

International Conference (Online)



Bee Pollination Under Climate Change Scenario

🕒 May 20, 2021

Institute of Plant Protection
MNS University of Agriculture, Multan-Pakistan



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 **May 20, 2021**

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Online International Conference **Bee Pollination Under Climate Change Scenario**

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**“International Conference on
Bee Pollination Under
Climate Change Scenario”
on May 20, 2021.**

The Conference AIMS & OBJECTIVES



The International Conference will provide insight into current status, innovations and advances in Bee Pollination under the changing climate with special focus on native social and solitary bees. A pool of thought provoking opportunities would enable networking and provide opportunities for collaborations and alliances on bee pollination; stimulate and facilitate discussions and dialogues between stakeholders like scientists, researchers and practitioners including policy makers, business, civil society, beekeepers and farmers. By acquainting with new research ideas we can explore the pollinator diversity of different areas as well as their conservation strategies.



“International Conference on Bee Pollination Under Climate Change Scenario” on May 20, 2021.

Main Themes

1. Biodiversity of Bees

- **Biodiversity of floral resources and bees**
- **Impact of temperature on diversity of bees**
- **Plant pollinator-interactions in relation to climate change**
- **Biodiversity of wild and native bees in different regions**
- **Conservation of beneficial plants to restore bee diversity**

2. Conservation of Bees

- **Innovative techniques to conserve bees**
- **Plantation of bee friendly plants**
- **Reduction of pesticide use**
- **Global issues in bee conservation**
- **Role of urban parks and gardens**

3. Crop Pollination

- **Hazards of climate change in crop pollination**
- **Role of wild bees in crop pollination**
- **Pollination of major food crops**
- **Pollination of horticultural crops**
- **Drought /Heat stress effect on crop pollination**

4. Beekeeping

- **Innovative techniques in beekeeping**
- **Problems associated with beekeeping**
- **Modern beekeeping**
- **Beekeeping in relation to climate change**
- **Beekeeping and rural development**





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KEY NOTE SPEAKERS



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Participating Countries in International Bee Conference (MNS-UAM)

Online Participation

1. Pakistan



2. India



3. USA



4. UK



5. South Korea



6. South Africa



7. Turkey



8. Cambodia



9. Oman



10. Qatar



Written/Oral Participation

1. Pakistan



2. India



3. USA



4. Cuba



5. South Korea




6. Saudi Arabia



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Online International Conference Bee Pollination Under Climate Change Scenario



INDEX

Code	Title	Page No.
BEE-BIO-101	Faunistic Study of Bees (Hymenoptera: Apoidea) of Bahawalpur Region	13
BEE-BIO-102	Autumn bees' Abundance and their Natural Enemies in Bahawalpur, Pakistan	14
BEE-BIO-103	Effect of Seasonal Variation on Foraging Population of Honeybees	15
BEE-BIO-104	<i>Apis</i> and Non- <i>Apis</i> bee Fauna (Apoidea: Hymenoptera) of District Rahim Yar Khan, Punjab, Pakistan	16
BEE-BIO-105	Bee pollinators' Diversity in the Canola (<i>Brassica napus</i> L) Crop Grown in the Semi-arid Conditions of Rahim Yar Khan (Punjab), Pakistan	17
BEE-BIO-106	Diversity of Native Bees in Different Crops of Southern Punjab Pakistan- A Review	18
BEE-BIO-107	iDigBees Network, Towards Complete Digitization of Bee Collections to Promote Ecological and Evolutionary Research in a Keystone Clade	18
BEE-BIO-108	Diversity and Abundance of Insect Pollinators on Spring Flowers in Wah Cantonment Urban Parks	20
BEE-BIO-109	Assessment of Bees in Different Orchards of Kullu Valley, Himachal Pradesh, India	21
BEE-BIO-110	Spatio-temporal behaviour of <i>Bombus simillimus</i> (Hymenoptera: Apidae) from Tolipir National Park, Azad Jammu and Kashmir, Pakistan	22
BEE-CON-201	Preliminary Assessment of Foraging Behavior of <i>Bombus haemorrhoidalis</i> Smith in Doon Valley, Uttarakhand, India	24
BEE-CON-202	Predicting the Suitable Habitat of Bumble Bees in Trans-Himalayan Region of Himachal Pradesh, India	24
BEE-CON-203	Resource Partitioning in Pollinator Guilds among Sub-Tropical Plant Communities of Punjab, Pakistan	25
BEE-CON-204	Conservation of Alfalfa Leaf-cutting Bees (Hymenoptera: Megachilidae): A Review	26
BEE-CON-205	Threats to the Honeybees: A Review	27
BEE-CON-206	Impact of Climate Change on Pollinators and Food Security	28
BEE-CON-207	Pollinators are at Risk due to Climate Change	29
BEE-CON-208	Wastewater Irrigation Threat to Pollinators and its Treatment in a Constructed Wetland System	29

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MNS University of Agriculture, Multan-Pakistan

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Online International Conference **Bee Pollination Under Climate Change Scenario**

INDEX

Code	Title	Page No.
BEE-CON-209	Global warming Impact on Plant-Pollinator Interaction	30
BEE-CON-210	Bumblebee Colony Development is affected by Different Diets	31
BEE-CON-211	Conservation of Bees through Community Participation in the Indian Trans Himalayan Region: Climate Change Perspective	32
BEE-CON-212	Comparative Study of Foraging Behavior of <i>Apis mellifera</i> L. at Two Different Agro Climatic Conditions in Khyber Pakhtunkhwa	33
BEE-CON-213	Pollination Capability and Host Plants of the European Honey Bee (<i>Apis mellifera</i> Linnaeus) in the Arid to Semi-arid conditions of the District Rahim Yar Khan (Punjab), Pakistan.	34
BEE-CON-214	Conservation of Bees through Local Ornamental Flowering Plants of South Punjab, Pakistan	35
BEE-CON-215	Impact of Climate Change on Bee Pollination	36
BEE-CON-216	Pollinator Stewardship: An International Challenge for Food Security and Environment	37
BEE-CON-217	Plan B, in Absence of Bees	38
BEE-CON-218	Pollination, Ecosystem and Climate Change: A Narrative for the Conservation of Native Pollinator Diversity	39
BEE-CON-219	Insect Pollinators and Disease Transmission: A Review	40
BEE-CON-220	The Conservation, Importance and Restoration of Bees in Agriculture: A Review	41
BEE-CON-221	Comparative Pollination Efficacies of Solitary Bees, Honey bees and Flies on <i>Medicago sativa</i> L. Seed Production in Pakistan	42
BEE-CP-301	Native Bees Increase Tomato Pollination Isolated from the Pollination Network	44
BEE-CP-302	Effects of Native Pollinator Communities on the Physiological and Chemical Parameters of Loquat Tree (<i>Eriobotrya Japonica</i>) under Open Field Conditions	45
BEE-CP-303	Foraging Behavior of Western Honey Bee (<i>Apis mellifera</i>) in Different Time Intervals on <i>Brassica campestris</i>	46
BEE-CP-304	Role of Native Pollinators in Amplifying Seed Yield of Berseem	47

 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

 mnsuam.edu.pk

Online International Conference Bee Pollination Under Climate Change Scenario



INDEX

Code	Title	Page No.
BEE-CP-305	Role of <i>Apis dorsata</i> and <i>Apis florea</i> in Cross-pollination of Cauliflower in Bahawalpur	48
BEE-CP-306	Efficiency of Pollination on Field-Grown Tomato Compared with Isolated Under Same Condition	49
BEE-CP-307	Pollinators Diversity and their Effects on Eggplant Production in Faisalabad, Punjab (Pakistan)	50
BEE-CP-308	Pollination of Canola, <i>Brassica napus</i> L. by <i>Apis dorsata</i> and <i>Apis florea</i> (Apidae: Hymenoptera)	51
BEE-CP-309	Onion Flowers Anthesis and Bees Pollinators Preferences on Onion (<i>Allium cepa</i> L.) Crop	52
BEE-CP-310	Bee Pollination Increases Yield Quantity and Quality of Cash Crop in D.G. Khan: Pakistan	53
BEE-CP-311	Effect of Native Pollinators on Physical and Biochemical Properties of Phalsa	54
BEE-CP-312	Role of Native Pollinators in Seed Production of Sunflower Hybrid Cultivars	54
BEE-CP-313	Effects of Pollinators and Pollination on Canola (<i>Brassica napus</i> L.)	55
BEE-CP-314	Visitation Optimization of Bumblebees for the Pollination of Greenhouse Tomatoes in Multan	56
BEE-CP-315	Role of Native Pollinators in the Fruit Production of Apple Orchards	56
BEE-CP-316	Insect Pollinators and their Role in Sunflower (<i>Helianthus annus</i> L.) Seed Production	57
BEE-CP-317	Pollination of Falsa, <i>Grewia asiatica</i> (Malvaceae) by Female and Male	58
BEE-CP-318	<i>Megachile cephalotes</i> (Megachilidae: Hymenoptera)	58
BEE-CP-319	Role of Honeybees in the Pollination of Apricot (<i>Prunus armeniaca</i>)	59
BEE-CP-320	Honey Bees Pollination under Climatic Change Scenario	60
BEE-BK-401	Side Effects of Commonly used Insecticide on <i>Apis mellifera</i> in Cotton	63
BEE-BK-402	Field	
BEE-BK-403	Pollination Services by Honeybees in the Punjab, Pakistan	63
BEE-BK-404	Training of <i>Apis mellifera</i> (Hymenoptera: Apidae) to Refine Its Foraging Activities: A Review	64

🕒 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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Online International Conference **Bee Pollination Under Climate Change Scenario**

INDEX

Code	Title	Page No.
BEE-BK-405	Exploring Gut Microbiota of <i>Apis dorsata</i> through Culture Dependent Approach	65
BEE-BK-406	Multienzyme and Antibacterial Potential of Bacteria Isolated from Gut of Asian Honey Bee (<i>Apis cerana Indica</i>) using Culture Dependent Method	65
BEE-BK-407	Queen Cells Acceptance Rate and Royal Jelly Production in Worker Honey Bees of Two <i>Apis mellifera</i> Races	66
BEE-BK-408	Effects of Supplementary Feeding on the Health of <i>Apis mellifera</i> Population	67
BEE-BK-409	Small Hive Beetle (SHB), <i>Aethina tumida</i> Murray: An Invasive Pest of Honey bee	68
BEE-BK-410	Correlation of Greater Wax Moth (<i>Galleria mellonella</i> L.) in Colonies of Honeybees (<i>Apis mellifera</i> L.) with Weather Factors	69
BEE-BK-411	Problems and Challenges in Scaling up Apiculture Sector in Pakistan	70
BEE-BK-412	Contribution of Beekeeping in Sustainable Development Goals: A Review	71
BEE-BK-413	Aptness of Some Basic Factors Affecting the Results of Instrumental Insemination of Honeybee Queens <i>Apis mellifera</i> under Lab Conditions	72
BEE-BK-414	Hemolytic Activity of Pathogenic Bacteria, Erythrocyte Membrane Protection and Immune-Stimulatory Effects of Saudi Honeybees	73
BEE-BK-415	Reproduction of <i>Tropilaelaps clareae</i> Mites in Worker Brood Cells of Honey Bee (<i>Apis mellifera</i>) Colonies	74
BEE-BK-416	Susceptibility of Honeybee, <i>Apis mellifera</i> to some Neonicotinoid Insecticides under Laboratory Conditions	75
BEE-BK-417	The Livelihood Impacts of Apiculture Integrated with Aquaculture	76
BEE-BK-418	Impact of Low Temperature on Honey bee Developmental Stages	77
BEE-BK-419	Determination of Oral and Dermal Toxicity of Different Concentrations of Acetamiprid on Mortality of <i>Apis mellifera</i> L (Hymenoptera, Apidae)	78
BEE-BK-420	Toxicity of Some Insecticides to the Haemocytes of Domesticated Honeybee, <i>Apis mellifera</i> (Hymenoptera: Apidae) under Laboratory Conditions	78

🕒 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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Online
International Conference
**Bee Pollination
Under Climate Change
Scenario**

INDEX

Code	Title	Page No.
BEE-BK-421	Determination of Effect Processing and Time Period on Physicochemical Properties of Sedir and Acacia Honey from <i>Apis mellifera</i>	80
BEE-BK-422	Role of Beekeeping in Food Security: A Review	81
BEE-BK-423	Importance of Honey bees in Crop Pollination	82

🕒 **May 20, 2021**

Institute of Plant Protection

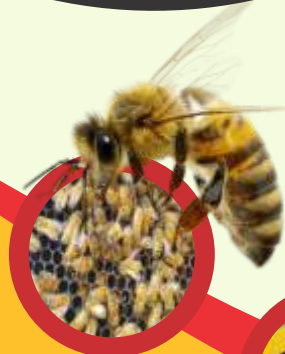
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Biodiversity



Laura Russo



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BEE-BIO-101

Faunistic Study of Bees (Hymenoptera: Apoidea) of Bahawalpur Region

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Abstract:

Introduction: Bees (Hymenoptera: Apoidea) are the major group of insect pollinators, contributing an important ecosystem service of cross-pollination in flowering plants. Bees are distributed all over the world and their distribution varies with geographical regions. Although, Pakistan lies in Oriental biogeographical realm but its bee fauna largely belongs to palearctic region and a small proportion to Afrotropical region.

