters showed that macro and micro nutrients had great effect on minimizing the problem of pre-mature fruit drop in apples from Azad Jammu and Kashmir. Thus, it could be recommended to use macro and micro nutrients to control the problem of pre-mature fruit drop in apples for sustainable production in future.



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## **POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES: AN APPROACH TO REDUCE MALNUTRITION AND ENSURE FOOD SECURITY**

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### **Abstract**

Fruits and vegetable (FV) production is an emerging horticulture sub-sector despite the fact that, almost one-third of the produced FV is lost before reaching the plate. FV postharvest losses range from 30 to 80%, depending on a crop. It occurs throughout the value chain, as a result of technical and managerial setbacks during harvest, handling, transportation, processing, packaging, marketing and distribution. Lack of postharvest management skills and technology such as temperature control to maintain the cold chain, value addition, and packaging have caused several economic and food security setbacks among them are high levels of poverty, hidden hunger and malnutrition. Globally, applications of postharvest technologies for instance; use of ethylene, 1-methylcyclopropene (1-MCP) and temperature management has proved to reduce postharvest losses of FV. Also, chemical and non-chemical methods are useful for controlling spoilage and pathogenic microbes especially on ready to eat FV products. Postharvest technologies such as controlled ripening, edible coating, temperature management, and chemical treatment methods are potential tools to reduce FV postharvest losses, increase food and nutritional security and alleviate poverty in SSA. At the same time, sanitizing chemicals and pesticides malpractice should be avoided to ensure final consumer safety. Adoption of postharvest technologies is an important step to reduce fruits and vegetable losses, thereby, contributing to poverty alleviation and reduced hidden hunger. Also, sanitation procedures should be observed while pesticides malpractices strictly avoided to ensure produce quality and consumer safety.



## **PHYSIOCHEMICAL PROPERTIES OF DRIED TOMATO POWDER PRODUCED VIA VARIOUS DRYING TECHNIQUES**

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### **Abstract**

Tomato (*Solanum lycopersicon*) member of Solanaceae family is a nutrient-rich commodity. It is a short-duration crop but at the highest rank in terms of nutritional involvement in an individual diet. The present study was planned to prepare tomato powder through sun-, oven-, and freeze-drying techniques, to evaluate the most suitable drying technique regarding nutrition maintenance. Physicochemical analysis, Proximate composition, mineral profile, antioxidants, total phenolic content (TPC) of fresh, sun-, oven-, and freeze-dried tomatoes was carried out according to the given procedures. Selection of the best treatment was done based on antioxidant profiling and total phenolic content. Total phenolic contents for fresh, sun-dried, oven-dried, and freeze-dried tomato powder were reported to be 87.07±0.08, 53.37±0.98, 75.29±0.27, 95.69±0.52 mg GAE/100 g. Antioxidant % was 96.07±0.01, 94.07±0.06, 92.93±0.02, and 96.10±0.02 % inhibition corresponding to fresh, sun-, oven-, and freeze-dried tomato powder. Resultant data were analyzed statistically and each significant effect was compared by using the Tukey test at a 5% probability level. From the present work, it is concluded that freeze-drying is the best method as compared to sun-drying and oven-drying and the consumption of freeze-dried tomato powder-based innovative products should be prompted in our daily routine.



## **IMPACT OF CALCIUM GLUCONATE AND SALICYLIC ACID ON POST-HARVEST QUALITY AND SHELF LIFE OF GUAVA FRUIT (*Psidium guajava*) AT AMBIENT TEMPERATURE**

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### **Abstract**

Horticulturally, guava is an important and major fruit crop in Pakistan. In Pakistan, production of guava fruit ranked 3rd with respect to the area and its production. Fresh guava fruit having a limited shelf life due to its thin peel. Current study was conducted to improve the fruit quality and to enhance the shelf life. Fruits were treated with Calcium gluconate and Salicylic acid with different combinations and stored at ambient temperature for 12 days. Maximum fruit firmness 73 N was recorded in 0.5% calcium gluconate + 0.75 % Salicylic acid, while the lowest value was found in control. Disease incidence was found unaffected in treated fruits than control. 1.5% salicylic acid showed best results in fruit weight loss, juice weight, and decay. Total phenolic and ascorbic acid in guava fruit of 1% calcium gluconate + 1.5% salicylic acid was maximum after 12 days of storage. Total phenolic in guava fruit reached up to 308.07 µg ml<sup>-1</sup> FW. The minimum increase in TA and ion leakage was 0.03% and 98.91%, respectively. A higher value of total carotenoids (3.45 mg/100 mL) was found in fruits containing 0.5% calcium gluconate and 0.75 salicylic acid, while the lowest value was in the fruit of the control. 0.5% calcium gluconate + 0.75 salicylic acid and 1% calcium gluconate + 1.5% salicylic acid showed significant maintain the quality of fruit and its quality attributes.



## **ENHANCING MANGO FRUIT QUALITY AND PROLONGING SHELF LIFE: THE IMPACT OF POST-STORAGE VAPOR HEAT TREATMENT ON *Mangifera Indica* CV. AZEEM CHAUNSA**

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### **Abstract**

A study was carried out to assess the effects of post-storage vapor heat treatment (VHT) on the quality and shelf life of mango fruits harvested from Azeem Chaunsa trees. The fruits, which were healthy, mature, and free of disease, were subjected to cold storage at  $12\pm 1^{\circ}\text{C}$  and 85-95% relative humidity for 0, 7, 14, and 21 days. Upon weekly removal from cold storage, the fruits were subjected to VHT ( $47^{\circ}\text{C}$  for 25 minutes) and allowed to ripen under ambient conditions ( $25^{\circ}\text{C}\pm 1$ ; 60-65% relative humidity) for shelf-life evaluation. The experiment was designed using a completely randomized design with a factorial arrangement. Various fruit physiological (fruit weight loss, ethylene production, respiration rate), physical (fruit firmness, fruit color), and biochemical (total soluble solids, titratable acidity, pH, vitamin C, total antioxidants, total phenolic, total carotenoids, and antioxidative enzymes) parameters were monitored throughout the investigation. The results revealed that VHT-treated mango fruits displayed superior biochemical and antioxidant attributes compared to untreated control fruits, exhibiting improved juice pH, titratable acidity, ascorbic acid content, and higher total phenolic content and enzyme levels. Furthermore, mango fruits stored for 0 and 7 days' post-harvest exhibited improved performance in terms of fruit firmness, physical appearance, low respiration rate, higher phenolic content, antioxidant content, and enzyme values compared to fruits stored for 14 or 21 days. During post-storage fruit ripening, VHT-treated mango fruits stored for 0 and 7 days showed improved physiological parameters such as reduced fruit weight loss, ethylene production, and respiration rate compared to untreated fruits. In conclusion, the study finds that VHT improves the quality and shelf life of mango fruit, with the best results achieved for fruits subjected to cold storage for 0 days (for air freight) and 7 days (for sea shipment).



## **POST-HARVEST FRUIT QUALITY OF POMEGRANATE CULTIVARS “SANDHORA” AND “KALEHAR” SOURCED FROM DIFFERENT LOCATIONS OF SOUTH PUNJAB**

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### **Abstract**

Harvest location and cultivars have a significant influence on post-harvest fruit quality of many fruits including pomegranate. Therefore present study was planned to evaluate the post-harvest fruit quality of pomegranate cultivars sourced from different locations of South Punjab. Commercially mature fruit of two pomegranate cultivars (Sandhora and Kalehar) were harvested from three districts of South Punjab Pakistan, i.e. Rahim Yar Khan, Muzaffargarh and Lodhran and kept at shelf ( $25 \pm 2$  °C & 55-60% RH) for further analysis till marketable. Results revealed that cultivars and harvest locations had significant influence on fruit quality of pomegranate. Among physical fruit quality parameters, higher fruit weight (213g/fruit), diameter (77.86 mm) and 100 arils weight (33.11 g) was recorded in ‘Sandhora’ cultivar harvested from Rahim Yar Khan. Where- as, Maximum fruit firmness (69.55 N) was noted in ‘Kalehar’ cultivar harvested from Rahim Yar Khan. Among biochemical fruit quality parameters, higher total soluble solids (15.92 °Brix), vitamin C (54.35 mg/100mL of juice), ripening index (45.45) was found in fruit harvested from district Rahim Yar Khan as compared to others locations. However, maximum titratable acidity (0.52 %) was recorded in ‘Kalehar’ cultivar. Results regarding phytochemicals including carotenoids (0.27 µg, g-1 FW), anthocyanin (0.030 Δ Ag-1FW), total antioxidant (76.17 % inhibition) and total phenolic contents (214.48 mg GAE 100g-1) were found to be maximum in ‘Sandhora’ as compared to ‘Kalehar’. As for as enzymatic studies were concerned, superoxide dismutase (67.61 U mg-1 protein), peroxidase (3.62 U mg-1 protein) and catalase activities (46.25 U mg-1 protein) were found higher in arils of ‘Kalehar’ cultivar as compared to ‘Sandhora’. Among different locations maximum enzymatic activities were found to be more in fruits harvested from Rahim Khan followed by M.Garh and Lodhran. So, it is concluded that ‘Sandhora’ cultivar harvested from RYK was found to be best for postharvest fruit quality attributes of pomegranate.



## **THE EFFECT OF LOW STORAGE CONDITIONS ON THE FRUIT QUALITY OF CHENAB GOLD AND AZEEM CHAUNSA VARIETIES OF MANGO**

Muhammad Imran<sup>1\*</sup>, Muhammad Tariq Malik<sup>1</sup>, Abdul Ghaffar Grewal<sup>1</sup>, Abid Hameed Khan<sup>1</sup>  
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### **Abstract**

The mango fruit comes under the attack of different post-harvest diseases like black spot, stem end rot and anthracnose caused by *Alternaria alternata*, *Lasiodiplodia theobromae* and *Colletotrichum gloeosporioides* respectively. The pathogens infect fruit in the field and remain quiescent until the ripening of fruit. The shelf life and quality of fruit is affected by these pathogens and technique that delays the activity of quiescent pathogens and prolongs the shelf life, is direly required. Study was conducted on two mango varieties named Chenab Gold and Azeem Chaunsa. The fruits were harvested following maturity indices and stored at 12 o C up to 28 days. The fruits were removed from storage after 7 th , 14 th , 21 th and 28 th day and subjected to ripening. After ripening, the incidence of post harvest diseases like stem end rot, body rot and anthracnose was assessed. The fruits in control were subjected to direct repining after harvest. The results showed that no post-harvest disease was noted in control treatment after repining. The effect of chilling injury was higher as compared to post harvest diseases in fruits stored at low temperature in Chenab Gold. The symptoms were in progression with storage duration. No post-harvest disease and effect of chilling injury was observed up to storage of 14 days on fruits of Azeem Chaunsa. Further investigation is required for suitable storage temperature for Chenab Gold variety.



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## **EXOGENOUS MELATONIN ENHANCES DEFENCE SYSTEM AND MAINTAINS QUALITY OF APPLE FRUIT DURING STORAGE**

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### **Abstract**

Melatonin is an effective free-radical scavenger in plants and playing an essential role in plant growth, development and stress responses. Apple fruit is extensively appreciated worldwide for its flavour, taste and nutritional value. However, rapid flesh softening and inappropriate postharvest management practices lead to postharvest decay, which affect the apple fruit quality. The role of melatonin during the long-term storage of apple fruit was studied using local varieties. The apple fruit were treated with melatonin at the rate of 0, 30, 60 and 90  $\mu\text{mol L}^{-1}$ , and stored at 12 °C for 30 days. The melatonin treatment significantly delayed the changes in weight loss, firmness, soluble solids concentration and titratable acidity as compared to control. The melatonin treatment efficiently maintained higher ascorbic acid, total flavonoids, total phenolics and radical scavenging activity of apple fruit. The results indicated that melatonin treatment regulated defence system of apple fruit through maintaining high activity of ascorbate peroxidase (APX), catalase (CAT), glutathione reductase (GR) and superoxide dismutase (SOD) enzymes. The postharvest treatment of melatonin could be a useful strategy for maintaining the postharvest quality and enhancing the shelf life of apple fruit.





## **APPLICATION OF ALOEVERA GEL BASED EDIBLE COATING TO MAINTAIN POSTHARVEST QUALITY OF TOMATOES**

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### **Abstract**

To address the major issue of postharvest losses (20-50%) of a productive crop like tomatoes, a novel aloe vera gel based edible coating was developed as postharvest treatment. The objectives of this study were to develop and optimize aloe vera gel based edible coating and to study the effect of storage on physicochemical parameters related to tomato quality and safety. For this purpose, an edible coating from aloe vera gel was developed, analyzed and applied to tomatoes. There were five treatments (A0, A20, A40, A60, A80) varying in aloe vera gel concentration from 0 to 80%. Samples having different percentages of aloe vera gel were analyzed for their physicochemical, textural and microstructural parameters during storage period of 30 days at refrigerated conditions with an interval of 10 days. Control treatment (A0) showed rapid deterioration with an estimated shelf life of 14 days as compared to A80 treatment with extended shelf life of 35 days. Percent weight loss, Size modification, decay percentage, color changes and decrease in firmness was higher for A0 (control) 20, 13, 92, 31.69 and 37%, respectively, whilst the minimum in A80 (Tomatoes coated with 80% aloe vera gel) as 4, 0.4, 7.69, 19.73 and 11.46%, accordingly. A significant decrease in acidity value of control tomatoes was observed from  $4.56 \pm 0.32$  to  $4.28 \pm 0.03$  as compared to A80. Microstructural analysis showed that coating tomatoes with coating solution having 40% aloe vera gel gave uniformity and continuity on the surface of tomatoes. It was concluded that aloe vera gel could be an excellent edible coating material and should be used commercially as a technologically viable postharvest preservation technique for fresh produces.



## **POSTHARVEST SHELF-LIFE EXTENSION OF GUAVA BY USING HPMC (HYDROXYPROPYL METHYL CELLULOSE) BASED EDIBLE COATING**

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### **Abstract**

Horticultural fruits are grown all over Pakistan, but among these fruit crops, guava fruit is considered a very important crop. Due to its medicinal, nutritional, and economic importance, guava fruit can be successfully grown in Punjab. It is a rich source of vitamin C and minerals, but due to its perishability, it has a very short shelf life. To improve this shelf life, a trial was conducted by using edible coating at different concentrations of HPMC (1%, 2%, and 3%) and dipping fruits in the solution. After the application fruits were dried and stored for 12 days at ambient temperature. Data showed that the loss of fruit color, weight loss (18.28), Fruit decay (13.07), and TA (0.39) was minimum at 3% HPMC than others. Fruit Firmness (35.39), TSS (7.03), and total sugar (19.29) were maximum in 3% HPMC and lower in control. It was concluded that 3% HPMC showed better results than control and others. Application of 3% HPMC showed better results to improve quality and enhance shelf life for 12 days of storage.



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## STANDARDIZATION OF POSTHARVEST HANDLING PROTOCOLS FOR CUT CELOSIA STEMS

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### Abstract

Celosia (*Celosia argentea* var. *crisitata* L.), a member of family Amaranthaceae, is a commercially grown specialty cut flower, which is popular due to its vibrant colors and magnificent flowering. Florists adore it for its distinctive inflorescence, which resembles the appearance of a wavy crest. Optimal postharvest handling protocols are needed to extend the vase life of cut stems, which are still not standardized for this emerging specialty cut flower crop. Therefore, a study was conducted to optimize different postharvest practices for cut celosia at Commercial Floriculture Research Laboratory, Institute of Horticultural Sciences, University of Agriculture, Faisalabad, during 2022. Four experiments, viz. harvest stage, harvest time, handling procedures and water quality were conducted to find out best harvest and handling practices for cut celosia stems. All experiments were laid out individually in completely randomized design with three replications for harvest stage and time or five replications for handling procedure and water quality trials. Data were collected on vase life (days), change in fresh weight (g), dry weight (g), water uptake (mL), change in flower quality, flower diameter (mm), change in solution pH, change in solution EC ( $\mu\text{S cm}^{-1}$ ) and termination symptoms, viz. flower wilting, flower necrosis, stem bending, leaf wilting, leaf necrosis and/or stem end rotting. In Expt. I, celosia stems were harvested at three stages with 2-3 cm, 5-7 cm and >8cm flower diameter. Stems with small- est diameter (2-3 cm) had longest vase life (18 days), while later-harvested stems with >8 cm diameter had better visual appearance than early harvested stems. Harvest time (morning (7-8 AM), noon (12-1 PM & evening (5-6 PM) and handling procedure (either dry in floral box or wet handling in water) had no effect on celosia vase life, which depicted the durability of cut celosia stems, which can tolerate abiotic stresses quite well. Among different water quality sources, stems with 5% sucrose plus tap water exhibited shortest vase life (3.9 d) compared to stems with 2% sucrose + DD water (15.3 d). In summary, celosia stems should be harvest- ed with small flower head of less than 5 cm for longest vase life. Harvest time and handling procedures had no effect on vase life, while cut celosia stems did not tolerate 2% or 5% sucrose pulsing, while use of DD water extended the vase life, but tap water reduced vase life due to high EC and may not be used for handling cut celosia stems.



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## **POST HARVEST MANAGEMENT OF FRUITS AND VEGETABLES: AN APPROACH TO REDUCE MALNUTRITION AND ENSURE FOOD SECURITY**

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### **Abstract**

Fruits and vegetable (FV) production is an emerging horticulture sub-sector even though, almost one-third of the produced FV is lost before reaching the plate. FV postharvest losses range from 30 to 80%, depending on a crop. It occurs throughout the value chain, as a result of technical and managerial setbacks during harvest, handling, transportation, processing, packaging, marketing and distribution. Lack of postharvest management skills and technology such as temperature control to maintain the cold chain, value addition, and packaging have caused several economic and food security setbacks among them are high levels of poverty, hidden hunger and malnutrition. Globally, applications of postharvest technologies for instance; use of ethylene, 1-methylcyclopropene (1-MCP) and temperature management has proved to reduce postharvest losses of FV. Also, chemical, and non-chemical methods are useful for controlling spoilage and pathogenic microbes especially on ready to eat FV products. Postharvest technologies such as controlled ripening, edible coating, temperature management, and chemical treatment methods are potential tools to reduce FV postharvest losses, increase food and nutritional security and alleviate poverty in SSA. At the same time, sanitizing chemicals and pesticides malpractice should be avoided to ensure final consumer safety. Adoption of postharvest technologies is an important step to reduce fruits and vegetable losses, thereby, contributing to poverty alleviation and reduced hidden hunger. Also, sanitation procedures should be observed while pesticides malpractices strictly avoided to ensure produce quality and consumer safety.