Methods: The bee fauna of Pakistan largely remained unexplored as very few attentions have been given to the bee taxonomy. Keeping in view the lack of published literature on bee's taxonomy especially from southern part of Punjab, Pakistan, current study was undertaken to explore the taxonomic diversity of bees and their host plants in District Bahawalpur of Punjab, Pakistan.

Results: A total of 1007 specimens were collected across the year and identified in 12 tribes, 25 genera and 15 sub-genera (i.e., morphotyped). Only 13 species under seven genera were identified i.e., *Apis dorsata* Fabricius, 1793, *A. florea* Fabricius, 1787, *A. mellifera* Linnaeus, 1758, *Xylocopa fenestrata* (Fabricius, 1798), *X. basalis* Smith, 1854, *Megachile bicolor* (Fabricius, 1781), *M. lanata* (Fabricius, 1775), *M. cephalotes* Smith, 1853, *Lasioglossum albescens* (Smith, 1853), *L. vagans* (Smith, 1857), *Pseudapis oxybeloides* (Smith, 1875), *Andrena savignyi* Spinola, 1838, *Ceratina smaragdula* (Fabricius, 1787). The 1007 specimens of 65 bee species or morphospecies were collected from 74 host plant species.

Conclusion: The results presented in this study will not only serve as a baseline for better understanding of existing taxonomic diversity of bees but will also support future large-scale surveys and conservation programs in the region.

Keywords: Diversity, bees, hymenoptera, taxonomic diversity, Bahawalpur, Pakistan

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BEE-BIO-102

Autumn bees' Abundance and their Natural Enemies in Bahawalpur, Pakistan

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Abstract:

Introduction: In Pakistan, autumn season lasts from October to November. Most of the bees decline in their populations during these months and by the end of November these undergo into hibernation to survive upcoming winter.

Methods: In the present study the abundance of different cavity and ground nesting bees of the autumn season was investigated at the Baghdad-ul Jadeed campus of the Islamia University of Bahawalpur, Punjab, Pakistan during 2019. The floral host plants and the population of their natural enemies (parasitic wasps, predators and cleptoparasitic bees) were also recorded.

Results: The maximum abundance was recorded for the three bee species i.e. *Trianthema portulacastrum*, *Leucaena leucocephala* and *Carthamus oxyacantha*. A soil and a cavity nesting bee i.e., *Pseudapis* sp.1 and *Ceratina* sp., respectively visited the maximum number of plant species. A total of 10 bee species (including three cleptoparasitic bees) and 9 parasitic or predatory wasp species were recorded, however; bees were more abundant than wasps. Ground-nesting bees comprised 90.09% of total bee abundance. Parasitic or predatory wasps were higher in abundance than cleptoparasitic bees.

Conclusion: Current study gives a baseline for future conservation and pollination management programs in this region.

Keywords: Native bees, ground-nesting, cavity-nesting, cuckoo bees, floral sources.

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BEE-BIO-103

Effect of Seasonal Variation on Foraging Population of Honeybees

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Abstract:

Introduction: Pollen is the primary source of protein for honeybee colonies, so colony growth is highly dependent on pollen availability. Alterations in available resources are known to affect the pollen intake of honeybees in temperate zones as agriculture intensifies and climate change occurs. However, little is known about how bees react to such natural conditions in tropical areas. Honey bees (*Apis mellifera*) often have a competition for shared flower resources, which can change their population dynamics and flower preferences.

Methods: For this experiment, from 2019 to 2021, there were different choice bioassays conducted in summer, winter and autumn seasons. In all field seasons honey bees showed significant preference for pollen collection and flower choice at different locations i.e. Central Cotton Research Institute (CCRI), Cotton Research Institute (CRI), University of Agriculture Multan and Bahauddin Zakariya University Multan,

Results: Experimental results revealed that there was low honey bee population observed in autumn and winter season than in summer season. Our results showed that due to the presence of more flowers during the summer season, more nectar was present and greater honey bees' population was observed in all experimental fields.

Conclusion: These results suggest increasing floral resources for honey bees to conserve their populations during that time when floral resources decreased. This study also suggests the nutritious importance of different floral plants for honeybee colonies.

Keywords: Honeybees, seasonal abundance, variation, floral resources.

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BEE-BIO-104

***Apis* and Non-*Apis* bee Fauna (Apoidea: Hymenoptera) of District Rahim Yar Khan, Punjab, Pakistan.**

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Abstract:

Introduction: The bees fauna belongs to superfamily Apoidea, family Apidae and subfamily Apinae are well known for their stinging, foraging and pollination behavior. More than 17000 bee species have been identified worldwide but still numerous needs to be described. Because of their tremendous role in the pollination process, these bees are potentially considered as extraordinary pollinators of various crops, trees, whereas some of these are with parasitic behavior too.

Methods: Therefore, in the light of their natural service and importance, multiple surveys were conducted to collect different *Apis* and Non-*Apis* bee species from the different localities of Rahim Yar Khan district was carried out during 2019-2020 to provide insight and important records for the scientific communities. Multiple localities of district Rahim Yar Khan were targeted and surveyed. The collected specimens were identified under microscope by using available literature. Bee details including valid names of collected material, measurements, date of collection, distribution range was illustrated by using ArcGIS map tool. Moreover, taxonomic bee character was illustrated by colored diagrams. The host plants parts were also collected, identified and preserved in a herbarium. All the identification procedure was carried out in the insect Taxonomy laboratory of Fareed Biodiversity Conservation Centre, Department of Agricultural Engineering, Khwaja Fareed University of Engineering and Information Technology, Rahim Yar Khan

Results: About 12 species from 9 genera and 3 subfamilies of *Apis* and Non-*Apis* bees were recorded from the surveyed areas. Moreover, multiple host plant with the bee's trophic association was also recognized.

Conclusion: The current research work provides a baseline and will be supportive for the management and conservation of the bee populations. Moreover, it will be helpful through uplifting of the bee species pollination services in better crop yield in the current study areas of the Southern Punjab, Pakistan.

Keywords: Bees, *Apis*, non-*Apis*, pollination, apidae, conservation, biodiversity, Rahim Yar Khan.

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BEE-BIO-105

Bee pollinators' Diversity in the Canola (*Brassica napus* L) Crop Grown in the Semi-arid Conditions of Rahim Yar Khan (Punjab), Pakistan.

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Abstract:

Introduction: Canola (*Brassica* sp) has been conceded as one of the most important and prime sources of edible oil in different countries of the world. Bee pollinators are essential for the plant taxon reproduction ultimately for their overall survival. Agricultural productivity strongly dependent on the trophic interaction of bee pollinators and the crops grown. Locally there is a myth among the farmers that the pollinators harm the crops flower (pollen or nectar) and don't care during pesticides application. Keeping in view the above scenario, current study was conducted that will be supportive in the better crop pollination and pollinators conservation.

Methods: The experiment was conducted in the Agriculture research farm of Khwaja Fareed University of Engineering and Information Technology, Rahim Yar Khan, Punjab, Pakistan during 2020-21 seasons to study the bee diversity of canola (*Brassica napus* L) crop. Observations and insect collections were conducted from 09:00 am to 1:00 pm throughout the season.

Results: About 09 bee species were recorded for the first time from the current study area i.e. *Apis florea* (Fabricius, 1787), *Apis dorsata* (Fabricius, 1793), *Apis mellifera* (Linnaeus, 1758), *Anthophora confusa* (Smith, 1854), *Nomia curvipes* (Fabricius, 1793), *Ceratina (Pithitis) smaragdula* (Fabricius, 1787), *Amegilla (Zonamegilla) cingulata* (Fabricius, 1775), *Nomia (Hoplonomia) westwoodii* (Gribodo, 1894), *Nomia (Hoplonomia) elliotii* (Smith, 1875), *Xylocopa (Koptortosoma) pubescens* (Spinola, 1838)

Conclusion: Our study provided insight of local bee pollinator species belonging to Hymenoptera insect order. The reported pollinators should be protected for the better utilization by environmentally sound pest management practices to achieve higher levels of crop yield

Keywords: Canola, bees, pollinators, diversity, Rahim Yar Khan, Punjab, Pakistan.

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BEE-BIO-106

Diversity of Native Bees in Different Crops of Southern Punjab Pakistan- A Review

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Abstract:

Introduction: Solitary bees are highly efficient pollinators than honey bees. They provide essential pollination services to pollinate our crops. Solitary bees are very important for the crop pollination and enhancing the crop yield. Due to the increased demand of pollination of crops the honey bees may not fulfill the requirement of pollination.

Results: As an alternate solitary bees can replace honey bees. In many studies conducted in Southern Punjab showed solitary bees were better pollinators in oil seed crops, vegetable and fruit crops than honey bees. Different studies shows that in Oil seed crop i.e. Canola *A. mellifera* was the most abundant followed by *Apis florea* and *Apis dorsata*. In fruit crop i.e. Phalsa *Megachile cephalotes* was efficient pollinators in fruit crops. In vegetables in Pumpkin i.e., *Nomia sp*, *Apis dorsata*, *Halictus sp*, were abundant and efficient pollinators. In Bitter gourd the most abundant pollinators were *Apis florea*, *Parnara guttata* and *A. dorsata*. The most efficient pollinator was *A. dorsata* followed by *A. florea*. In Radish the abundant pollinators was *Episyrphus balteatus* followed by *Andrena sp.*, *Apis florea*, *A. dorsata*.

Conclusion: Enhancing and conservation of the solitary bees could increase the crop production of Pakistan.

Key words: Solitary bees, conservation, pollination, yield

BEE-BIO-107

iDigBees Network, Towards Complete Digitization of Bee Collections to Promote Ecological and Evolutionary Research in a Keystone Clade

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Abstract:

Introduction: Bees are the most important pollinators in both managed and natural landscapes, and concerns about declines in bee diversity and numbers are growing. Only a small fraction of the ~20,000 known bee species in the world have adequate data to assess the status of populations and species. The iDigBees program addresses this dilemma by achieving near-complete digitization of 8 million bee holdings in the United States, greatly increasing data depth and breadth for use in a wide spectrum of ecological-evolutionary research. iDigBees incorporates innovations through emerging digitization processes, molecular identification network, phenology and phylogeny plugins, and R-based workflows to promote biodiversity research.

Methods: iDigBees will employ the following methods: 1) The LightningBug process, which includes semi-automated 3D imaging, optical character recognition (OCR), and structured text parsing to increase specimen transcription and imaging rates by at least four-fold. 2) A molecular identification network (BeeDNA) that will coordinate insect genetics labs to aid bee species identification and discovery. 3) Core occurrence data and images served on Symbiota Collections of Arthropods Network and provided to GBIF. 4) Informatics tools that will promote researcher use of bee occurrence data and aid in integrating abiotic factors and biotic associations. 5) A new Cyberspecimen Learning Tool, SMARTBees, will be developed to specifically address the learning needs of students in college bridge programs, high school equivalency programs, and English language learners.

Results: LightningBug images and processes label data and provide a 360° photogrammetric image of the

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specimen for comprehensive trait analysis. Label images are transcribed via computer-human workflow via OCR and structured text parsing. The BeeDNA program will contribute to a larger Global Bee Genetics Initiative (USDA-ARS), the goal of which is to complete DNA barcoding for all bee species, at least for the United States. Collectively, iDigBees data products will be used to examine patterns from species to families across environmental (latitude, elevation) and management gradients (urban, agricultural), and identify historical trends over decadal timescales, including changes in species distributions and bee-plant phenology shifts. iDigBees is creating an "inventory completeness" dashboard that will allow people to track occurrence data for species or regions. The iDigBees network will work with the Biodiversity Literacy in Undergraduate Education (BLUE) project to build, assess, disseminate, and implement novel biodiversity data-centric Open Education Resources that promote student-centered learning. SMARTBees will link students with biocollections promoting accessibility and science equity while increasing the diversity of the STEM workforce.

Conclusion: The iDigBees model will be promoted throughout North America and other continents to foster "deep global digitization" of all bee species for research, education, and informing conservation policy.

Keywords: Native bees, biodiversity, digitization, DNA barcoding, conservation, pollination, biodiversity education

BEE-BIO-108

Diversity and Abundance of Insect Pollinators on Spring Flowers in Wah Cantonment Urban Parks

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Abstract:

Introduction: Insect pollinators contribute significantly in global environment. We studied the diversity and abundance of spring flower visiting insect pollinators in city parks of Wah cantonment, Islamabad.


Methods: Weekly surveys for collection of insect pollinators from four different parks (Sher Shah Park, Jinnah Park, Fatima Jinnah Park and New City Phase 1 Park) were carried out from February to May, 2019.

Results: A sum total of 717 insect pollinators from different urban parks including Sher Shah Park, Jinnah Park, Fatima Jinnah Park and New City Phase 1 Park with 249, 175, 146, and 147, respectively were observed. Five insect orders namely Hymenoptera, Lepidoptera, Diptera, Coleoptera, and Hemiptera were common visitors from four different urban parks on weekly basis. Among all pollinators, families of Hymenoptera were Apidae and Formicidae, and Pieridae, Nymphallidae and Papilionidae families of Lepidoptera showed the most abundance. Pyrochorridae from Hemiptera and Culicidae with Chironomous species from Diptera showed the least abundance when compared to Lepidoptera and Hymenoptera.

 **May 20, 2021**

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Chironomous spp., *Xylocopa* spp. and *Pieris brassicae* were the most frequent visitors with most diverse in Sher Shah Park and Fatima Jinnah Park.

Conclusion: Such studies highlight the presence of insect pollinator fauna available for crop pollination and to protect it from anthropogenic hazards.