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## STANDARDIZING OPTIMAL HARVEST STAGE FOR GLADIOLUS L. HYBRIDS FOR EXTENDING POSTHARVEST LONGEVITY

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### Abstract

Gladiolus (*Gladiolus L. hybrids*), a member of Iridaceae family, is extensively cultivated as cut flower in different parts Pakistan on account of its relatively easy cultivation, low cost, and high market demand. However, its harvest stage needs to be optimized for having longest vase life. Therefore, a study was conducted at Commercial Floriculture Laboratory, Institute of Horticultural sciences, University of Agriculture, Faisalabad, during 2022, to evaluate three different harvest stages to find out best suited stage for longest vase life. Stems were harvested at closes bud stage (when first floret started showing color), 2-3 florets open, or half spike (4-5 florets) open. Experiment was laid out according to completely randomized design (CRD) with five individual stem replications. Results demonstrated that longest vase life (11.2 days) was recorded when gladiolus stems were harvested at 2-3 florets open stage. However, visual quality of later-harvested stems was more than early harvested stems due to high number of total florets opened during the vase period. Early harvested stems had higher water uptake than later harvested stems. Stems harvested on bud stage lost less fresh weight (5 g), while those harvested at 2-3 florets opened (8.1 g) during the vase period. Stems harvested at 4-5 florets opened had highest petal wilt (100%) compared to stems harvested with 2-3 florets opened (86%), which was the major symptom of termination. In summary, gladiolus stems should be harvested when two to three florets opened, for longest vase life and for better visual quality until termination.



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## **HARVEST MATURITY AFFECTS FRUIT PHYSICO-CHEMICAL, ANTIOXIDATIVE AND SENSORY ATTRIBUTES 'SANTA ROSA' PLUM AT AMBIENT CONDITIONS**

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### **Abstract**

The impact of maturity stages significantly affect the fresh fruit ripening and fruit quality attributes. Plum fruit being perishable exhibit abundant postharvest losses due to harvesting at improper fruit maturity. The fruit of plum cultivar Santa Rosa were harvested at two maturity stages [M1: fruit peel colour, Red (80%) & Black (20%) or M2: fruit peel colour Red (20%) & Black (80%)]. Fruits of plum 'Santa Rosa' cultivar was harvested at two maturity stages to evaluate for physio-chemical, antioxidative, nutritional attributes and sensory evaluation on daily basis upto day-9 of shelf. The data were analyzed statistically, and the comparison between or among treatments were determined using the LSD test with a significance level of  $P \leq 0.05$ . As the shelf period progressed, plum fruit harvested at harvest maturity M1 retained higher fruit firmness and titratable acidity (TA) with as fruit ripening progressed as compared to plum fruit harvested at M2. However, plum fruit harvested at harvest maturity M2 attained higher total soluble solids (TSS), fruit color, juice pH, vitamin C, TSS:TA and sensory attributes at fruit ripening with fruit ripening progressed as compared to plum fruit harvested at M1. However, overall fruit harvested at both maturity stages exhibited significant losses in fruit weight, TA, vitamin C and fruit firmness with fruit ripening progression at shelf. The plum fruit harvested at M1 exhibited less fruit quality losses during shelf period. Moreover, higher sensory attributes with highest aroma, taste, and flavor were recorded in plum fruit harvested at M2.



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## **SHELF-LIFE EVALUATION OF EARLY AND LATE MATURING GRAPE CULTIVARS (HIMROD AND RAINBOW) UNDER COLD STORAGE CONDITIONS**

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### **Abstract**

Grapes are non-climacteric berries that are a rich source of vitamins, carbohydrates, and various kinds of nutrients. Himrod and Rainbow are early and late maturing varieties respectively that are admired due to their attractive bunch color, and excellent taste. The aim of this study was to evaluate the shelf life of both varieties kept under cold storage conditions. For this purpose, fresh berries were harvested and shifted to the postharvest laboratory. After initial sorting, bunches of both varieties were stored at 5°C with a relative humidity of 90-95%. Physiochemical analyses were performed after every 5 days. Results showed that the total soluble solids of Himrod and Rainbow enhanced significantly, and titratable acidity decreased in both cultivars as well. Moreover, reducing sugar also increased in both cultivars, respectively. Finally, Himrod and Rainbow cultivars can be stored at low temperatures for 20 and 35 days, respectively. The major handicap for the shelf-life extension of both varieties includes the incidence of fungal diseases during cold storage.



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## **POSTHARVEST LOSSES AND FRUIT QUALITY ASSESSMENT OF POMEGRANATE (*Punica granatum* CV. KANDHARI) DURING TRANSIT TO VARIOUS LOCATIONS.**

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### **Abstract**

Transportation is an important factor which affects the overall quality of perishable fruits including pomegranate. This research was carried out to evaluate the postharvest losses and quality variation in pomegranate fruit during transportation to different locations in Pakistan. Fruit of pomegranate cv. Kandhari were harvested from Afghanistan and transported to various locations i.e Chaman, Multan and Faisalabad for assessment of postharvest losses and fruit quality evaluation. Fruit quality parameters including Physical (Fruit color, fruit firmness, bruise, injury, sunburn, cracks, insect damage, crown rot, decay, blemish, super facial injury, over size, misshapen, and shriveling), biochemical (Total soluble solids (TSS), Titratable acidity (TA), Ascorbic acid (Vitamin C), Juice pH, TSS/TA ratio) and Organoleptic (Taste, Aroma, Texture, Flavors, and Color) were recorded during the study. The study was laid out under Randomized completely block design (RCBD) with factorial arrangement and the experimental data were statistically analyzed statistical software. Among physical fruit quality parameters weight loss, cracks, mechanical injuries, misshapen, oversized, shriveling and biochemical parameters PH, TA was higher in pomegranate fruit transported to FSD while Color, firmness, Blemish, Bruise, Crown, Decay, Injury was higher in fruits transported to Multan. TSS and vitamin C was higher in pomegranate fruits transported to Chaman. Overall organoleptic attributes (Taste, Aroma, Texture, and flavor) were found to be higher in pomegranate fruit transported to Chaman.





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## **EFFECT OF MATURITY STAGES ON PHYSIOLOGICAL FRUIT QUALITY OF BANANA DURING STORAGE AT AMBIENT CONDITIONS.**

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### **Abstract**

Maturity has significant effect on quality of many fruits including banana. Therefore, present study was planned to evaluate the Effect of maturity stages on physiological fruit quality of banana during storage at ambient conditions. Bananas have short shelf life ambient temperatures due to climacteric ripening-related changes such as fast softening, senescence spotting, off-odor development, and chilling injury during storage below 13 °C. A study was done to examine physiological and biochemical changes at two distinct maturation stages in Banana fruit during room temperature storage. During ripening, the firmness of mature bananas was found to be higher than that of immature bananas based on data collected over 15 days with three days interval. Total Soluble Solid, of mature banana was more than that of immature banana. Titratable acidity decreased more in mature banana than in immature with increasing storage days. After six days of shelf life, the DPPH and Phenolics content of ripe banana increased dramatically but then declined. Completely Randomized Design was used for the study (CRD). The gathered data were statistically evaluated with SAS Software, and the LSD test was utilized to assess the differences in treatment mean differences.



## **PHYSIO-MORPHOLOGICAL CHARACTERIZATION OF CHILLI GERMPLASM UNDER DIFFERENT SOWING SEASONS**

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### **Abstract**

Chilli is the world's second most important vegetable after tomato. Pakistan ranks 5 th in its production worldwide, with a gradual increase of 3.7 percent in overall production. Nutritionally, chilli is an excellent source of vitamins (A, B2, B6, C, and K) and essential minerals (potassium, phosphorus, calcium, iron, and zinc) besides this, it also contains mixture of antioxidants notably carotenoids, ascorbic acid, flavonoids and polyphenols. This makes it a very important constituent of many foods, adding flavor, color and pungency and, hence, an important source of nutrition for humans. Considering its high nutritive value and export potentiality in Pakistan it is imperative to take attempts for successful cultivation which depends on several factors like sowing time and plant spacing. It ensures proper growth and development of plants resulting in more yield with economic use of land. The experiment was conducted at PMAS Arid Agriculture University to clarify the optimum sowing/planting time for maximum yield and better quality. Observations for three varieties of chillies (Local & Hybrid) was recorded on growth, yield, quality characters viz plant height, no. of branches per plant, fruit length, fruit girth, seeds per fruit, yield and phenolic compounds. Experiment was conducted with the treatments of different sowing seasons (Summer and Winter) by keeping three replications. In general, a significant relation was found on growth, yield and quality of chilli. Variety P6 (hybrid) performed best for most of the parameters. Number of fruits and yield per plant were maximum during the summer season with a mean value of 12.2 and 26.1g respectively. During summer season variety longi performed best with a mean value of 12.1 while during winter P6 had the highest number of fruits with a mean value of 13.0. Ascorbic acid contents as affected by seasons was maximum during the winter season with a value of 2.82 as compared to summer with a value of 1.51. Longi and Hi fly was found statistically similar with a value of 2.18 for vitamin C content. A significant effect was also observed between varieties for storage under different conditions. P6 performed best with maximum number of days upto 20 days for storage at low temperature as compared to room temperature.



## **IMPROVEMENT IN SHELF LIFE OF ICEBERGLETTUCE (*Lactuca Sativa L.*) WITH DIFFERENT ROOT LENGTH**

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### **Abstract**

In Pakistan, two cultivars namely leaf lettuce and iceberg are commercially important and grown on a wide scale. Iceberg is favored due to its crispy leaves. Iceberg is highly nutritious as they are composed of minerals, essential nutrient elements, fiber, moisture and antioxidants like vitamins (C, E and B9), phenols, flavonoids, and carotenoids. Major portion of human diet consist of plants. The crop is very perishable in nature and wilt quickly. Keeping in view the issue mentioned aspects, this study was planned with the aim of retaining the freshness of Iceberg at different conditions at Arid Agriculture University Rawalpindi. Harvested plants were stored in boxes for treatment with root length of 0.0cm, 2.0cm, 3.5cm, 5.0cm and 6.5cm. The leaves were kept at both room temperature of 27oc and cold temperature of 3°C. Plant physiological parameters were observed at both conditions with dissimilarity in root length. Leaves were taken for the estimation of secondary metabolites like total flavonoid contents and total phenolic contents in plants. Additionally, a number of signs were seen, including variations in the rate at which lettuce was losing weight, the colour of the leaves, and the rate at which its chlorophyll concentration was depleting. The findings showed that keeping the lettuce's with root helped to prevent colour change at temperature of 3°C and root length of 5 cm with improved freshness as well flavonides.



## **RECLAMATION OF SALT AFFECTED SOIL USING BIOCHAR AND COMPOST FOR IMPROVED GROWTH AND QUALITY OF GRAPEVINES**

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### **Abstract**

The purpose of the research is to demonstrate how salt accumulation in soil affects its physical, chemical, and biological properties and to discuss organic reclamation additives as well as monitor the growth and productivity of grapevines. Biochar, compost, and pyroligneous solutions have been used as an organic source of carbon as well as to enhance the physical, chemical, and biological properties of soil for the reclamation of salt-affected soils, the improvement of soil carbon content, and carbon sequestration. However, these organic amendments have very little and insignificant effects on fruit quality and vine growth. As a result, the use of organic sources in topsoil has no economic impact on grapevines. In addition to these strategies, gaps in understanding have been identified as a need for further study. By the application of biochar and compost, not only the soil aggregation and its different properties have been improved, but also the soil organic content has been enhanced, which ultimately increased the microbial biomass in the soil. Organic amendments proved to be more efficient and effective reclamation techniques for the salt-affected soils. Furthermore, due to the vast range of biochar and compost sources as well as different types of soils, very little work has been reported in this field. However, biochar application on non-saline soils has been done in the past. For the proper amelioration of organic substrates such as biochar and compost, more understanding and research are needed. Biochar and compost are organic amendments that can improve the carbon pool of soil as well as soil aggregation, but topsoil applications of both biochar and compost have non-significant effects on the growth of grapevines and fruit quality. In addition, research gaps in this area should be filled to ensure proper knowledge and understanding.



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## **ROLE OF NUTRACEUTICALS & FUNCTIONAL FOODS TO CONTROL FOOD CRISIS**

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### **Abstract**

The increasing global population and climate change have led to a growing food crisis, characterized by food shortages and rising food prices. This crisis not only affects the availability of food but also its nutritional value and accessibility. One potential solution to this problem is the use of nutraceuticals and functional foods. These foods are fortified with additional nutrients, such as vitamins and minerals, and have been shown to improve health outcomes and prevent chronic diseases. In this research, we explore the role of nutraceuticals and functional foods in controlling the food crisis. We investigate the impact of these foods on hunger, malnutrition, and sustainable food systems. Additionally, we examine the potential of nutraceuticals and functional foods as a means of addressing food insecurity in developing countries and the feasibility of their large-scale production and distribution. Our findings suggest that nutraceuticals and functional foods have the potential to play a significant role in preventing food crises, by providing a sustainable and nutritious food source for populations at risk of hunger and malnutrition. These foods can also improve overall health and reduce the burden of chronic diseases, particularly in low-income communities where access to nutritious food is limited. Furthermore, we found that the development and implementation of appropriate policies and regulations for the production, distribution, and consumption of nutraceuticals and functional foods can help to overcome barriers to their widespread adoption. This research highlights the need for more investment in the development and promotion of nutraceuticals and functional foods as a means of addressing the food crisis and promoting sustainable food systems.



## **DRIED MINOR FRUITS BASED VALUE ADDED NUTRITIOUS BAR**

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### **Abstract**

Dried fruits like figs, prunes and apricots are important in food products due to their energy, antioxidant and flavonoid properties including dietary fiber, gluten-free, essential minerals, vitamins, antioxidant activity. The fruit bar represents an alternative nutritious snack with more potential as compared to local snack bars. To meet the purpose, fruits were assessed for proximate and minerals profiling. The compositional results of apricot, fig and prunes showed crude fiber  $2.37 \pm 0.03$ ,  $3.98 \pm 0.41$ ,  $1.76 \pm 0.15$ , crude ash  $3.50 \pm 0.2$ ,  $4.20 \pm 0.81$ ,  $2.33 \pm 0.31$  crude fat  $1.30 \pm 0.02$ ,  $0.77 \pm 0.240$ ,  $0.3 \pm 0.2$  crude protein  $0.70 \pm 0.02$ ,  $3.08 \pm 0.29$ ,  $0.47 \pm 0.15$  and moisture  $12.67 \pm 1.06$ ,  $15.60 \pm 1.07$ ,  $13.53 \pm 1.07$  respectively each fruit. Whereas minerals values of sodium, potassium and calcium mg/100g in fruit apricot  $18 \pm 0.11$ ,  $509 \pm 0.15$ ,  $104 \pm 2.0$  mg/100g fig  $0.5 \pm 0.11$ ,  $780.01 \pm 2.76$ ,  $280.6 \pm 0.13$  mg/100g and prune  $2.76 \pm 0.12$ ,  $725 \pm 0.14$ ,  $39.33 \pm 0.11$  mg/100g respectively. Afterward dried fruit bar was prepared with apricot, fig and prunes with 10%, 20% and 30% of each fruit to check storage stability by considering the following sensory parameters. In sensory profiling, during storage at control treatment color showed a minimum of  $6.25 \pm 0.03$  at 0 day and a maximum for prune-based treatment was noticed on 20-day moisture 9.55% at 0 days 10.18 at 30 days flavor  $5.08 \pm 0.02$  at 0 day and maximum  $8.82 \pm 0.03$  in all treatment mostly T8 and T7 nutritional profiles satisfactory. The calorific value obtained ranges from  $390 \pm 0.02$  kcal at T0 in 0 days the maximum at T6  $550 \pm 1.25$  kcal on 20th day.



## RECENT DEVELOPMENTS IN MICROBIAL DECONTAMINATION OF FRUITS AND VEGETABLES

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### Abstract

Microorganisms can be found in all places with just a few exceptions such as sterilized surfaces. It is not possible to completely eradicate them from our daily life. Hence, they often find their way into the human food chain especially fruits and vegetables which are a source of vital nutrients required for growth and well-being. A lot of species of these microbes are pathogenic in nature and cause food-borne illnesses in humans. An exponential growth in the world population in past decades has increased the demand for fruits and vegetables because of higher consumption. Higher demand has pushed the agricultural industry to higher production leading to a higher risk of microbial contamination. Consumption of fruits and vegetables has been linked to various foodborne illnesses such as diarrhea, vomiting, nausea, abdominal pain and cramping, fever, loss of appetite, hemolytic uremic syndrome, and weight loss. Over the last decades, there has been intensive research on the interaction of pathogens with fruits and vegetables to improve their microbial safety. In this study, we reviewed the main methods of microbial contamination of fruits and vegetables. We also reviewed the methods that have been developed recently and are being used for microbial decontamination such as ultrasonication, acid-electrolyzed water, ozonation, irradiation, gamma rays, ultraviolet radiation, high-pressure processing, antimicrobial coating, and cold plasma-based hurdle technologies.



## **JAMUN (*Syzygium cumini*) SEED; ANTIOXIDANT EFFECT AND ITS BIOLOGICAL ACTIVITIES**

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### **Abstract**

Jamun (*Syzygium cumini*), a nutritious fruit and has historically been used as both as an edible and a traditional medicine. The jamun seed act as an inedible by-product of one of the minor fruits of Pakistan. However, maximum concentration of phytochemicals makes them valuable components of nutraceuticals. Numerous studies on diverse biological activities of jamun seeds have warranted their application in human health and biomedical fields. Different research have discussed critically the phytochemical composition of jamun seeds and the bioactivities, including their antioxidant, anti-inflammatory, anti-cancer, antidiabetic, antimicrobial, anti-obesity, hepato-protective, cardio and gastro-protective properties. Jamun is a perfect antioxidant fruit for human consumption because of its high anthocyanin and ellagic acid/ellagitannin content, which could significantly reduce the risk of cancer and other degenerative diseases. The presence of phenols, flavonoids, steroids, alkaloids, triterpenoids, tannins, and saponins in jamun seed is associated with its bioactivity. Animal research in vivo, and in vitro experiments with human and animal cell models support the idea that jamun seed extract can be valuable additions in food and biomedical fields due to the diverse bio-functional properties. However, in-depth and systematic in vivo clinical trials using human subjects must be conducted to confirm the safe consumption limit and establish other therapeutic roles of jamun seeds for their abundant utilization as a nutraceutical or pharmacological component. Moreover, research is required to understand the exact mechanisms of the bioactivities exhibited by jamun seeds.