Keywords: Urban parks, insect pollinators, abundance, diversity, environmental stress

BEE-BIO-109

Assessment of Bees in Different Orchards of Kullu Valley, Himachal Pradesh, India

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Abstract:

Introduction: Pollinators are a very diverse group, with more than 16,000 pollinator bee species (Hymenoptera: Apidae) described worldwide. Apart from bees, there are also various non-bee pollinators such as flies, wasps, moths, butterflies, beetles, ants, birds, and bats. The economic contribution of animal pollinators to global agriculture through crop pollination has been estimated about 153 billion pounds (£) annually. In India, Himachal Pradesh is known as the horticultural state of the country, with diverse agro-climatic zones and effective cultivation of a wide range of horticultural crops. The commonly grown temperate fruit crops i.e., apple, plum, peach, cherry, pear, and apricot occupy approximately 35 percent of the total area of this hill state, and the majority of these crops are pollinated by bees. Considering the growing contribution of horticulture to the state's economy, we have conducted this study to assess the status of apis and non-apis bees in various apple and plum orchards of Kullu valley in Himachal Pradesh.

Methods: The intensive assessment has been done during different blooming status of flowers in multiple apple and plum orchards from February to April, 2021. We have covered both the side of the Beas river basin covering a 75 km long stretch along various disturbance gradients and distance from natural forest. For assessing the diversity and abundance, we opted standardized sampling method of coloured pan trap and sweep netting. Abundance estimation was done in 1×1 square meter area along branches to reduce the biasness. We also recorded foraging activities of different bees to assess their efficiency for plant pollination.

Results: The preliminary results showed four species of *Apis* bees and three non-*Apis* bees were mainly observed in these orchards. The abundance of introduced/cultured European honey bee (*Apis mellifera*) reduces the abundance and diversity of other native bees in the orchards. Also, endemic Himalayan giant bee (*Apis laboriosa*) was found only in orchards those are near to the natural forests. The carpenter bees were also found only in comparatively less disturbed areas.

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Conclusion: Assessing effect of abiotic factors on bee diversity under different disturbance gradients will be further helpful to identify the potential threats and conservation priorities of native bees and their habitats in this landscape.

Key words: Pollinators, bees, conservation, Indian Himalaya, Horticulture

BEE-BIO-110

Spatio-temporal behaviour of *Bombus simillimus* (Hymenoptera: Apidae) from Tolipir National Park, Azad Jammu and Kashmir, Pakistan

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Abstract:

Introduction: From the last decades use of commercial bumblebee species for crop pollination in managed cropping systems is increasing and on other hand *Bombus* pollinators are in decline, becoming endangered species around the globe. *Bombus simillimus* is native bumblebee species of Azad Kashmir and Northern Pakistan.

Methods: This study was designed to explore their ecological behavior like seasonal distribution, habitat preference and floral host range from Tolipir National Park Azad Jammu and Kashmir, Pakistan.

Results: Results explore that hibernating queens of *B. simillimus* emerged in April and start of May, workers recorded from July to last of September and sexual (male and daughter queens) were found in September and October. Maximum population was observed in August and there was no population from November to March. Queens of *B. simillimus* mostly preferred the forest boundaries for nesting place and their least preference was forest area to build their nests. Individuals of *B. simillimus* were recorded on 33 floral host plants during the foraging activities and Asteraceae plant family found with maximum foraging plants of *B. simillimus*.

Conclusion: Hibernating queens emerged from April to May and preferred the forest boundaries for nesting place. Maximum population of *B. simillimus* found in August and Asteraceae plant family was major foraging host family for this species. This study will be helpful to develop conservation strategies for this important native bumblebee pollinator in future.

Key Words: *Bombus. simillimus*, ecological studies, tolipir national park, Pakistan

 **May 20, 2021**

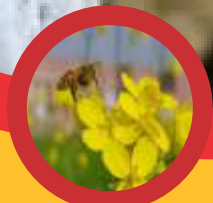
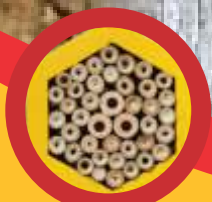
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Conservation of Bees



<https://www.dragonfli.co.uk/products/beepol-solitary-bee-cocoon-cartridge>

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BEE-CON-201

Preliminary Assessment of Foraging Behavior of *Bombus haemorrhoidalis* Smith in Doon Valley, Uttarakhand, India

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Abstract:

Introduction: Bumble bee, the native pollinator belongs to family Apidae of genus *Bombus* is the most suitable pollinator in agroecosystem and forested areas.

Methods: Preliminary study on foraging behavior of *Bombus haemorrhoidalis* Smith has been conducted in Doon Valley, Dehradun, Uttarakhand, which is surrounded by agroecosystem and subtropical temperate landscape situated at the foothills of outer Himalayan region with an altitudinal gradient of 640 m amsl. The study was conducted in four different habitats viz. riverine; agricultural fields; forest area and semi urban areas of Doon Valley. Samples were collected from all habitats with the help of systematic net sweeps and examined in the laboratory. Field observation on foraging behavior and species abundance with emergence of queen bee has been documented from October 2020 to April 2021.

Results & Conclusion: The preferred foraging plant species are *Cirsium arvense* (Asteraceae), *Lantana* sp. (Verbenaceae), *Tropaeolum majus* (Tropaeolaceae) and *Solanum melongena* (Solanaceae). Their foraging activity depends on seasonal availability of floral resources in the study area.

Keywords: *Bombus haemorrhoidalis*, doon valley, floral resources

BEE-CON-202

Predicting the Suitable Habitat of Bumble Bees in Trans-Himalayan Region of Himachal Pradesh, India

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Abstract:


Introduction: Around the world, climate change exerted significant direct and indirect impacts on the terrestrial ecosystems which may induce a broad array of adverse effects to various ecosystems. Many studies have recently focused on the ecological, ethological and biological changes in relation to climatic change.

Methods: In the present study we used various bioclimatic and biophysical variables to understand the

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current distribution of bumble bees in the Lahaul and Spiti district of Himachal Pradesh with respect to predict their future distribution in the respective region. The model was predicted in the area of 19068 km². A total of 6 species of bumble bees were reported from the study area during April 2018 to August 2019. The future predictions were done under the scenario of RCP 2.6 for the year 2050 using the variables having 1000m spatial resolution by using a maximum entropy (MaxEnt) species distribution model. Jackknife test was used to evaluate the contribution of the variables for predictive modeling.

Results & Conclusion: Maximum entropy model for the year 2050 revealed that bumble bees' habitat is under threat. This reduction of the species distribution area may lead to the extinction of such important pollinators of wildflowers in near future.

Keywords: *Bombus*, trans-himalaya, maxent, climate change

BEE-CON-203

Resource Partitioning in Pollinator Guilds among Sub-Tropical Plant Communities of Punjab, Pakistan

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Abstract:

Introduction: The understanding of resource partitioning in pollinators helps in devising the conservation strategies of plant communities by reducing competition among species. Present study was performed for the first time in Pakistan in order to evaluate the existence of resource partitioning in pollinator guilds among sub-tropical plant communities.

Methods: The study was conducted in a sub-tropical forest of Bahawalpur, Pakistan during spring season where all available floral visitors and flowering plants were considered. On the basis on symmetry, morphology and color, plants were categorized in to certain functional groups. The observations of floral visitor were made on weekly basis. During each census floral visitors were recorded on 30 individuals per plant species in blooming.

Results: No significant resource partitioning was recorded in plant species in terms of floral symmetry, colors and shapes. The results showed that there was a non-significant difference (R-value < 0.168) among all the pairs of floral symmetry, shapes and colors (with the exception of white and yellow). The SIMPER test regarded flies as the most responsible within group similarity i.e. 19% similarity in floral symmetry, 19-21% similarity in shapes and 16-30% similarity in colors followed by long-tongue bees

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Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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i.e., 18% similarity in symmetry, 14-21% similarity in shape and 9-19% similarity in colors, respectively.

Conclusion: There exists a generalist pollination system in sub-tropical Pakistan with no detectable resource partitioning in pollinator species. Thus, there could be high competition for pollinator species. Therefore the overall pollination process is less prone to the species loss in sub-tropical conditions of Pakistan.

Keywords: Resource partitioning, competition, plants-pollinators interactions, sub-tropical regions.

BEE-CON-204

Conservation of Alfalfa Leaf-cutting Bees (Hymenoptera: Megachilidae): A Review

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Abstract:

Introduction: Alfalfa leaf-cutting bees (Megachilidae) are solitary bees and are well known for their pollination services in different agricultural crops i.e. carrots, wild blueberries, oil rape seed and especially in alfalfa. These were introduced in American continent and Australia from Europe. Currently, Canada is the biggest producer and exporter of these bees population to U.S states and other countries.

Methods: Current study aimed to review the nesting requirements of alfalfa leaf cutter bees for developing conservation plan of these bee species in the Southern Punjab, Pakistan.

Results: Wood and polystyrene are two predominantly used nesting material by alfalfa leaf cutting bees. These mostly don't dig up their tunnel but make nest in already available holes that are present near pollen and nectar sources. Size of the tunnel is highly detrimental for the conservation of *Megachile spp.*, because the size of the next brood could be shortened if bee lay eggs in short size tunnels. This adversely affects the performance of bees and their productivity. Moreover, use single large sized field domicile is more helpful than several small, dispersed nesting sites for conservation of these bees. The structure of domicile is important for the protection of larvae from excessive heat and humidity since both these factors have major influence for the occurrence of chalk-brood disease.

Conclusion: Identification and protection of nesting sites is the most important step in the conservation approach of alfalfa leaf cutter bees. Availability of pollen and nectar sources near nesting site, abandoning of pesticide use during blooming season are also crucial factors for conservation of these solitary bees.

Keywords: Solitary bees, pollination service, trap nests, conservation.

 **May 20, 2021**

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BEE-CON-205

Threats to the Honeybees: A Review

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Abstract:

Introduction: Honey bees are an important part of humans' life and have major impacts on the environment as well. Survival of mankind is not possible if honey bees disappear from the world, major reason is that they play an important role in pollination. 90% of commercial pollination is performed by honey bees. Anthropogenic activities play a key role in the increasing dangers to honey bees. Due to the increase of global environmental problems and research activities threats to honey bee colonies are also increasing day by day. Biotic and abiotic factors are involved in honey bee destruction. Diseases caused by viruses, bacteria, fungus and mites are some of the main threats to apiculture. Snooty brood, acariasis, noseiosis, chronic bee paralysis virus (CBPV), amebiasis, american foul brood and tropilaelapsosis are some of the common pathogenic diseases. For commercial purposes, beehives are transfer from one place to another which exposes hives to low and high-temperature extremes and sometime exposure to new areas cause pathogenic diseases. The use of neonicotinoid insecticides is very harmful to honeybees. It causes serious colony losses in bees therefore; these insecticides have been banned in many parts of the world. Limited floral exposure is also a major threat to honey bees. Habitat destruction and fragmentation are also playing a major role in threatening. Increased use of pesticides and lower genetic density is considered a major threat. Due to increased technological use bees are also at risk of electromagnetic waves which are very harmful.


Conclusion: The decline in honeybees can cause serious losses in crop production all over the world. Hence, it is important to reduce such activities which cause threat to honeybees. Conservation of bees is an important factor to save them from dangers. It is important to provide floral resources and nesting sites to bees in order to save the nature.

Keywords: Anthropogenic activities, conservation, climate change, pathogens

 **May 20, 2021**

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BEE-CON-206

Impact of Climate Change on Pollinators and Food Security

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Abstract:

Introduction: Pollinators are regarded as keystone species because they raise productivity and food security while also preserving habitat diversity. Pollination by insect pollinators is needed for the production of 75% of crops, as well as the majority of fruits and vegetables. Pollinator habitat loss, geographical shifts, and biodiversity extinction trends are all a result of climate change. As a result, mitigating the effects of climate change, as well as maintaining food security and agricultural sustainability, has become a current concern. Climate change must be taken seriously because it has a significant effect on pollinator species, resulting in lower productivity and putting food security at risk.

Conclusions: Hence, strategies and policies for pollinator protection, regeneration, and augmentation must be developed to ensure high productivity and food security for everyone. Growing more flowers, shrubs, herbs, and trees that provide nectar and pollen as food for pollinators during the year can be one of these strategies. Providing water for the bees to return to the hive, avoid disturbing or killing insects that are nesting or hibernating in grassy areas, hedgerows, bare soil, trees, and walls, or dead timber. Pesticides should be used with caution, particularly where pollinators are active or nesting, or where plants are in bloom.

Keywords: Climate change, pollinators, biodiversity, food security, and agricultural sustainability.

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BEE-CON-207

Pollinators are at Risk due to Climate Change

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Abstract:

Introduction: Climate change puts the pollinators at risk, requires effective measures and policies to protect them. It has the potential to jeopardize bee population diversity, abundance, interaction networks, phenology synchronization, diurnal activity habitats, and shift in species distribution ranges. Pollination services provided by native bees are essential for habitat diversity, resource conservation, and food production.

Results: Pollinator conservation, restoration, and plant protection programs are urgently needed since it will not be worthwhile to preserve or reintroduce species that will not find suitable habitats in the near future; these activities should depend on climate change studies. Function such as landscape properties, deforestation, habitat degradation, the existence of agriculture fields, or other forms of anthropogenic disturbances that could promote pollinator settlement and mobility.

Conclusion: These must be developed and applied to protect pollinators from the effects of climate change, which cannot be slowed down but only mitigated.