## COMPARISON OF VARIOUS DRYING METHODS & TEMPERATURES FOR PRESERVING QUALITY AND VALUE ADDITION OF SELECTED ORNAMENTALS

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### Abstract

Value-added floriculture is a process of increasing the economic value and consumer appeal of any floricultural commodity. Dried and preserved plant materials are popular all over the world for home decor. A study was conducted to optimize drying techniques and temperatures for preserving flower quality of selected ornamental crops, viz. celosia and rose. Experiments were laid out according to completely randomized design (CRD) with three replications. In study I, cut celosia stems were harvested at half open stage with five stems in each treatment and dried by using air drying (bunches of five stems were tied with rubber band and hanged inverse-ly at room temperature, viz. 15-20°C for two weeks, press drying (stems were wrapped in newspaper and placed under weight for one week), or oven drying (in a controlled temperature dehydrator) at 40°C for two hours. Flowers dried by air drying exhibited 27.9% moisture loss and with least change (3.1) in flower quality, while controlled temperature drying at 40°C exhibited 30.2% moisture loss and retained fresh color in celosia. In study II, rose petals were dried at varying temperatures, viz. 30, 35, 40, and 45°C to a specific moisture level in petals. Flower petals dried at 30°C in dehydrator exhibited best color retaining (77%) and fragrance (100%) followed by 55% color retaining and 66% fragrance at 35°C, for best quality dried petals. Rose petals dried at 40°C and 45°C exhibited poor color retention and fragrance (33% each) with greatest reduction (change) in flower quality (4). It was concluded that controlled temperature drying at 40°C is best among tested techniques for celosia, while for rose petals, 30°C temperature is optimal for best color retaining and fragrance and may be used for preserving flower quality and value addition.



## **POMEGRANATE ARIL AND FRESH JUICE PHYSICO-CHEMICAL AND MICROBIAL ATTRIBUTES OF VARIOUS POMEGRANATE JUICE VENDORS IN MULTAN, PAKISTAN.**

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### **Abstract**

Fruit juices are common beverages in many countries including Pakistan, a lot of consumers attracted to road side stalls of fresh juice during hot summer season. However, the food safety and quality of the fresh juice has not been widely studied and warrants investigations. Multan being one of the metropolitan and highly populated city have plenty of fresh juice vendors. Keeping in view the facts, a study was carried out to quantify the physicochemical and microbial characteristic of pomegranate aril and fresh juice sourced from various pomegranate vendors of Multan. A total of fifteen fresh juice pomegranate fresh juice vendors were selected and were samples for aril sampling. The samples arils were instantly transferred to Postharvest Science and Technology lab, MNS-University of Agriculture Multan for analysis. The recorded data was subjected to ANOVA and mean comparison tests. The total colony forming units of juice samples revealed a higher bacterial count in all the samples. The range of bacterial counts in this study were observed the value of around 1-1.8 x 10<sup>6</sup> CFU/mL. Moreover, the result indicated a significant differences for juice various physicochemical and microbial load results. the range of titratable acidity (TA) of pomegranate juice sample ranged from 0.22-0.36%, total soluble solids (TSS) ranged between 16-19.67 Brix, vitamin C ranged from 73-114 mg/100ml, juice pH range was 3.7-4.1 and TSS:TA ratio ranged 48-85. The microbial loads of most of the fruit's juices were higher than the specifications set for fruit juices sold in the WHO and other parts of the world. There is no specification set for the permissible level of microbes in fresh fruit juices being served in Pakistan. As dominant isolates were colonies of organisms, the poor hygienic practice of the fruit juice handlers and lack of sound knowledge source of fruit aril, besides the conducive physicochemical profiles of the fruit juices, might have contributed to the high microbial load. Thus, there is need create awareness among pomegranate fresh juice vendors to improve the microbial quality, safety, and shelf-life of the final product.



## UTILIZATION OF MANGO KERNEL OIL FOR VALUE ADDED PRODUCTS

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### Abstract

Mangifera indica is the king of all fruits due to its fascinating appearance, nutritional composition, taste, and aroma. Pakistan contributes a lot in production of mango fruits in the total world's production. Some portion of mango fruits consumed freshly or used to prepare different food items like juice, jam, marmalade, and chutneys. Major portion of mango fruits discarded as a waste in the form of peel and seeds which have various valuable constituents which includes antioxidants and unsaturated fat. Recent study was composed to use mango kernel oil in production of value-added products. Edible fat used for bakery products can be substituted by mango kernel oil. During this study mango seed was broken by specialized designed cutter to remove the tenacious coat of mango seed and separated the mango seed kernel from the outer layer of mango seed. Mango kernel contains applicable amount of oil about 11.63%. Mango seed oil was extracted by two techniques including solvent extraction through Soxhlet assembly and mechanical extraction through simple expeller. The resulted oil was used to prepare the different varieties of bakery items. The prepared bakery products were evaluated for different quality parameters including physical analysis, chemical analysis, color analysis, textural study and sensory properties. The presented products prepared by mango seed oil are used to enhance the value addition characters. Mango seed oil extracted from the mango seed through solvent extraction in Soxhlet extractor by using n-hexane on lab scale.



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## **PREDICTION OF DRYING RATE OF FRUITS AND VEGETABLES USING MACHINE LEARNING**

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### **Abstract**

One of the biggest concerns about food security is the lack of provided facilities. This issue is estimated to affect around 1.3 billion tons of food each year. Food waste is a major contributor to global food production loss. It may also have an impact on the energy, water, and land used in food production. One of the most effective ways to prevent food spoilage is by solar drying. This process can also help combat hunger and global warming. This method of food preservation can help in reducing the development of molds and dangerous bacteria. This study aims to forecast fruit and vegetable drying rates using machine learning. This research examines the time period of different vegetables required to dry properly in various environments. The use of machine learning (ML)-based algorithms in the food drying process is a fascinating and cutting-edge strategy for developing drying technologies. I'll be using various samples of fruits and vegetables to dry in a solar dryer while measuring the moisture ratio (MR), temperature (°C), R.H., and drying rate. The next step is dataset analysis and data preprocessing to prepare it for data prediction machine learning model.



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## **RESPONSE OF DOMESTIC ORGANIC WASTE TO DOMESTIC FARMING AND VEGETATION, AND ENVIRONMENTAL SAFETY**

Kashif Ali Khan<sup>1</sup>, Abdul Basit<sup>1\*</sup>, Muhammad Mueen Akram<sup>1</sup>, Muhammad Murtaza<sup>1</sup>, Mishal Kainat<sup>1</sup>, Shamsa Bibi<sup>1</sup>, MuhammadAmjad Bashir<sup>1</sup> and Hafiz Muhammad Ali Raza<sup>1</sup>

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### **Abstract**

The increasing birthrate leads to an increased population globally that is causing severe malnutrition and food security issues. However, a mob of people is used to domestic farming and vegetation (DFV). Besides, people dispose of whole household waste that includes a high proportion of organic waste (OW) (i.e., eggshells, peels of fruit and vegetables, and plant litter). OW has high nutrient efficiency to boost yield. Composed OW's utilization for DFV fulfills malnutrition and food security problems at the household level. For justification, numerous experiments were conducted in different areas of Pakistan. With a reasonable decomposition rate of OW, statically domestic farming yielded more. The prominently increased yield was not only enough to fulfill household requirements, but it was also revealed as beneficial to local businesses. Moreover, DFV also enhances ecosystem conditions by avoiding pesticides and hazardous chemicals and exhilarating the effect of atmospheric gases.



## **FRESH CUT QUALITY OF STRAWBERRY FRUIT AND POMEGRANATE ARILS: EFFECT OF FREEZING TEMPERATURE, DURATION AND TYPE OF CUT**

Farzana Rafeeq<sup>1\*</sup>, Sami Ullah<sup>1</sup>, Ishtiaq Ahmad Rajwana<sup>1</sup>, Kashif Razzaq<sup>1</sup>, Nazar Faried<sup>1</sup>, Gulzar Akhtar<sup>1</sup>, Shafa Nayab<sup>1</sup>, Shabbir Ahmad<sup>2</sup> and Khursheed Ahmed Dhawa<sup>1</sup>.

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### **Abstract**

Ready to eat fresh cut fruits has recently gained much popularity as ready to consume food. However, the quality of fresh cut fruit is highly influenced by freezing temperature, duration and types of cut because of vulnerable to lose water and microbial contamination. Therefore, an integrated study was carried out to investigate the effect of freezing temperature and duration on fresh cut strawberry and pomegranate aril quality. For this purpose, two independent studies were carried out to explore the effect of freezing temperature and duration conducted on fresh cut strawberry and pomegranate arils. Study-I evaluated fresh cut type (WH 1=whole fruit, WH 2=whole fruit with pedicel removed only, FC 1=pedicel + 6 mm cortex removed, FC 2= pedicel + 6 mm cortex removed + fruit cut into two halves) and freezing duration on strawberry cv chandler stored at ultra-low freezer (-40) for three months with one month interval, while, study-II investigated freshly extracted arils of pomegranate fruit cv. Sawa at three freezing temperatures (0°C, -20°C, -40°C) for six months duration with two months interval. The results revealed that after 3-month of freezing, the fresh cut strawberry subjected to FC 2 exhibited higher activities of superoxidase (SOD), peroxidase (POD) and catalase (CAT) enzymes irrespective to freezing duration. Strawberry fruits stored as FC 1 exhibited minimum microbial load (CFUg<sup>-1</sup>), while maximum was noted in strawberry fruit frozen as WH 1. As far as the results of pomegranate arils study is concerned, freshly extracted pomegranate arils stored at -40°C showed higher antioxidative enzymatic activities such as SOD (40 U mg<sup>-1</sup> of protein), POD (2.70 U mg<sup>-1</sup> of protein), CAT (8.48 U mg<sup>-1</sup> of protein), retained sensory quality while minimum bacterial growth (0.84 Log CFUg<sup>-1</sup>) and browning index as compared to other freezing temperature at the end of freezing duration. However, microbial load was increased with the advancement of freezing duration irrespective to temperature. It was concluded that fruit cut strawberry quality was decreased with advancement of freezing period, strawberry fruit frozen FC2 retained higher antioxidative properties, while strawberry stored as WH 1 retained its quality with higher microbial load. While in case of study-II, various freezing temperatures affected the quality of pomegranate arils, however, aril stored at freezing temperature -40°C maintained the higher quality attributes by exhibiting higher enzymatic activities, retained sensory quality and suppressed the growth of microbes on frozen arils.



## **INFLUENCE OF PREHARVEST GINGER EXTRACT APPLICATION TO ENHANCE THE POSTHARVEST STORAGE FRUIT QUALITY ATTRIBUTES OF PAPAYA CV. RED LADY UNDER LOW TEMPERATURE STORAGE**

Muhammad Azam<sup>1\*</sup>, Shiza Muqadas<sup>1</sup>, Rashad Qadri<sup>1</sup>, Beenish Chaudhary<sup>1</sup>, Muhammad Arslan Khan<sup>1</sup>, Muhammad Hassan Javed<sup>1</sup>, Saeed Ahmad<sup>1</sup> and Muhammad Ali Umer<sup>1</sup>

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### **Abstract**

Papaya is important fruit crop having great nutritional value. Due to its highly perishable nature, it deteriorates quickly after harvest and results in postharvest losses. Therefore, the effect of preharvest application of ginger extract on ripening patterns and overall quality of papaya (*Carica papaya* L. cv. 'Red Lady') fruits have been investigated. Preharvest ginger extract of 1%, 2% and 3% were applied one week before harvest and control fruits were treated with distill water. After treatments, fruits were stored at 10 °C for 21 days in cold storage. Preharvest ginger extract @ 2% resulted in higher firmness, reduced respiration rate and higher titratable acidity than untreated fruits. Moreover, weight loss, color development and disease incidence were minimum in fruits treated by ginger extract 2%. We observed that 2% ginger extract showed higher sensory qualities and extended the shelf life of papaya fruit by reducing fruit decaying and enhancing the enzyme activities and maintaining good keeping quality during storage. Overall quality of fruits treated with ginger extract maintained higher quality than control fruits. Therefore, it is safe to use preharvest ginger extract (2%) commercially to prolong the shelf life of papaya during storage.



## **COMBINE APPLICATION OF ESSENTIAL OILS AND GUM ARABIC COATING INFLUENCES POSTHARVEST DECAY AND QUALITY OF POMEGRANATE FRUIT DURING COLD STORAGE**

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### **Abstract**

Postharvest rot disease is a serious disease in pomegranate (*Punica granatum* L.) plantations in Pakistan. This disease usually weakens tree vigor, and seriously reduces the ornamental value, fruit yield, and quality. A better understanding of the pathogen that causes a postharvest disease is important for its control. Thus, the aim of this study was to isolate and identify the pathogens causing postharvest rot disease and to explore substances for its biological control. Assessment of stored fruit showed that *Penicillium implicatum* and *Penicillium expansum* were the most devastating fungal pathogens. Antifungal effects of 8% gum arabic (GA), 0.50% clove oil (CLO), 0.25% cinnamon oil (CMO) and their combinations, clove+gum arabic, cinnamon+gum arabic were investigated against both the associated pathogens *in vitro* as well as *in vivo*. Gum arabic alone did not show any promising results while the combination of clove+gum arabic showed effective results in reducing the mycelial growth of the tested pathogens. *In vivo* studies also indicated that combination of clove+gum arabic showed promising effects in reduction of decay incidence in artificially inoculated pomegranate fruit. Combined application of clove+gum arabic also reduced the weight loss and maintained soluble solid contents, titratable acidity and ascorbic acid contents of pomegranate fruits. The results suggest the possibility of using gum arabic in combination of clove oil as a new tool for postharvest disease management, preservation and shelf-life extension of pomegranate fruits.





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## **PINE NUTS VALUE CHAIN ANALYSIS IN ZHOB DIVISION, BALOCHISTAN**

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### **Abstract**

Value chain is defined as a complete arrangement of activities that are involved during the flow of products from growers to consumers. Pine nut (Chilgoza) is an evergreen coniferous gummy tree belonging to the Pinaceae family. Pine nut production in Zhob division is declining due to Government and local bodies' negligence. Poor governance and weak linkages amongst commission agent, retailer, wholesaler and contractors are the factors contributing to Pine nuts decline. The present study was designed to study value chain of pine nut and suggest measures for upgradation of pine nut value chain in Zhob. The questionnaire was prepared for different stakeholders such as growers, wholesalers, retailers and processors from Sherani region of Zhob division. A total of 120 interviews were conducted including 30 growers, 30 wholesalers, 30 retailers and 30 processors. Growers total cost of production was Rs. 6673 per bag of cones and they sold the pine-nut bag for an average Rs. 12000 and they gained 48 percent profit while wholesaler gained 12.75 percent profit after selling to processors. Processors gained 5.2 percent and retailer gained 8.5 percent profit from consumers. The average selling price of pine-nuts per kg was Rs 2600. Lack of necessary equipment and experience are the major reasons of loss during harvesting and drying process of pine nuts in the Sulaiman Mountain range of Sherani region. Government should promote and educate the grower and other stakeholder in the field of value chain for better production.



## **ASSESSMENT OF POTATO CROP IN PROJECT AREA OF KURRAM AND ORAKZAI, MERGED DISTRICTS, KHYBER PAKHTUNKHWA, PAKISTAN**

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### **Abstract**

The study open-up the initial results of a project interventions to ensure availability of virus free seed potatoes to the farmers of merged districts, Khyber Pakhtunkhwa, Pakistan and down country and to generate livelihood opportunities for local populations through creation of potato seed industry and to increase farmers' earnings through increase in potato productions using disease free certified seed potato. The study was based on a survey of 80 beneficiaries' farmers, comprising 40 farmers each from districts Orakzai and Kurram. After removing the outliers, a total of 69 farmers were used for further analysis. Data were collected using a well-structured and pretested interview schedule. Descriptive statistics and indices were used in the study. The empirical findings revealed that the farmers were young and educated in both districts. Farming was the main occupation and income source of the respondents. An average area of 2.32 acres and 5.61 acres was cultivated by respondents of districts Orakzai and Kurram, respectively. Area under potato cultivation was increased in both districts and the farmers ranked potato cultivation as "More Profitable" on top and they were fond of high yielding potato varieties. The study results also revealed that trainings improved the knowledge level with index of 0.87 and 0.81 for districts Orakzai and Kurram respectively. Kuroda variety was given to majority of the farmers in both districts that yielded acre-1 of 93.53 mounds and 105.32 mounds in districts Orakzai and Kurram respectively. SM Kaghan variety of potato was given to 6 percent and 12 percent of the farmers of districts Orakzai and Kurram that yielded acre-1 of 127.50 mounds and 213.25 mounds respectively. Asterix variety of potato was given to 5 percent and 3 percent of farmers that yielded acre-1 of 70 mounds and 80 mounds respectively. The findings also revealed that majority of the potato produce in both districts were sold followed by stored for seed purpose, exchanged and kept for home consumption. The BCR was 1.33 for potato production using improved seed while 1.09 for potato production using local seed last year for farmers of district Orakzai. Similarly, the BCR was 1.91 for potato production using improved seed while 1.01 for potato production using local seed last year for farmers of district Kurram. Based on the study findings, the suggestion was the continuity and replication of said model in same and other districts and for other crops, more adaptive and verification trials, and studying market behavior of potato producers according to socio-econ-psycho-and climatic conditions of the area.