Keywords: Climate change, pollinators, conservation, food production

BEE-CON-208

Wastewater Irrigation Threat to Pollinators and its Treatment in a Constructed Wetland System

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Abstract:

Introduction: Pollinator biodiversity is diminishing due to several environmental challenges, posing a significant danger to ecosystem resources. Heavy metals are toxins that pose a serious threat to bees. Heavy metals are found in wastewater that is used to irrigate vegetables; plants uptake heavy metals. These are then ingested by bees collecting pollen and nectar, eventually contaminating bee nests or moving up the food chain. The protection of such bees by the enforcement of environmental legislation

 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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aimed at mitigating pollution and its impact on pollination is a problem that requires immediate action. To mitigate the hazard, it is critical to remove toxins from wastewater.

Methods: Constructed wetlands (CW) are an environmentally sustainable, energy-efficient, and low-cost alternative for wastewater treatment in developing countries like Pakistan, for the treatment of wastewater. CW uses a variety of methods to remove contaminants, including sedimentation, volatilization, microbial activity, adsorption, filtration, and phytoaccumulation.

Results and Conclusions: This treated wastewater has a great potential to be used as an alternative source of irrigation to crops, without those pollutants that are harmful to bees.

Keywords: Pollinators, biodiversity, heavy metals, pollution, constructed wetlands.

BEE-CON-209

Global warming Impact on Plant-Pollinator Interaction

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Abstract:

Introduction: Plant-pollinator interactions could be disrupted as a result of global warming, resulting in possible mismatches and placing plant and pollinator species at risk of extinction. Temperature changes can affect pollinator foraging activity, plant attractiveness, quality, and quantity of plant resources.

Results: The most possible effect on pollinators would be a 1-2 °C rise in average temperature, which will have a detrimental impact on crop growth and yield and endanger about 20-30% of identified pollinator species, potentially leading to extinction. Pollinator responses to global warming include changes in foraging behaviour, life period, body size, pollination success, and pollen flow patterns. It has also changed plant flowering, nectar, and pollen production, as well as the availability, nature of floral resources, distribution, pollinator reproductive growth, and the threat of invasive species.

Conclusion: Current knowledge of where and why spatial mismatches exist, as well as how they affect plant and pollinator fitness, is needed to fully determine whether adaptive evolutionary improvements will keep up with global warming projections.

Keywords: Climate change, pollinators, plant-pollinator interactions, global warming

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BEE-CON-210

Bumblebee Colony Development is affected by Different Diets

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Abstract:

Introduction: Bumblebees are most important and efficient pollinators for greenhouse economical crops. To maintain their good colony structure and development, these require pollens and nectar for dietary needs.

Methods: In this study, effect of fresh pollen pellets and pollen patties with 40, 50 and 60% of sugar on life history parameters of *Bombus terrestris* was investigated.

Results: Pollen patties with 40% sugar solution exhibited to be the best at colony initiation stage with earlier pre-oviposition (6.6 ± 0.97 days), maximum numbers of egg beads in first batch (1.4 ± 0.22) and earlier emergence of first workers (28.3 ± 1.02). At colony foundation stage, pollen patties with 50% sugar solution were suitable for colonies to reach earlier at this stage (51.4 ± 2.53), late start of switch point and early new daughter queen emergence. At colony maturation stage, pollen patties with 40% sugar solution was the best than that of patties with different concentrations of sugar solutions for total number of emerged males, daughter queens workers, competition point and mother or foundation queen longevity.

Conclusion: It can be suggested that pollen patties in 40% sugar solution at colony initiation and colony maturation stages while pollen patties in 50% sugar solution at colony development stage were the most suitable food mix levels for efficient rearing of bumblebees under controlled laboratory conditions.

Keywords: *Bombus terrestris*, fresh pollen, pollen patties, sugar solution concentration, colony development

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BEE-CON-211

Conservation of Bees through Community Participation in the Indian Trans Himalayan Region: Climate Change Perspective

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Abstract:

Introduction: Honeybees are highly social and cosmopolitan insects of great economic importance to mankind. They not only render economic benefits in the form of a number of hive products like honey, beeswax, royal jelly, and bee venom but also provide ecosystem services by cross pollination of several cultivated and wild plant species. The pollination activity of honeybees are an important integration function, as they contribute to the sustainability and diversity of agricultural and botanical resources and thereby contribute to increased productivity, environmental health and maintenance of biological diversity. Generally speaking, it is a bee with gentle temperament, industriousness quality and can be handled easily. Management of bees (honeybees, some species of bumble bees, solitary and stingless bees) is the basis for the provision of pollination services for large parts of the global crop production, particularly for fruits and vegetables. However, Species loss due to habitat loss and fragmentation is a major crisis for biodiversity at present and will aggravate with the intensification of land use by the end of this century. Improving skills and capacity building at individual and community level throughout the landscape in managing the habitat usage through awareness in the community through training and workshop could be an effective tool for the conservation of bees.

Conclusion: Considering these facts, this study has been done in Indian Trans Himalayan Region Capacities building of local communities, youth, school children and baseline agencies have been achieved by workshop, conservation awareness program and participatory rural appraisal approach. Participatory Rural Appraisal (PRA) exercise has been conducted with the community. The exercise developed linkages between community and natural resources of poor rural households. Practices of farming and use of fertilizers and pesticides are recorded, as well as their dependence on modern technologies. Different workshops were organized mainly related to importance and conservation of bees, importance of organic farming and less use of harmful chemical, inorganic pesticides and fertilizers harmful for pollinators or other beneficial insects of ecosystem.

Keywords: Climate change, conservation, ecosystem management

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BEE-CON-212

Comparative Study of Foraging Behavior of *Apis mellifera* L. at Two Different Agro Climatic Conditions in Khyber Pakhtunkhwa

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Abstract:

Introduction: Honey bees are social insects. They belong to order Hymenoptera, family Apidae and genus *Apis*, with 9 species. The well-known species among these include *Apis mellifera*, *A. cerana*, *A. florae* and *A. dorsata*. *A. mellifera* and *A. cerana* have been domesticated. Honeybee colony has different set of workers having responsibilities to collect nectar, pollen and sometimes both. The collection of pollen and nectar from flowering plants by bees is called foraging behaviour. Around 25 percent of adult bees are foragers in a colony. The study was aimed to compare the foraging behavior of *Apis mellifera* at different agro climatic conditions in different seasons (*Acacia modesta* and *Zea mays*).

Results: Peak foraging activity of pollen collectors in *Acacia modesta* season was observed between 08:00 to 10:00 am (14.68 No. of bees/ 10 mins) followed by 10:00 am to 12:00 pm (8.18 No. of bees/ 10 mins) then 12:00 to 2:00 pm (6.49 No. of bees/ 10 mins) while decline in population was recorded at 2:00 to 4:00 pm (5.75 No. of bees/ 10 mins). Similarly, maximum number of nectar collectors was observed from 12:00 noon to 2:00 pm (25.04 No. of bees/ 10 mins) followed by 10:00 am to 12 pm (17.80 No. of bees/ 10 mins) then 2:00 to 4:00 pm (12.24 No. of bees/ 10 mins) and minimum number of nectar collection was noticed from 8:00 to 10:00 am (10.54 No. of bees/ 10 mins). On the other hand, the data also showed that highest number of pollen foragers in *Zea mays* was observed from 8:00 to 10:00 (20.18 No. of bees/ 10 mins) followed by 10:00 to 12:00 (17.14 No. of bees/ 10 mins), 12:00 to 2:00 (6.05 No. of bees/ 10 mins) and 2:00 to 4:00 (3.48 No. of bees/ 10 mins) respectively while maximum number of nectar foragers was recorded from 12:00 to 2:00 pm (6.91 No. of bees/ 10 mins) followed by 2:00 to 4:00 pm (4.37 No. of bees/ 10 mins) then 10:00 to 12:00 (3.05 No. of bees/ 10 mins) thus the decline was observed at morning from 8:00 to 10:00 (2.02 No. of bees/ 10 mins).

Conclusion: Peak pollinators' foraging activity was recorded in the morning whereas the rest of day, bees were focused on nectar collection. Hence, pollen collection and nectar collection are directly associated with temperature. If the temperature is optimum, pollen collection will be done adequately. Same goes for nectar collection, it is smoothly done in warm environment. Therefore, the overall performance of honeybees is directly associated with climate. Any change in climate can be hazardous

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for honeybee keeping.

Key words: *Apis mellifera*, foraging behavior, *Acacia modesta*, *Zea mays*.

BEE-CON-213

Pollination Capability and Host Plants of the European Honey Bee (*Apis mellifera* Linnaeus) in the Arid to Semi-arid conditions of the District Rahim Yar Khan (Punjab), Pakistan.

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Abstract:

Introduction: Honey bees play a vital role in the pollination of the plants and the conservation of floral diversity. Three species of honey bees including little honey bee (*Apis florea* F.), giant honey bees (*Apis dorsata* F.) and the Indian bee (*Apis cerana indica* F.) are native to Pakistan, Whereas European Honey Bee (*Apis mellifera* L.) is occidental pollinator and was introduced in 1977 by Pakistan Agriculture Research Council (PARC), Islamabad and now has been successfully established in Pakistan. The European Honey Bee is an exotic species and has been proved as an effective pollinator of multiple plant species in the arid to semi-arid conditions of the various Asian countries. The domestic rearing of this specie in district Rahim Yar Khan is recently started and a little is known about the pollination potential and flora of this important pollinator. Therefore, current study was designed to get the knowledge of pollination capacity and potential host plants of *Apis mellifera*.

Methods: The research here presented to assess the pollination potential and host plants range of *Apis mellifera*. The abundance and foraging behavior of the bee foragers on various host plants was ascertained to study their pollination potential in the study area. The data of various plants visited by the forager was recorded and maintained throughout the year.

Results: The European honey bee visited about 63 host plant for nectar or/and pollen collection and performed as a dominant pollinator of more than 38 host plant in the arid to semi-arid environmental conditions of district Rahim Yar Khan.

Conclusion: *Apis mellifera* was seen foraging on more than 38 host plants of arid to semi-arid conditions of district Rahim Yar Khan. So, keeping in view these remarkable pollination services, this honey bee species need more multiplication and conservation efforts.

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Keywords: European honey bee, *Apis mellifera*, arid to semi-arid conditions, excellent pollinator, foraging, pollination, Rahim yar khan.

BEE-CON-214

Conservation of Bees through Local Ornamental Flowering Plants of South Punjab, Pakistan

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Introduction: Pollination is an important ecosystem service. About 87% of angiosperm plants are dependent on insect pollinators particularly on bees for their fruit and seed production. However, biodiversity of pollinators is decreasing globally due to the loss of flowering plants as a result of agricultural intensification. Therefore, current study was planned to screen the variation in attraction of winter annual flowers for bees and other floral visitors i.e. syrphid flies, butterflies, wasps, moths etc.

Methods: Twelve different varieties of winter annual flowering plants grown locally in winter season were selected. These belong to families of Plantaginaceae, Asteraceae, Solanaceae, Polemoniaceae, Brassicaceae, Lamiaceae, Violaceae and Caryophyllaceae. The attraction of bees and other insect floral visitors to these flowering plants was assessed through their arrangement in circular shape under Randomized Complete Block Design. The abundance and diversity of bees along with other floral visitor groups was recorded through visual count (for three minutes) for each flowering plant group per replication.

Results: Our results showed that different groups of pollinators' i.e bees, syrphid flies, housefly, fruit fly, butterfly, moth and blow flies were recorded. Syrphid flies were most abundant pollinators of seasonal winter ornamental flowers followed by bees. *Petunia atkinsiana* attracted more diversity of pollinators followed by pansy and antirrhinum. Bees were highly attracted towards *P. atkinsiana* (Solanaceae) followed by *Dahlia pinnata* (Asteraceae) while the less attractive flower was *Gazania linearis* (Asteraceae). Similarly syrphid flies are most abundant pollinators in *P. atkinsiana* followed by pansy (Violaceae). Butterflies and moths were most abundant in *Phlox paniculata* (Polemoniaceae) followed by pansy.

Conclusion: By growing these flowers, we can conserve the diversity of native pollinators in this region and increase the pollination service which ultimately increase the production of crops and ensure food security.

Keywords: Biodiversity, pollinators, foraging needs, conservation

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BEE-CON-215

Impact of Climate Change on Bee Pollination

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Abstract:

Introduction: Climate change is mainly occurring due to urbanization and deforestation which has severe impact on natural ecosystem and living organisms. Pollination is very important for the production of many crops. According to estimation, the contribution of pollinators to economy of Pakistan is estimated about US\$ 1.59 billion. It is done by many insects, birds and winds. About 87% of the crops are pollinators dependent and pollination of 80% percent crops is done by the insects in which about 73% is done by bees. Population of pollinators is declined from few decades all over the world. There are many factors of pollinator's decline in which climate change is one of them. Pollination of crops is associated with the interaction of pollinators and blooming flowers. Climate change effect on the pollinators directly and indirectly. Climate change has multiple effects on managed bees and wild bee. It has the potential to have a direct impact on their behavior and physiology. By the climate change flowering and maturity time of the crops, nectar and pollen production and the hibernation stage of the pollinators is changed. Due to less numbers of flowers, the production of pollen and nectar reduced which is important diet for the future worker bees to improve their health and immunity. On a larger scale, conflicts on pattern of rainfall, variations in temperature, and other numerous environmental fluctuations over the complete period may alter pollinator abundance, diversity, and foraging behavior. Due to this food availability is reduced ultimately.

Conclusion: Hence climate change has severe impact on bee population and other main crops which may cause the shortage of food to the world.

Keywords: Bees, flowers, decline, physiology, temperature, food

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BEE-CON-216

Pollinator Stewardship: An International Challenge for Food Security and Environment

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Abstract:

Introduction: The forests, grassland and wetlands provide critically important ecosystem services of healthy natural system for an essential food security. The provision of clean water, soil fertility, biological control of pests and mainly focuses on the reporting of pollination are the main services provided by the ecosystem. Pollinators are critical for global crop production, with an annual market value attributable to pollinators ranging from \$235 to \$577 billion (IPBES, 2016). The fertilization and reproduction of the crops is also done by wild pollinator's viz. butterflies, bees, birds and bats. Almost 75% of the world leading crops (melons, cucumbers, pumpkins, apples, peaches, edible oil canola, sunflower and turnip) depend on pollination. The pollinated crops play vital role to human nutrition, livelihoods and sustainable economic growth for food security. The bees from family Halictidae, Andrenidae, Apidae, Colletidae, Melittidae have been reported to support the pollination to sustain their yield. Potential drivers of pollinators' loss, including habitat loss and fragmentation, agrochemicals, pathogens, alien species, climate change and interactions between them. Pollinators decline can result in loss of pollination services which have important negative ecological and economic impacts that could affect the maintenance of wild plant diversity, wider ecosystem stability, crop production, food security and human welfare. The insect pollinators contributed an estimated 30% to oilseed crop yield. Pollination by a local honeybee species increased yield per plant from 29 to 45%, depending on the number of hives per hectare. In an analysis of smallholder crops in Tanzania, researchers estimated that production of mango would decrease by 40-90% in the absence of pollinators. Pollination by bees can increase the productivity of some varieties of soybean by 20 %. Nine different species of insect pollinators visited avocado flowers; exposure to pollinators increased fruit yield by over 200% and improved seed quality. Pollination by wild bees in cowpea crop increased the fruiting rate by 32% and number of seeds by 30%.


Conclusion: So, it is concluded that the conservation of wild pollinator populations play a significant role in food security, nutrition, and sustainable livelihoods. Bee species diversity is also positively correlated with yield.

Keywords: Pollinators, food security, ecosystem, yield, crops

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BEE-CON-217

Plan B, in Absence of Bees

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Introduction: Bees are the best at what they do i.e., pollinate many more plants including commercial fruits and crops. Seventy out of the top hundred human food crops which supply about 90 % of the world's nutrition are pollinated by bees. Since last many decades, the population and diversity of bee species are recorded to be constantly declined throughout the world due to many reasons. Among these, anthropogenic based climate change, habitat destruction, injudicious use of pesticides, nutrition deficit and air pollution are more important.

A severe threat to human food security may be faced in observing yield loss in cross pollinated crops. At this time, we don't wish for extinction of bees because these little creatures are the most efficient pollinators and beauty of the nature as well. May the bees prosper, but the finding alternate artificial pollinating ways can be a try for preparing the worst. Artificial pollination is a method used to pollinate plants when natural pollination is insufficient and / or undesirable. It's not something new but is being used since ancient times. In present review, some modern artificial pollinating methods are being debated. Some studies in Japan depicted the use a soap bubble maker to carry out the artificial pollination. This bubble maker was attached to a UAV (unmanned aerial vehicle) for pollinating the flowers. The bubbles did not damage the flowers because of lightweight, soft, and highly flexible. In another work done at Savannah College of Art and Design in Georgia, Haldenwang created a product to help in artificial pollination in the future. Some Russian scientists have proposed a concept of Nano Copter which can artificially pollinate plants, flying from one flower to another, collecting and transferring pollens at the same time.

Conclusion: So, this review can be a food for thought for academia, scientists and policy makers to work in advance to overcome some unfortunate situation of bee absence.

Keywords: Artificial pollination, bubble maker, nano-copter, drone.

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BEE-CON-218

Pollination, Ecosystem and Climate Change: A Narrative for the Conservation of Native Pollinator Diversity

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Abstract:

Introduction: Pollinators provide us every bite out of the 3rd existing food item. The pollinators not only support biodiversity but have positive correlation with the diversity of plants and pollinators. Apart from the most common group of insect pollinators, about 2, 00,000 other species and about 1,500 vertebrate species are responsible for this novel activity. Pollinators are continuously supporting the living community on earth that is only relying on the food they pollinate. They create and maintain the ecosystem by providing excellent ecosystem services as over 90% of the flowering plants are facilitated by these pollinators for reproduction. Enough pollination provides the plants to reproduce and propagate enough seeds, maintains the genetic diversity of the crops and development of fruit and fruit set adequate to support the community worldwide. Climate changes have drastic effects on pollinator's biodiversity and ecosystem decline. Sudden changes in environmental temperature in spring impose plants to go for flower earlier than flowering initiation. This may lead to the temporal mismatch between flowering plant and pollinator species. A-synchronization affects the pollinator's survival and limits the plant reproduction. The major consequences affecting the global decline of pollinators includes 1) climate change, 2) habitat alteration, 3) agricultural intensification, 4) reduced flowering resources, and 5) pathogens spreading disease in pollinator's biodiversity. These factors are responsible for the native pollinator's extinctions which may shift composition, plant pollinator interaction, and ultimate loss or zero pollination services to too many wild and crop plants.

Conclusion: Organic farming, well preserved floral resources, conservation of natural habitats, and increased landscape heterogeneity supports pollinator's biodiversity in intensive cropping systems. The uninterrupted supply and access to floral resources is the utmost demand of pollinators. However, more practical trends on specific climatic effects may lead the basis for the conservation program for the native pollinators worldwide.

Keywords: Pollinators, ecosystem, climate change, conservation and biodiversity.

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Insect Pollinators and Disease Transmission: A Review

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Abstract:

Introduction: In general, social life is linked to a higher risk of spread of disease, but it also allows for behavioral defenses on an individual and collective level. The improper evaluation of the critical role played by controlled and native insect pollinators is a major challenge to the long-term viability of current agricultural practices. The economic benefit of pollination, fruit formation, and seed set provided by such insects far outweighs that indicated with more conventional indicators, such as wax and honey created by honeybees. Pollination is an important ecological service that relies on symbiosis of the species, the pollinated species and the pollinator. The animal products that we consume, such as beef, mutton, poultry and dairy product, are derived from insect-pollinated legumes, such as alfalfa, clover, and some other plants. The economic value of insect pollinators is US\$ 954.59 million in Pakistan's Himalayan region. In Pakistan, the production value of pollinated dependent crops has recently been quantified to be US\$ 1.59 billion. In agriculture systems, plant diseases are widespread and are significant causes of economic loss. An economically important crop affected by an insect-vectored, fungal pathogen, and bacterial diseases.


Conclusion: The current review summarized the pollinator's diseases transmitted by bacteria, virus and fungus. We emphasized the source of transmission of diseases by different ways. The results showed that pollinators are affected by different diseases and reduce the production and development of agricultural crops. It is important to learn and understand about the insect pollinators and disease transmission for the benefit of agriculture.

Keywords: Pollinators, insect, bacteria, fungal, viral, transmission

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BEE-CON-220

The Conservation, Importance and Restoration of Bees in Agriculture: A Review

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Abstract:

Introduction: Bees are pollinators of Angiosperms pollinate most wild plant species on earth and provide crops with economically beneficial pollination services. So, their loss is significant for biodiversity and humans. Most workers and a variety of bee species were found in garden and farmland habitats. These bees are highly important since they pollinate roughly one-third of all crop species. It has been reported in Pakistan; total 18 species of 14 genera including 7 families of orders Lepidoptera, Hymenoptera and Diptera have been discovered. Deforestation and overhunting are the two most serious threats to bee populations. Therefore, we need to regulate integrated conservation planning for all endangered wild bees. Concerns about the loss of plant and pollinator species, as well as the effect on ecosystem functioning have heightened awareness of local and global threats to bee diversity. Bee species and ecosystems are characterized by significant variation i.e autecological characteristics, population size and role of plant-pollinators that are contributing to their extinction vulnerability. Therefore, it's an urgent need for to latest research to find the reasons causes declination of the bees. There is a major threat to bee diversity is habitat loss. Some other factors also affect the bee population like pesticide use, developing new diseases, invasive species, and climate variation. We proposed that future conservation strategies need to be implemented i.e making eco-friendly habitats for bees, controlling habitat loss, training public and scientists in bee identification and taxonomy, learn about autecological population genetic studies, estimation of the importance of DNA barcoding for bees conservation, determining the impact of protruding plants, pathogens, animals and parasites. Although assimilate this information to apprehend the potential impact of autecological changes on current bee diversity.

Keywords: Pollinator, conservation, biodiversity, ecosystem services

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BEE-CON-221

Ecosystem Services Based Modeling as a Tool for Conservation of Bee Pollinators in Mountain Agroecosystem

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Abstract:

Introduction: The agriculture sector, in an Indian context, is the primary occupation of the people that involves the direct or indirect participation of 41.49% of the total workforce. While the major concern is, this rate has shown a continual declining trend since 2010. Currently, the mountain agroecosystem in its conventional form attempts only to fulfill the subsistence aspect of rural livelihood. Each year adamant issue of climate change and global warming has forged the direction of innovation and research in field of pollinator diversity and crop pollination.

Methods: The current study is based on the data gathered from secondary sources and through the participatory observation method.

Results: Agricultural scientists and conservationists often find it difficult to maintain support for the protection of crop pollinators or showcasing their profits for the society. Modeling tools such as ARIES, Costing Nature, Invest, and a set of GIS procedures can be used to determine the biodiversity resources, crop pollination & production, Aesthetic & recreational value generated through crop pollination, carbon storage & sequestration and help in quantifying, specializing, and evaluating the overlap between ecosystem services.

Conclusion: Consequently, evaluation of ecosystem services has gained momentum in conservation science, as these services validate suitable conservation and management practices. A multifarious approach is required to shift agriculture away from a crisis–response model to a resistant and resilient agroecosystem. Thus, the need for ecosystem services-based modelling becomes crucial to safeguard the conservation of crop pollinators and their habitat.

Keywords: Crop pollination, ecosystem services based modeling tools, mountain agro-ecosystem

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BEE-CP-301

Comparative Pollination Efficacies of Solitary Bees, Honeybees and Flies on *Medicago sativa* L. Seed Production in Pakistan

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Abstract:

Introduction: Alfalfa (*Medicago sativa* L.) is a cross pollinated crop which require entomophily pollination for its flower tripping and subsequent pod and seed set. Alfalfa seed production is critical in evaluating; which pollinators are beneficial for farmers. However, little is known about the diversity and effectiveness of this crop's native wild pollinators.

Methods: To discover the pollinator community of alfalfa and for its best pollinators, two years' field trials were conducted in MNSUAM, South Punjab, Pakistan. Abundance and diversity of insect pollinators along with foraging behavior of abundant insect pollinators in terms of stay time, visitation rate, pollen harvest and tripping efficiency was recorded. Moreover, the single visit efficiency in terms of number of seeds per pod, germination and seed yield was evaluated.

Results: Ten major pollinators (five solitary bees, three social bees and two flies) were tested for their pollination efficiency. *Megachile hera*, *M. cephalotes*, *Amegilla* sp., *Eucera* sp., and *Nomia* (*Hoplonomia*) were identified as the most abundant native solitary bee species. The single visit efficiency of solitary bees showed the significant differences in terms of the studied parameters over the course of the two years. The seed yield findings show a significant interaction between pollinator species and years ($p < 0.01$).

Conclusion: In comparison to honeybees and flies, solitary bees produced the most seed in alfalfa. Solitary bees can be recommended as an effective pollinator as compared to honeybees and flies for alfalfa seed production.

Keywords: Solitary bees, *Medicago sativa*, effective pollinators, seed production.

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BEE-CP-302

Native Bees Increase Tomato Pollination Isolated from the Pollination Network

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Abstract:

Introduction: Pollination is a key process for successful reproduction of angiosperms. Several crops require pollination, in many cases specialized pollination. Tomato, for instance, is pollinated only by buzzing bees. These bees are usually native, with muscles capable of vibrate to extract pollen from the poricidal anthers of tomato flowers. Honeybees rarely visit the flowers of tomato, because this species cannot buzz-pollinate. We investigate the pollination network around tomato fields in different agroecosystems of Cuba and analyze the effect of pollinators in increasing tomato fruit yield. We performed bagging experiments and measure four fruit features.

Results: *Exomalopsis pulchella* and *Melipona beecheii* were the only pollinators that visited tomato flowers. However, *M. beecheii* only visited tomato once, which could be accidental. The interactions of tomato flowers and *E. pulchella* were isolated from the rest of the pollination network. This network was composed by 12 plant species and 11 pollinator species. *E. pulchella* also visited other ruderal plants present in the agroecosystem. Ruderal plants could be the main trophic resource in the period when tomato flowers are not available. We propose to farmers increasing the areas of ruderal plants to offer nectar and pollen to pollinators. The bagged flowers produce significantly smaller fruits, with fewer amounts of seeds and lower weighted. This indicates that the native bee *Exomalopsis pulchella* is essential for tomato production in the agroecosystems of Cuba.

Conclusion: *Exomalopsis pulchella*, a native bee of Cuba, pollinate tomato flowers and increase tomato yield.