## **EVALUATING SOILLESS GROWING SYSTEM AND GREENHOUSE ENVIRONMENT FOR CHERRY TOMATO GROWTH AND PRODUCTIVITY**

Muhammad Shoaib<sup>1</sup>, Hafiz Nazar Farid<sup>1\*</sup>, Sami Ullah<sup>1</sup>, Gulzar Akhtar<sup>1</sup>, Kashif Razzaq<sup>1</sup>, Tanveer Ahmad<sup>1</sup>, Syeda Anum Masood Bokhari<sup>1</sup>, Abid Hussain<sup>2</sup>, Mohsin Bashir<sup>3</sup> and Ali Asad Bahar<sup>1</sup>

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### **Abstract**

Increasing urbanization and decreasing water resources emphasize on the due need of alternative production systems (e.g., soilless cultivation) for high value crops like cherry tomato to ensure food security for sprawling population. Therefore, present study was planned to evaluate the performance of different cherry tomato cultivars under soilless growing systems. The crop was grown in two soilless growing systems (grow bags and trough/channel containing 100 % coco coir) under partially environment-controlled greenhouse (10,000 ft<sup>2</sup>) equipped with fan and pad evaporative cooling system. The study was laid out under Complete Randomized Design (CRD) with three factors factorial arrangement (growing system, cherry tomato type and temperature zones). Growing systems (grow bag and trough/ channel system), Temperature (T<sub>0</sub> =22-24°C, T<sub>1</sub> = 25-27°C and T<sub>2</sub> =28-30°C) and varieties of cherry tomato were the treatments combinations. Various morpho-physiological, biochemical and yield related parameters were studied. Collected data was analyzed by analysis of variance technique and HSD turkey's test at 5% probability test to compare the differences among different treatment x variety and growing systems means. Results obtained from the experiment showed that "Premium Ruby" and Grow Bag system had reported significant increase in all attributes including growth, physiological, and yield. Results further indicated that biochemical attributes (total soluble solid (TSS), titratable acidity (TA), ascorbic acid, anthocyanin, phenolics antioxidants, significantly increased in grow bag culture, Premium Ruby showed maximum performance well under temperature regimes of 25-27°C. However, maximum increase in growth parameters and values was recorded under T<sub>1</sub> over other treatments in all varieties. Overall, premium ruby variety grown in a trough system under temperature regimes of 25-27°C showed maximum performance, thereby suggested to be evaluated for commercial scale.



## **EXOGENOUS APPLICATIONS OF DIFFERENT RHIZOBACTERIAL STRAINS IMPROVE VEGETATIVE AND FLORAL ATTRIBUTES OF *Calendula officinalis* L.**

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### **Abstract**

*Calendula officinalis* L. is an herbaceous perennial flower from Asteraceae family. Rhizobacterial strains (RBS) have beneficial effects on growth of plants by stimulating growth of roots and shoots. RBS solubilize phosphorous and make available to the plants and increase plant growth and yield under field conditions. In the current research, various strains of rhizobacteria were used to observe their effect on potted *Calendula*. Treatment combinations were comprised of To: Control, T 1 : *Pseudomonas* sp. (MN9), T 2 : *Bacillus* sp. (AS-53), T 3 : *Burkholderia* sp. (PsJN), T 4 : *Pseudomonas* sp. + *Bacillus* sp. (MN9 + AS-53), T 5 : *Pseudomonas* sp. + *Burkholderia* sp. (MN9 + PsJN), T 6 : *Bacillus* sp. + *Burkholderia* sp. (AS-53 + PsJN), T 7 : *Pseudomonas* sp. + *Bacillus* sp. + *Burkholderia* sp. (MN9 + AS-53 + PsJN). The experiment was executed under CRD with three replications. Analysis of variance (ANOVA) technique were used to determine the overall significance of the proposed research trial and treatment means were compared by least significant difference (LSD) test at 5% level of probability. Various parameters such as number of leaves per plant, number of branches per plant, plant height, leaf area index, stem diameter, plant fresh weight, plant dry weight, and number of days to 1st bud initiation, number of flowers per plant, flower diameter, flower weight, and leaf chlorophyll contents were measured. The treatment combination of three RBS (*Pseudomonas* sp. + *Bacillus* sp. + *Burkholderia* sp.) showed best results in all parameters viz. number of leaves per plant (46.20), number of branches per plant (11.8), plant height (58.60 cm), leaf area index (19.5 cm<sup>2</sup>), stem diameter (11.03 mm), plant fresh weight (74.6 g), plant dry weight (18.35 g), days to 1st bud initiation (76.39 d), number of flowers per plant (10.8), flower diameter (75.62 mm), and flower weight (11.3 g) of *Calendula officinalis* L. as compared to all treatments. It can be concluded that the application of RBS (*Pseudomonas* sp. + *Bacillus* sp. + *Burkholderia* sp.) in combination can be used to improve vegetative and floral attributes of *Calendula officinalis* L.



## **HORTICULTURAL CROP WASTE COMPOSTING: A WISE AND JUDICIOUS ENTERPRISE**

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### **Abstract**

Depletion of soil fertility is a major restraint for horticulture crop production in Pakistan. The use of organic plant nutrient source compost not only recycles organic horticultural waste causing environmental pollution but also conserves rich pool of nutrients resources, which can reduce the sole dependence on chemical fertilizers. Due to Composting horticultural and other crops waste could be managed which resultantly improve soil health and enhance soil microbial activity. It is being used in soil media and nursery management of horticultural crops. Horticultural crops and field waste like pruning material, fruit and vegetable waste, kitchen waste, cow manure, fresh leaves, dry Leaves and chopped straw were used during preparation of compost. Compost was prepared through open air, pit, heap, tumbler, earth worm, EMO and windrow turner commercial composting methods. For orchard, vegetables and ornamental commercial horticultural crops farming the windrow turning through heap composting method is the wise and judicious enterprise to achieve sustainable production under changing climatic scenario.



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## OPTIMIZATION OF MANGO SHELF-LIFE THROUGH IOT

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### Abstract

Mango is a perishable fruit, and its export plays a vital role in Pakistan's economy. Due to inappropriate storage techniques, a large number of export quality of mangoes get wasted. Information Technology plays a key role and can convert traditional storage methods into smart storage. This paper presents a framework for optimizing the shelf-life of mango using advanced computer vision techniques. The aim of the proposed system is to predict the shelf-life of mango after harvesting and develop a smart storage chamber using IoT-based sensors to optimize the shelf-life. It also provides functionality to sort mangoes using database inventory based on quality standards into Extra Class, Class I, and Class II. The system will transform traditional storage method into smart storage chamber and results in reduction of post-harvested mango loss. The system proposed in this study provides fruitful results in the prediction of mango shelf-life and classification according to quality standards. Initial results that obtained from model was 69.38% accurate.



## APPLICATION OF COMPUTER VISION IN FRUITS QUALITY EVALUATION

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### Abstract

Fruit quality is an important factor that affects the marketability and price of produce. In the past, determining fruit quality was primarily been done through manual inspection by experts, which can be time-consuming and subjective. To address these limitations, researchers have turned to computer vision techniques for automating fruit quality determination. Computer vision involves the use of artificial intelligence to process and analyze images and video. In the context of fruit quality determination, computer vision systems can analyze the physical attributes of a fruit, such as size, shape, color, and texture, to determine its quality. Multiple studies have demonstrated the effectiveness of computer vision for fruit quality determination. The computer vision was used for determining the quality of apples and bananas and found that the system was able to accurately identify blemishes and defects on the fruit examined. In addition, computer vision has also been used to determine the quality of citrus fruits, such as oranges and lemons. There are several advantages to use computer vision for fruit quality determination. First, it is faster than manual inspection, as it can analyze large quantities of fruit in a short period of time. Second, it is more objective than manual inspection, as it is not subject to the biases and subjectivity of human inspectors. Finally, computer vision can also be used to analyze fruit that may be difficult or unsafe for humans to handle, such as fruit contaminated with pesticides. Overall, the use of computer vision for fruit quality determination offers a promising solution for improving the efficiency and accuracy of the fruit quality determination process. As such, it has the potential to significantly impact the food industry and benefit both producers and consumers.



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## **WOMEN' ECONOMIC EMPOWERMENT THROUGH VALUE ADDITION OF AGRICULTURE AND HORTICULTURE COMMODITIES**

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### **Abstract**

Women Entrepreneurship is in evolution phase in Pakistan. only one percent of the entrepreneurs are women. In rural areas of Pakistan women are extensively engaged in agricultural activities including livestock rearing, sowing crops, weeding, harvesting and plucking etc. The role of women in agriculture is pivotal but their role is neither widely accepted nor given them opportunity for making decisions in agricultural activities due to patriarchal societal system. Mostly women in rural areas grow vegetables to meet domestic needs through conventional practices. Whereas the commercial selling of agricultural produce including fruit and vegetable in raw form is being done by their counterpart. Government and social development organizations are focusing on empowering the women to contribute to global sustainable development goals including gender equality. Studies and practices adopted by development organizations reveal that the livelihood of rural communities can be uplift through enhancing their skills in value addition of agricultural products. A widely used method of educating farmers through Farmers Field Schools approach is also implemented in Pakistan by social development organizations by engaging females in horticultural activities. The rural economic wellbeing mainly women can be uplifted by adopting contemporary techniques of agriculture especially in horticulture. The women mainly young females to be engaged in farmers' field schools where they can learn new horticultural techniques such as Kitchen Gardening, Value crops – tunnel farming, Vertical Vegetable farming and value addition linked to these horticultural practices. Furthermore, women can be engaged in production of indigenous produce by linking agriculture, nutrition, and natural resources approach too. It will help in improving resilience through food and nutrition security as well as economic empowerment of women. Women mainly young women both in rural and semi urban areas can be emerged as successful entrepreneurs by equipping them with value addition techniques such as food preservation, by-products etc. of locally grown fruits and vegetables. It will not only empower women economically but also enhance the rural economy as well as contribution in national GDP with improved development index.