Keywords: Buzz pollination, pollination network

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BEE-CP-303

Effects of Native Pollinator Communities on the Physiological and Chemical Parameters of Loquat Tree (*Eriobotrya Japonica*) under Open Field Conditions

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Abstract:

Introduction: Wild and managed pollinators are the key component of biodiversity, contributing to important ecosystem services such as pollination and supporting human food security. Pollination by insects is a crucial component of the food chain that ensures the production of fruits and strongly affects the fruit quality, but the effect of insect pollination on fruit physiological and chemical parameters is largely unknown.

Methods: The current study was conducted to determine the insect pollinators' diversity and their relative abundance in the loquat (*Eriobotrya japonica*) orchard during 2017–19. Further, the effect of insect pollinators' pollination on the physiological and chemical parameters of fruit quality as compared to control pollinated flowers was investigated.

Results: The results revealed that a total of 22 species from 3 families (Apidae, Halictidae, and Syrphidae) were identified during the flowering season. The Apidae and Syrphidae were the most frequently observed families with major groups honey bees (67.89%) and hoverflies (21.57%), respectively. Moreover, results indicated that the fruit yield by the open-pollinated flowers (22.31 ± 0.34

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kg/tree) was significantly higher than the control pollinated flowers (14.80 ± 0.25 kg/tree). Physiological and chemical parameters of loquat fruit differed significantly when fruits obtained from open-pollinated flowers as compared to control pollinated flowers.

Conclusion: These results suggested that native insect pollinators play important role in the fruit quality of loquat. Hence, maintenance of appropriate habitat of native pollinators near loquat orchards is necessary to ensure good productivity and fruit quality.

Keywords: Pollinators diversity, hymenopterans, *Eriobotrya japonica*, abundance, fruit yield, physiological parameters.

BEE-CP-304

Foraging Behavior of Western Honey Bee (*Apis mellifera*) in Different Time Intervals on *Brassica campestris*

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Abstract:

Introduction: The pollen foraging showed a collective approach by honeybees belonging to a colony

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which organize and carefully regulate it with the passage of time. The comparative amounts of larval brood and stored pollen in the hive closely correlated with the pollen requirements of a honeybee colony. Intercrop, diversity and average number of visiting pollinators contributed positively to the fruit weight and fruit quality. The flight activity of honey bees is greatly subjective to the weather and flow conditions along with the strength of colony and the number of foraging bees. Weather conditions usually depend on the wind intensity, air temperature and wind force. The situation of flow relies on diurnal flowering pattern, nectar and the pollen output alongside the combination of these aspects.

Methods: The observation included following steps i.e. installing pollen traps at the entrance of the hive, recording number of pollen carrier bees returning to the hive, calculating quantity of bee pollen collected in the pollen trap trays and weighing the total weight of pollen collected by the hive, calculating the Visitation Rate (number of flowers visited by pollinators in one minute), Visitation Frequency (number of pollinators visit one plant per minute) and Pollinator Diversity (different pollinators found during 5 minutes visit of field).

Results: *Apis mellifera* entering in the hives with pollens at the different time intervals of 8:00, 10:00, 12:00, 14:00 and 16:00 hours for five minutes. The highest number of bees entering in the hives were at 12:00 hours showing the average value of 73.2. The starting and ending time period i.e. 08:00, 10:00, 14:00 and 16:00 shows lower average value of 14.6, 30.3, 66.4 and 28.6 respectively.

Conclusion: Foraging behavior of the honey bee is started just after sunrise and continue till sunset while the activity at its peak 12:00 pm to 4:00 pm at brassica crop

Keywords: *Apis mellifera*, Brassica, foraging behavior, honey bee

BEE-CP-305

Role of Native Pollinators in Amplifying Seed Yield of Berseem

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Abstract:

Introduction: Berseem is multi-cut, winter annual fodder crop which is extensively used in south Punjab region as cattle fodder. Berseem depends upon insect pollinators for better seed production.

Methods: An experiment was conducted at the research field of MNS-University of Agriculture, Multan, Pakistan to find out the effective pollinators of berseem. The abundance, visitation rate and visit duration of the pollinators were determined. The yield parameters: seed per head, 1000 seed weight, head size and floret per head were also determined.

Results: Pollinators community was consisting of hymenopterans (*Pseudapis* sp., *Apis dorsata*, *A.*

🕒 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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mellifera, *Vespa* sp.), dipterans (*Eristalinus aeneus* and *Episyrphus balteatus*) and some species of lepidoptera. Results shows that *Pseudapis* sp., was most abundant bee followed by *A. mellifera* while syrphid flies were less abundant. Furthermore, *A. mellifera* had the highest visitation rate (17.27 ± 0.67) followed by *Pseudapis* sp (11.33 ± 1.32) and least visitation rate was recorded for *A. dorsata* (5.57 ± 0.27). Visit duration of *Pseudapis* sp was highest (19.93 ± 7.07) followed by *A. dorsata* (12.11 ± 1.23) and *A. mellifera* (11.68 ± 0.99). In open pollination 57% more seed yield were recorded than caged pollination.

Conclusions: Conserving native pollinators may increase seed yield of Berseem crop in South Punjab region of Pakistan.

Keywords: Berseem, *Pseudapis* sp., *A. mellifera*, effective pollinator, visit duration.

BEE-CP-306

Role of *Apis dorsata* and *Apis florea* in Cross-pollination of Cauliflower in Bahawalpur

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Abstract:

Introduction: Cauliflower (*Brassica oleracea* Var. botrytis L.) is a valuable vegetable throughout the word which is used as food in winter season. In the study, foraging behaviour of *Apis dorsata* and *Apis florea* was studied at two sites *i.e.* at IUB and in RARI in terms of their visitation rate, visitation frequency, stay time on flower, stigma contact events, nectar robbing and pollen grain deposition on stigma and their pollination impact on post-harvest success of cauliflower.

Results: The visitation frequency of *A. dorsata* was significantly higher than *A. florea* at both study sites and pollen deposition was significantly higher in *A. dorsata* (167.68 ± 16.34 per visit at IUB and 203.1 ± 19.68 per visit at RARI) than *A. florea* (76.46 ± 4.47 per visit at IUB and 98.7 ± 20.82 per visit at RARI, respectively). The maximum stay time was recorded for *A. florea* (14.88 ± 0.29 sec at IUB and 14.72 ± 0.28 sec at RARI) followed by *A. dorsata* (6.26 ± 0.14 sec at IUB and 6.089 ± 0.13 sec at RARI, respectively). The visitation rate was significantly higher for *A. dorsata* (6.18 ± 0.07 floral visit per 120 seconds at IUB and 7.23 ± 0.18 floral visit per 120 seconds at RARI) than *A. florea* (3.061 ± 0.04 floral visit per 120 seconds at IUB and 4.47 ± 0.065 floral visit per 120 seconds at RARI, respectively). However, the post-harvesting of cauliflower in term of pod length was recorded maximum in *A. dorsata* (7.46 ± 0.27 cm at IUB and 8.084 ± 0.75 cm) at RARI followed by open pollination, *A. florea*, and caged plants. The minimum pod length was recorded in *A. florea* with mean value of 4.78 ± 0.178 cm. Post-

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MNS University of Agriculture, Multan-Pakistan

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harvest in term of pod weight was higher in *A. dorsata* with mean value of 0.11 ± 0.0038 g at IUB and 0.24 ± 0.052 g at RARI followed by open pollination, *A. florea* and caged plants. The higher number of healthy seeds was found in *A. dorsata* in the range of 16.4 ± 0.86 at IUB and 17.37 ± 0.75 at RARI than open, *A. florea* and caged plants. Germination was determined with higher percentage in *A. dorsata* ($91.14 \pm 1.055\%$ at IUB and $91.09 \pm 1.24\%$ at RARI) followed by open pollination, *A. florea* and caged plants. Minimum percentage of germination was recorded in caged pods ($58.44 \pm 5.97\%$ at IUB and $37.003 \pm 4.52\%$ at RARI).

Conclusion: It was concluded that *A. dorsata* is a better pollinator in terms of post-harvest qualities of cauliflower.

Keywords: Pollinators, *Apis dorsata*, *Apis florea*, cauliflower, pollination biology

BEE-CP-307

Efficiency of Pollination on Field-Grown Tomato Compared with Isolated Under Same Condition

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Abstract:

Introduction: Tomato (*Lycopersicon esculentum*) is a widely consumed vegetable in the world. Based upon cultivated area, tomato ranks first among vegetables. Insects and birds play an important role in enhancing the yield of tomato by the process of pollination. Lack of pollination from insects and birds shows adverse effects on the tomato fruit size, weight, seed content and yield. The main objective of this study was to check the role of pollinators in tomato crop.

Methods: The research was conducted at University of Agriculture, Faisalabad to check the effect of Insect pollination on tomato yield. Open tomato field was compared with the tomatoes that were covered with muslin cloth with same field conditions. There were 5 rows of open-pollinated tomatoes and 5 rows of caged tomatoes. Pollination effectiveness was compared among both fields while 15 plants were randomly selected from every row. Following parameters for tomato production were studied: fruit set, size, weight and seed content.

Results: After the comparison of pollination values from both fields, it was concluded that the tomatoes that were covered with muslin cloth had the lowest value. Outcomes also indicated that the open pollination tomatoes gave highest yield, fruit weight and fruit number set as compared to that of caged tomatoes. Seed number increased in open field was recorded double than the caged plants whereas no significant differences were seen among fruit firmness from both fields.

Conclusion: Naturally pollinated tomato showed positive results with respect to yield, fruit size, weight

🕒 May 20, 2021

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and number of seeds were recorded higher as compared to tomatoes that were covered with muslin cloths.

Keywords: *Lycopersicon esculentum*, pollination, fruit set, fruit size

BEE-CP-308

Pollinators Diversity and their Effects on Eggplant Production in Faisalabad, Punjab (Pakistan)

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Abstract

Introduction: Eggplant (*Solanum melongena* L.) is among the top ten vegetables of the world. It is grown throughout the whole year in Pakistan, requires high temperature and high rainfall. There are 8 insect species from 6 families and 3 orders which acts as a pollinator in eggplant. Insect pollinators play an important role in transferring pollen from anther to stigma in eggplant. Pollination is a key driver in eggplant for fruit set.

Methods: The research was conducted in the Research area of Department of Entomology, University of Agriculture, Faisalabad, to know the role of pollinators and abundance of pollinators, which are responsible for fruit set: yield and seed quality in eggplant. Three designed treatments for this experiment were (i) open plot, (ii) enclosed plot and (iii) covered plot.

Results: In our research, we found that there are 8 insects which act as pollinators in eggplants; these insects are honey bees (*Apis cerana* and *A. mellifera*), sulphur butterfly, house fly, syrphid fly, ant, wasp and sweat bees. Ant spent longest time duration on flower whereas syrphid fly spent shortest time interval on the flower. Whereas results also showed that honey bees (*Apis cerana* and *A. mellifera*) were the major insect pollinators for fruit set. Highest yield with bigger fruit size was obtained from open plot of eggplant while lowest yield was recorded from enclosed plot of eggplant.

Conclusions: Pollinators not only effect the yield of the eggplant but also effect the fruit weight, size and number of seeds per pod.

Keywords: Eggplant fruit, insect species, pollinators, foraging, yield

🕒 **May 20, 2021**

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BEE-CP-309

Pollination of Canola, *Brassica napus* L. by *Apis dorsata* and *Apis florea* (Apidae: Hymenoptera)

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Abstract

Introduction: Pollination is a most important ecosystem service provided by insects resulting in continuity and sustainability of the ecosystem.

Methods: The experiment was conducted at the oilseeds research station, Bahawalpur, Southern Punjab, Pakistan to discover the best native pollinators i.e., *Apis dorsata* and *A. florea* and pollinator community of canola, *Brassica napus* L.

Results: The insect pollinator community was composed of 21 species in 3 orders and 9 families. Majority of the bees and butterfly species foraged only for nectar, while all the flies foraged either for both pollen and nectar or pollen. Only *A. dorsata* and *A. florea* were tested for their pollination effectiveness. The maximum number of flowers visited by the *A. dorsata* (10.23 ± 0.21) than the *A. florea* (6.98 ± 0.36). *Apis florea* showed the highest stay time (8.56 ± 0.61) than *A. dorsata* (5.11 ± 0.19). The maximum number of pollen grains were harvested and deposited by the *A. dorsata* (675.20 ± 86 and 256.22 ± 29 , respectively). The highest pod length, number of seeds per pod and seed weight per pod was recorded in *A. dorsata* pollinated flowers. The single visit efficiency in terms of the number of seeds per pod revealed that *A. dorsata* was superior to *A. florea* for canola pollination.

Conclusions: With the increase in pod length and number of seeds per pod, seed weight per pod also increased, confirming the importance of these two pollinator species in canola production.

Keywords: Canola, pollinators' community, *A. dorsata*, *A. florea*, reproductive success

🕒 May 20, 2021

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BEE-CP-310

Onion Flowers Anthesis and Bees Pollinators Preferences on Onion (*Allium cepa* L.) Crop

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Abstract

Introduction: Onion (*Allium cepa* L.) is grown in almost every country of the world. It is consumed as a raw or cooked vegetable as well as in salads and condiments. A global review of major vegetables shows that onion ranks second after tomato in area. Approximately, 36 million tones onions are produced on 2-5 million ha globally.

Methods: The present study was carried out at National Agricultural Research Centre, Islamabad, Pakistan. The field experiment was conducted during the month of April 2019 to investigate the diversity of pollinators, visiting rate, visiting frequency and time spent by insect on a flower of *Allium cepa* L. Fluctuation in visits of insect pollinators on different days was observed.