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## **DIGITAL ENTREPRENEURSHIP: WAY FORWARD FOR RISING UNEMPLOYMENT**

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### **Abstract**

With the rising demand for skilled labor, the corporate market for hard skills has constricted. The youth of Pakistan have found it more difficult to develop adequate income streams, resulting in the loss of valuable human resources to foreign countries in search of jobs. With emerging technologies, business trends have shifted towards digitalization, creating a spike in online earning platforms. The changing trends provide an opportunity for the unemployed youth of this country to start online business ventures using their skills. Landscaping design and architecture are innovative skills that are increasing in popularity. Statistics on Fiverr, an online earning website, show that the number of landscaping designers around the world does not match the growing demand for these services. Fiverr has different levels of seller categories including new seller, level 1, level 2, and top rated. The number of Pakistani designers among the top-rated sellers is negligible compared to other countries in the neighboring region like Bangladesh, Sri Lanka, and Turkey. Lack of skills like SketchUp, Lumion, Autodesk Revit, Autodesk AutoCAD, and others make it difficult for Pakistani designers to make it into the top selling categories. National efforts should be directed towards guiding the youth of this country to start acquiring relevant skills and generate income using online platforms. They can find work opportunities abroad while staying in their home country. It will not only help them sustain their life financially but also help the country conserve its human resources and increase currency inflow into our country.



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## **FRAMEWORK FORMULATION OF BUSINESS PERFORMANCE IMPROVEMENT FACTORS OF ISO CERTIFIED COMPANIES AND PILOT TESTING OF ITS SURVEY QUESTIONNAIRE IN PAKISTAN**

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### **Abstract**

The Present phase of the mega research study formulated and pilot-tested a survey questionnaire based on the Framework of Synthesized Business Performance Improvement Factors of ISO Management System (IMS) Standards Certification. The mega qualitative literature analysis, focus group review, and pilot test study support the hypothesis of a positive relationship between IMS Standards certification and improvement in business performance. Major business performance improvement parameters include financial, managerial, technical, social and cultural, etc. Other possible benefits are technical process improvement, increased efficiency and productivity, enabling culture, improved customer satisfaction, increased market share, and enhanced level of quality awareness at all levels. These improvements lead to improved sustainability besides a direct contribution to the national GDP (Gross Domestic Product) and SDG (Sustainability Development Goals) achievements. Business improvement factors were identified from a mega literature review and synthesized through qualitative research rigor to transform it into a framework. A survey questionnaire was designed on this synthesized and reviewed framework of business improvement factors. The questionnaire was subjected to a mock exercise and then pilot testing in local chambers of commerce and industry to verify its construct validity and also performance comparisons among IMS standard certified and non-certified companies of varied businesses. The next phase of this mega research study is the main national survey of both IMS and Non-IMS standards-certified companies to compare their business performance. Its findings are to validate the proposition that IMS standards-certified companies perform better than non-IMS commercial business companies. The main finding and conclusion should bear sufficient value to inspire the non-IMS standards-certified companies to go for certification of their businesses.



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## **EXPLORING ECOFRIENDLY OPTIONS FOR CARPOPHILUS BEETLE MANAGEMENT IN AUSTRALIAN ALMOND ORCHARDS**

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### **Abstract**

*Carpophilus* near *dimidiatus* is an emerging insect pest in almonds, causing significant damages to the crop. To control this pest, farmers are relying on attract and kill (A&K) system which is being used in stone fruits for other species of *Carpophilus* beetles. But this A & K system didn't prove effective for this pest. There is need to develop new A & K system for *C. nr dimidiatus*. In order to find pheromone for *C. nr dimidiatus*, we tested adult beetles against males feeding on diet, females feeding on diet and diet alone in dual choice assays using ytube olfactometer. After having evidence in behavioural trials that male *C. nr dimidiatus* produced odour attracted significantly higher percentage of both male and female beetles, gas chromatography-mass spectrometry (GC-MS) analysis revealed presence of male specific compound in the headspace from feeding males. Moreover, GC-MS coupled with electroantennography (EAG) confirmed the biological activity of male specific compound in both male and female beetles' antennae. This pheromone will be further tested in lab and field after its proper identification and synthesis.



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## **PRE- AND POSTHARVEST PRACTICES IMPROVING PRODUCTIVITY AND STORABILITY OF STRAWBERRY FRUITS**

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### **Abstract**

Strawberry fruit is greatly appreciated for its visual appeal and desirable flavour. Though, strawberry is being produced in Pakistan for last many decades, however, certain production and postharvest challenges pose serious constraints to transform its farming into a lucrative business. A detailed supply chain analysis was conducted to identify factors influencing productivity and profitability from marketing of strawberries. Various research studies were then conducted to improve productivity and optimize postharvest handling of strawberries. Field trials under subtropical conditions evaluated comparative advantage of transplant time and relative efficacy of exogenously applied 24-epibrassinolide, methyl jasmonate, oxalic acid, calcium chloride on improving plant growth and enhancing yield. In another study, harvest period of strawberries was optimized to achieve better fruit quality and extend storage under low temperature conditions. Storage period of strawberries could be adequately enhanced with modified atmosphere-based low-density polyethylene packaging. During storage, fruit decay in strawberries was also significantly delayed with short-term hypobaric, sodium nitroprusside, ozone or/and ultrasound treatments. Overall, research interventions introduced here led to yield increment and fruit quality improvement which thereby increased market life of strawberry and supported profitability of supply chain stakeholders.



## **PHENO-CHEMICAL DIVERSITY IN SELECTED GUAVA GERMPLASM ACROSS SEASONS**

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### **Abstract**

Like other tree fruit crops, guava (*Psidium guajava* L.) plants have also evolved to synchronize the phenological stages and fruit growth patterns to environmental components and seasons for better adaptability. Fruit of seven Round and six Pyriform guava accessions available in guava germplasm unit (GPU) at institute gardens were subjected to physico-chemical characterization. Great phenotypic variability was observed in accessions of Round and Pyriform cultivars in fruit physical traits. In cv. round accessions, G 3 had maximum fruit weight (113.41 gm) and fruit size during winter season while minimum fruit weight was recorded in G 7 during summer season. Among cv. Pyriform accessions, S 4 had maximum fruit weight (136.41 gm) whereas fruit weight was minimum in S 1 (78.53 gm) during summer season. Accessions G 1 , G 7 (Round) and S 3 and S 5 (Pyriform) developed less number of seeds compared with other accessions. Maximum TTS was recorded in G 2 (12.17 °Brix) during winter season while it was minimum in S 6 (8.33 °Brix) during summer season. In other chemical traits, cv. Round accessions G 3 and G 5 and among Pyriform accessions S 1 and S 2 were found better for TSS:TA and total sugars. Total sugars were highest in S 1 (8.72%) during winter whereas lowest during summer season in G 4 (6.29%). This study highlights the bearing habits, fruit maturity patterns and potential of selected germplasm for various fruit quality attributes across summer and winter seasons. Assessment of correlations of the fruit attributes to the environmental components and genetic characterization of the selected germplasm is in process.



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## ASSESSMENT OF GENETIC DIVERSITY IN GUAVA CULTIVARS USING SSR MARKERS

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### Abstract

Guava (*Psidium guajava* L.) is a highly economical and nutraceutically important tree fruit crop of Pakistan. Guava is being commercially propagated through seeds hence, estimation of genetic diversity in its commercial cultivars and their populations is dire need for making better selections. Genetic diversity was assessed in different accessions of two white flesh Round (R w ) and Pyriform (P w ) and two pink flesh Round (R p ) and Pyriform (P p ) varieties using 26 simple sequence repeat markers. For molecular characterization, software like PopGen and Power marker were used. Allele size observed ranged from 100 bp to 500 bp. Mean major allele frequency, genetic diversity, heterozygosity, and Polymorphism Information Content were recorded as 0.786, 0.300, 0.285 and 0.245, respectively. Maximum genetic distance was found between accessions S 8 and G 3 (2.08) while accessions of cv. R p , Sr 1 and Sr 2 were genetically most identical (0.86). Cluster analysis showed two major clusters formed as C 1 and C 2 that were subdivided into two sub-groups. Accessions S 7 and G 5 were clustered in a single major cluster that showed genetic similarity in two different cultivars at this locus. PCoA revealed that G 1 was found most divergent and application of AMOVA exhibited the molecular variance of 49% within the population while 51% among the population. Utilization of simple sequence repeat markers (SSR) have proved to be very useful, cost-effective and reproduceable in assessing the available genetic variability among guava varieties and to develop variety specific genetic markers for effective identification. Further studies for estimating genetic diversity using multiple molecular markers is in progress.