Results: The visiting rate of insect pollinators was high at 10:00 am and 4:00 pm while visiting frequency was high during 8:00 am to 10:00 am. The community of pollinators was composed of two honeybee species (*Apis mellifera*, *A. dorsata*), Hornets, Wasps, Butterfly, and Syrphid fly. The most abundant pollinator was Syrphid fly followed by *A. mellifera*. The pollinator activity was observed after opening of the onion flowers. The pollination activity of Syrphid fly was greater than other observed pollinators.

Conclusions: So, it was concluded that Syrphid flies visited most the onion flowers. Further observation can be done in future.

Keywords: *Apis mellifera*, *Allium cepa*, diversity, pollinators

🕒 **May 20, 2021**

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BEE-CP-311

Bee Pollination Increases Yield Quantity and Quality of Cash Crop in D.G. Khan: Pakistan

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Abstract:

Introduction: In biodiversity the key components are mutualistic biotic interactions as among flowering plants and their insect pollinators. Pollination, especially by insects, is a key element in ecosystem functioning, and hence constitutes an ecosystem service of over-all importance. Not only sexual reproduction of plants is confirmed, but also yields are stabilized and genetic variability of crops is maintained and facilitating system resilience.

Conclusion: While experiencing rapid environmental change, there is an increased demand for food and income security, especially in third world countries, which are highly dependent on small scale agriculture. In these experiments, pollinator surveys and field managements, quantifies the contribution of bee pollinators to smallholders' production of the major cash crop like cotton in D.G. Khan.

Keywords: Smallholders, production, survey, field management, cash crop.

BEE-CP-312

Foraging behavior of Native Pollinators in *Bauhinia variegata*

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Abstract:

Introduction: *Bauhinia variegata*, commonly known as Kachnar is a medium sized tree native to Southeast Asia. The buds of Kachnar are consumed by cooking them in gravy. It is also used to make pickles in various parts of the world. Kachnar has many medicinal properties and has a great nutritional value.

Methods: Abundance and diversity of insect pollinators were observed in Kachnar in Southern Punjab region. Foraging behavior of most abundant pollinators was observed in terms of stay time, visitation rate and pollen deposition. Moreover, single visit efficacy was also observed in terms of pod length, pod weight, number of seeds and seed weight per pod.

Results: Different groups of insect pollinators i.e. Hymenoptera, Diptera and Lepidoptera were observed in the field. Among hymenoptera social bees i.e. *Apis mellifera*, *A. dorsata*, *A. florea* and solitary bees i.e. *Xylocopa* sp. were observed. Among diptera, *Eristalinus aeneus* and different species of syrphid flies

 **May 20, 2021**

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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were found in Kachnar field. Among all, *A. mellifera* was the most abundant in the field. Syrphid flies had the longest stay time on the Kachnar flowers whereas the highest visitation was observed for *A. mellifera*. The results also depicted that open pollination made the longest pods with more seed weight than caged flowers. The highest number of pollen was deposited by *A. dorsata*. Single visits showed that the longest pod having the highest seed weight was made in flowers caged with *A. mellifera*.

Conclusion: It is concluded that the honeybees, *A. mellifera* and *A. dorsata* proved to be the most efficient pollinators of Kachnar. If conserved, these pollinators can be effective in improving the number of seeds and seed weight of Kachnar.

Keywords: Honey bees, pollen deposition, single visit, syrphid flies, visitation rate

BEE-CP-313

Effect of Native Pollinators on Physical and Biochemical Properties of Phalsa

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Abstract:

Introduction: Phalsa is important cross pollinated fruit crop and is famous throughout the semi-arid and sub humid parts of the world. Pollination is necessary for fruit formation and improving the yield in terms of quality and quantity of fruit crops.

Methods: The experiment was conducted at research farm of MNS-University of Agriculture, Multan to check diversity, abundance and foraging behavior of insect pollinators in term of visitation rate, single visit efficacy and post-harvest features of the phalsa.

Results: The pollinator community in phalsa crop consists of solitary i.e *Megachile* sp., and social bees' i.e *Apis mellifera*, *Apis dorsata*, *Apis florea*, and other flies. Among all pollinators, *A. dorsata* and *A. florea* were more abundant pollinators followed by *M. cephalotes*. The visitation rate of *Megachile* sp. i.e *M. cephalotes* was higher followed by the *A. dorsata*. The single visit efficiency in terms of fruit weight of phalsa revealed that solitary bees *M. cephalotes* was efficient pollinators followed by *A. dorsata* while syrphid flies were least effective pollinators. Moreover, In open pollination experiment, better fruit set was observed in term of physical parameters (fruit weight, fruit size) and chemical parameters (TSS (%), Vitamin C, pH and TA) than self-pollinated plants.

Conclusion: The results concluded that the *M. cephalotes* can be considered as efficient pollinators in terms of quality and production of phalsa fruit crops in Pakistan. Moreover, bee pollination enhances the physical and biochemical parameters of fruit crops.

Keywords: Phalsa, abundance, effective pollinators, physical and biochemical parameters.

 **May 20, 2021**

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BEE-CP-314

Role of Native Pollinators in Seed Production of Sunflower Hybrid Cultivars

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Abstract:

Introduction: Sunflower (*Helianthus annuus* L.) is the third oilseed crops across the world which provide the high quality consumable oil and amount of protein at commercial level. Pollination is an important for crop yield because 75% of world's crops rely on insect pollinators. Previously few studies have been conducted regarding role of insect pollinators in hybrid sunflower seed production in Pakistan.

Methods: So, current study was focused to explore the abundance and diversity along with foraging behavior (visitation rate and stay time) of native insect pollinators and its impact of sunflower yield. Hysen-33 variety of hybrids sunflower were selected.

Results: In our study, *A. mellifera* was most abundant pollinator followed by *A. dorsata* and *Xylocopa* sp. while *Amegilla* sp. and *Pseudoapis* sp. were less abundant. *Ceratina* sp. had showed the highest visitation rate and stay time per flower per visit, while *Xylocopa* sp. had showed the lowest visitation rate and stay time. However, in open pollinated flowers seed weight and number of seeds was 25% high as compared to caged plant (with no pollinators visit).

Conclusion: Hence, it's proved that pollinators are necessary for the better seed production and quality of sunflower seeds.

Keywords: visitation rate, stay time, abundance.

BEE-CP-315

Effects of Pollinators and Pollination on Canola (*Brassica napus* L.)

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Abstract:

Introduction: Canola or oilseed rape (*Brassica napus* L.) is the most significant source of edible oil in the world. Canola is 70% self-pollinated. However, several studies have shown the importance of High numbers of insect species of different orders have been recorded as pollinators of canola plants. The honey bee is considered the most effective pollinator for maximizing the economic value of canola. Open pollination of canola has numerous progressive effects on the quantity and quality of canola

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development and productivity.

Methods: Experimental plots were divided into two areas, one accessible for insect pollinators and visitors as uncaged plant and the other unreachable for pollinators as a caged plant. Wood-framed cages covered with a white muslin cloth to ensure sufficient ventilation. The remaining plot was left open and freely reachable for pollinators and flower visitors.

Results: The results exhibited that there were nine species of insect pollinators and visitors belonging to four orders and eight families. The majority of the pollinators were hymenoptera (83%), especially honey bees (*Apis mellifera* L.). The topmost activity of honey bees was noted between 9 am and 11 am.

Conclusion: This study indicated that *A. mellifera* is the most proficient pollinator for enhancing canola crop yield and Canola crop was positively influenced by insect pollinators.

Keywords: Canola, *Apis mellifera*, production, yield, pollinators

BEE-CP-316

Visitation Optimization of Bumblebees for the Pollination of Greenhouse Tomatoes in Multan

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Abstract

Introduction: The tomatoes grown under greenhouse conditions require supplemental bee pollination for the better fruit set. The present study was conducted to evaluate the optimized role of bumblebees (*Bombus terrestris* L.) for tomato pollination under greenhouse conditions. The impact of increasing number of floral visits (i.e. 1 to 5) on physical and biochemical characters of tomato was studied on tomato variety 'Grandella' grown on an area of 500m².

Results: The self-pollination and hand vibration treatments were maintained for comparison. The three visits of bumblebees on a single flower resulted in the maximum improvement in physical (higher fruit length, fruit weight, fruit weight, no. of seeds per fruit, weight of 100 seeds) and biochemical properties (vitamin C, shelf life) as compared to hand vibration and self-pollination treatments. There was no improvement in physical and biochemical properties in fourth or fifth visit. Bumble bee pollinated fruits had low TSS, pH and postharvest weight loss than that of self-pollinated and hand vibrated treatments.

Conclusion: Three visits of bumblebees per flower are enough to get the optimum production of tomato under greenhouse conditions.

Keywords: Colony traffic, stay time, visitation rate, physical and biochemical properties, hand vibration, self-pollination

🕒 May 20, 2021

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BEE-CP-317

Role of Native Pollinators in the Fruit Production of Apple Orchards

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Introduction: Apple (*Malus domestica*) is found in the temperate region of the world. Vitamin A, C, and B are abundant in *M. domestica*. It contains approximately 11% sugar as well as large quantities of essential minerals. Pollination is an important ecosystem service for crop yield because 75% of world's crops rely on insect pollinators. Previously few studies have been conducted regarding impact of insect pollinators in apple production in Pakistan. Insects are important as pollinators for a variety of crops, particularly in apple orchards.

Methods: Current study was focused to explore the abundance and diversity along with foraging behavior, visiting time of native insect pollinators and its impact on Apple orchard yield. Red golden and Double red variety of Apple was selected.

Results: In our study, *A. dorsata* was most abundant pollinator followed by *Apis mellifera* and *Xylocopa* sp. while *Amegilla* sp. and *Psudapis* sp. were less abundant. *Ceratina* sp. had showed the highest visitation rate and stay time per visit, while *Xylocopa* sp. had shown the lowest visitation rate and stay time. However, open pollinated plants produced better fruit weight and number of fruits was 17% high as compared to caged plants (without pollination).

Conclusion: Hence, it's proved that pollinators are necessary for the better quality of apple fruits.

Keywords: Pollination, visiting time, yield, abundance.

BEE-CP-318

Insect Pollinators and their Role in Sunflower (*Helianthus annus* L.) Seed Production

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Abstract:

Introduction: Sunflower (*Helianthus annuus* L.) is an economically important oilseed crop (contributes 32% of domestic edible oil production) and is cultivated under variety of environmental conditions due to its resistance to adverse weather conditions, crop rotation, intercropping options and succession in

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seed-producing regions. There are several species of wild bees helping sunflower pollination. Honeybees have been reported as very important pollinators of sunflowers across the world.

Methods: A study was carried out to identify the pollinator community and its role in pollination of sunflower at the research farm of Bahauddin Zakariya University, Multan, Pakistan.

Results: Community of pollinators was composed of 14 insect species including eight bee species (Hymenoptera), four fly species (Diptera) and two butterfly species (Lepidoptera). Bees were the most abundant floral visitors. *Apis dorsata* Fabricius, *Xylocopa* sp and *Megachile* sp. were the most abundant among the bees with the highest visitation frequencies i.e. 1.33, 0.07 and 0.06 individuals per head per minute, respectively. The abundant flies included *Eristalinus aeneus* Scopoli and *E. arvorum* Linnaeus. The peak visitation activity of pollinators was recorded between 08:00 to 10:00 hrs.

Conclusions: Although there was no significant difference in number of seeds per head produced in insect pollinated (open) as compared with, without insect pollinated (caged) heads. However, insect pollination significantly increased the number of healthy seeds, 100 seed weight and germination percentage. As *A. dorsata* Fabricius was the major pollinator of sunflower, future studies should focus on its conservation for better crop production.

Keywords: Sunflower, pollination, pollinator community, reproductive success

BEE-CP-319

Pollination of Falsa, *Grewia asiatica* (Malvaceae) by Female and Male *Megachile cephalotes* (Megachilidae: Hymenoptera)

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Abstract:

Introduction: Due to difference in morphology and behavior, both female and male solitary bees perform different roles hence, may differ in their pollination efficiency.

Methods: The current study was conducted to examine the difference between foraging behavior of female and male solitary bee, *Megachile cephalotes* and its effect on pollination effectiveness of falsa, *Grewia asiatica* L. (Malvaceae) in terms of post-harvest characters, fruit setting and pollen deposition. The impact of abiotic factors i.e., temperature, relative humidity, wind velocity and light intensity on the

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MNS University of Agriculture, Multan-Pakistan

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foraging behavior of female and male (visitation frequency, visitation rate and stay time) was also studied.

Results: The higher pollen deposition, visitation frequency, and visitation rate were recorded in females than the males. Females had longer body and proboscis length than that of males. The peak activity of female was recorded at 12:00 pm followed by the slow decline until 4:00pm while the males' activity continued in low abundance all over the day without prominent fluctuation. Female pollinated fruits were attained maximum average fruit weight followed by open pollinated and male pollinated fruits. More gradual but lower fruit weight and wrinkling were observed in female pollinated fruits than the open pollinated and male pollinated fruits.

Conclusion: The results suggested that the females of *M. cephalotes* are more efficient pollinators of falsa in terms of post-harvest characters and its reproductive success than that of males. Further studies should focus on artificial nesting of *M. cephalotes* with emphasis on nesting ecology and biology.

Keywords: Falsa, *M. cephalotes*, post-harvest, pollination, fruit

BEE-CP-320

Role of Honeybees in the Pollination of Apricot (*Prunus armeniaca*)

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Abstract:

Introduction: Pollination is the phenomena or act of pollen shifted from male (anther) to female part (stigma) of flower. Plants or trees can be self-pollinated or cross-pollinated. Cross pollinated plants or trees are dependent on pollinating agents e.g. birds, insects, animals, humans, and wind. Among pollinating agents or pollinator sources, insects are most important pollinators. Insects especially bees are considered most effective pollinators; among bees, the honey bees were found most significant floral visitors of plants or trees especially in apricot. Pollination is most efficient way of increasing yield

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per acre of agricultural crops and orchards. In apricot trees, cross-pollination is more effective than self-pollination.

Methods: Therefore, the present study explains the efficacy of *Apis cerana* and *A. mellifera* and their impact in apricot orchard. Three hives of each honeybee species were placed in the orchard. Numbers of visits and fruits were observed in apricot orchard. Numbers of honey bees of both species and other foraging pollinators on the open branches were observed regularly during three different timings (i.e. morning, afternoon, and evening) a day on four different directions (North, South, East, and West) on apricot trees.

Results: Population of both species was directly proportional to the emergence of flowers. We recorded the highest fruits percentage in the open-pollinated trees (81%) than without pollinated trees (19 %). In pollinated branches, by honey bees, the significantly highest numbers of fruits were calculated at the east side of the apricot trees.

Conclusion: This study concluded that *A. cerana* was found more active than *A. mellifera* during flowering and shedding season of apricot. Our study would be helpful for future studies, as insecticides application, because this study has shown less population of *A. cerana* and *A. mellifera* in the evening.

Keywords: *Apis cerana*, *Apis mellifera*, apricot, insect pollinators, *Prunus armeniaca*

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BEE-BK-401

Honey Bees Pollination under Climatic Change Scenario

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Abstract:

Introduction: Honey bees through social animals that are not important for their products as well as they are increasing the word food production directly through their active participation in the pollination. Current blind and immense use of pesticides as well as creation of the smog due to the combustion of the fuels in the vehicles as well as other industries has caused adverse environmental changes. These adverse changes have directly affected the honey bees survival their potential to create the products like Honey as well as they are going to be endangered due to a serious threat of environmental changes. In Agro ecological zone the major crop like cotton rice and Maize at 17 are facing immense use of multiple different kind of pesticides including insecticides and fungicides especially full stop these pesticides are regularly being used at what cost areas without any kind of limitations. Therefore these practices has caused stomach and contact poison in the honey bees when they visit the field of infested areas.

Conclusion: The consequences especially in the cross pollinated crops like oilseed crops are severely affected with reference to their production day by day.

Keywords: Bee, pollination, environment

BEE-BK-402

Side Effects of Commonly used Insecticide on *Apis mellifera* in Cotton Field

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Abstract:

Introduction: Honeybees (*Apis mellifera* L.) offer not only high-value bee goods, but also vital free services such as cross-pollination, conservation of wild and cultivated plants, and preserving natural ecosystems. When bee larvae and adults come into contact with insecticide-contaminated pollen and nectar, they can die or undergo multiple sublethal effects.

Methods: The current study was performed to check the toxic effects of 7 insecticides on *Apis mellifera* using oral toxic test in cotton field.

Results: Results revealed that the most dangerous pesticide studied was Endosulfan, which had the lowest LC50 and LC90 values over all time ranges and the lowest LT50 and LT90 over all concentration,

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followed by Cypermethrine, Chlorpyrifos, Triazophos, and Quinalphos. Captan and Boscalid, on the other hand, had the greatest LC50 and LC90 at all times measured, as well as the maximum LT50 and LT90 at all concentrations. When pesticides were applied to cotton fields, the number of dead workers rose dramatically when compared to the control. The analyzed pesticides greatly reduced activities of bee workers which collect nectar, pollen grains, foraging and honey bee yields.

Conclusion: Captan and Boscalid were found to be the safest pesticides for honeybee in both lab and field conditions. So in future, these can be used as a part of cotton pest IPM system.

Keywords: Honey Bee, insecticides, cotton field

BEE-BK-403

Pollination Services by Honeybees in the Punjab, Pakistan

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Abstract:

Honeybees play a pivotal role in the cross pollination of over 100 cultivated crops throughout the globe. A mutually beneficial relationship exists between bees and plants. Flowers provide nectar and pollen for bees and the bees in return cross-pollinate the plants. The value of honeybees' pollination is 14 times the value of honey produced. Globally the value of pollinators is €153 billion (217 billion US dollars). Pakistan is endowed with more than 700 plant species known to be visited by honeybees which can support 0.4 - 0.5 million honeybee colonies. In a recent study, the increase in crop value and yield attributable to honeybees' pollination in Pakistan was calculated as US\$ 1.59 billion. This also reflects pollination services by honeybees may be best fitted in integrated crop management (ICM) to enhance crop production not only in quantity but in quality too. There are seven major migration schedule of apiculturists on major bees flora of the Punjab. It comprised of Brassica (October- February) in Salt Range and Potohar Region; Loquat (October- November) in Potohar Region; Citrus (March- April) in Sargodha, Sahiwal, Faisalabad; Deciduous fruits (March- April) in Murree hills; Mesquite, Shisham, Phulai, Bhaikar, Grunda (April May) in Taxila, Islamabad, Rawalpindi; Berseem, Sunflower (May-June) in Central Punjab, Rawalpindi, Taxila and Ber (August- October) in Chakwal, Attock.

Keywords: Honeybees, *Apis mellifera* L., pollination, migration schedule, bee forage plants, Punjab, Pakistan

 **May 20, 2021**

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BEE-BK-404

Training of *Apis mellifera* (Hymenoptera: Apidae) to Refine Its Foraging Activities: A Review

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Abstract:

Introduction: Western honeybee (*Apis mellifera*) is the most common species of honeybee worldwide. Due to honey production and pollination services *A. mellifera* provides to a wide variety of agricultural crops, human interaction with them has increased over the years. As a super-generalist pollinator, these provide almost 80% pollination in some plants. *A. mellifera* is responsible for adding about 15 billion dollars annually to the U.S farming sector alone by enhancing the yields of many crops. Due to its adaptability and non-aggressive nature European honeybee is found throughout the world except Antarctica. Honeybee can forage for nectar and pollen resources within the 3 km of their hive. *Apis* bees are most abundant on the globe and their transportation to many far-off places has augmented their population manifolds. Honeybees have a reputation for their olfactory memory that helps them in finding nectar resources in the same areas again and again. Once a honeybee has found a nectar resource, the whole hive is informed about the spot through waggle dance. In this review, many studies were compiled about the training of worker bees when they were fed artificial diets incorporated with the essence of different plant species separately, that were not in the reach of beehive then after some days the foraging activity of whole beehive is noted.

Conclusion: Results were made on many different parameters in every paper like waggle dance, chemical analysis of pollen collected from beehive and abundance of bees on that crop flowers. These results clearly suggest that honey bees possess strong olfactory memory. This attribute of worker honeybees could be exploited to sharpen its foraging activity.

Keywords: European honeybee, pollinator, yields, adaptability, nectar, olfactory

BEE-BK-405

Exploring Gut Microbiota of *Apis dorsata* through Culture Dependent Approach

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 **May 20, 2021**

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Abstract:

Introduction: Honey bees are social insects that live in large, well organized colonies. Honey bees are beneficial insects for the mankind by producing honey, bee products and crop pollinations. The factors for decline are agrochemicals, pathogens, foreign species and climate changes. Microbiota maintain gut physiochemical conditions, aid in digestion and metabolism of nutrients, neutralization of toxins, development, protection and pathogenic resistant. *Apis dorsata* are native large bees and efficient honey producers seasonally.

Methods: The gut cultivable bacteria of honey bees, 30 – 50 bees samples were collected from district Kohat, Khyber Pakhtunkhwa. Complete digestive system of the worker bee was dissected and processed for bacterial isolation.

Results: More than 200 bacteria were obtained and isolated by bacteriological parameters using morphological and biochemical identification followed by 16 sDNA sequencing. The gut isolates were classified into bacterial phyla of Firmicutes, Proteobacteria, and Actinobacteria with various population clusters.

Conclusion: The study is in progress and it is expected for obtaining more isolates from the gut of honey bees which will be identified for the first time. The next step for the current study is the metagenomic analysis.

Keywords: Honey Bees, honey, *Apis dorsata*, pollination, bee gut, bacteria.

BEE-BK-406

Multienzyme and Antibacterial Potential of Bacteria Isolated from Gut of Asian Honey Bee (*Apis cerana Indica*) using Culture Dependent Method

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Abstract:

Introduction: The bacteria residing in the gut of honey bees (HB) has demonstrated a significant role in protecting bees against various pathogens, production of honey and wax. However, no information exists about the antibacterial potential of bacterial isolates from gut of Asian HB, *Apis cerana indica* F. (Hymenoptera: Apidae), against human pathogens. This study aims to investigate the antibacterial and multienzyme potential of aerobic bacteria from *A. cerana* gut using culture dependent approach.

Methods: A total of 12 HB gut bacteria were characterized morphologically and biochemically. These strains were further screened for their antimicrobial activity against pathogenic human microorganisms *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Bacillus licheniformis* and *Bacillus*

🕒 **May 20, 2021**

Institute of Plant Protection

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subtilis using cross streak (primary screening) and agar well diffusion methods (secondary screening). Preliminary characterization of cell-free supernatant (CFS) of two promising isolates was performed by measuring lactic acid concentrations, enzymatic digestion of antimicrobial compounds, stability over a range of temperature, pH and amplification of *spaS* (subtilin) and *spoA* (subtilosin) genes.

Results: In primary screening, among 12 HB isolates, eight strains showed statistically significant highest zones of inhibition ($p \leq 0.05$) against *E. coli*, *K. pneumoniae* and *P. aeruginosa*. 16S rRNA sequencing revealed that *these isolates belong to Bacillus genus*, identified as *B. tequilensis*, *B. pumilus*, *B. xiamenensis*, *B. subtilis*, *B. amyloliquefaciens*, *B. safensis*, *B. licheniformis*, *B. altitudinis* (Accession numbers: MT186230-MT186237). Secondary screening revealed that among eight isolates, *B. subtilis* and *B. amyloliquefaciens* showed statistically significantly strong inhibition ($p \leq 0.05$) against all tested pathogens. Antibiotic susceptibility testing revealed that both isolates were resistant to antibiotics and possesses proteolytic, lipolytic and cellulolytic activities. The nature of the compound causing inhibitory activity was found to be proteinaceous and showed stability over a wide range of temperature as well as pH. PCR study confirmed the presence of bacteriocins by successful amplification of important antimicrobial peptide biosynthesis genes *spaS* and *spoA*.

Conclusion: These results suggest that the HB gut is a home to bacteria that possess antimicrobial activity and important enzymes with antimicrobial potential. To our knowledge, this is the first report demonstrating the antimicrobial potential of bacteria isolated from gut of HB (*A. cerana*) against human pathogens.

Keywords: honey bees, gut microbes, antimicrobial activity, *B. amyloliquefaciens*, *B. subtilis*, *A. cerana*

BEE-BK-407

Queen Cells Acceptance Rate and Royal Jelly Production in Worker Honey Bees of Two *Apis mellifera* Races

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Abstract:

Introduction: Royal jelly (RJ) is an acidic yellowish-white secretion of worker honeybee glands, used as food material of worker bee larvae for the first three days and queen bee larvae for the entire life. It is commercially used in cosmetics and medicinal industry in various parts of the world.

Methods: This study determined the queen cell acceptance rate and RJ production difference among Italian and Carniolan bee races. Furthermore, the effect of plastic cup cell priming media, diets and seasons were tested on the larval cell acceptance rate and RJ yield of both races.

Results: The results indicated that average queen cell acceptance rate was significantly ($p < 0.001$) higher in Italian race ($75.53 \pm 1.41\%$) than Carniolan race ($58.20 \pm 1.30\%$). Similarly, mean RJ yield per colony significantly ($p < 0.001$) differed between both bee races, which were 13.10 ± 0.42 g and 9.66 ± 0.43 g, in Italian and Carniolan races, respectively. Moreover, priming media, diets and seasons significantly ($p < 0.001$) affected queen cell acceptance rate and RJ production of both bee races.

Conclusion: This study would help breeders to select the bees with higher-level of queen cell acceptance rate and RJ production in the future.

Keywords: Managed honeybees, hypo-pharyngeal glands, queen bees, royal jelly, bee strains

BEE-BK-408

Effects of Supplementary Feeding on the Health of *Apis mellifera* Population

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Abstract:

Introduction: Winter is the greatest challenge to honey bee colonies as they suffer greatly from a shortage of nectar sources and unsuitable conditions for foraging in temperate zone. Poor pollen nutrition negatively affects individual honey bee health as well as colony performances rendering bees less resistant to other stressors such as pesticides and pathogens. Thus, beekeepers need to feed bees with supplementary diet alternatively mainly composed of sugar syrup, sucrose inverted syrup and starch syrup or high-fructose corn syrup. This study was aimed to establish the standard formulation of supplementary diets for *Apis mellifera* population and to observe the effects of supplementary diet on the health of brood production.

Methods: This study was conducted from November to March 2021 at KUST Bee farm, twelve (12)

🕒 May 20, 2021

Institute of Plant Protection

MNS University of Agriculture, Multan-Pakistan

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honey bee colonies were divided into 3 subgroups and treated with selected supplementary diet. Sugar syrup was used as a control diet. The artificial diets were prepared in cake form. Soya bean feed (F1) was constitute approximately 30% defatted soya bean flour, 10% brewer's dried yeast and banana feed (F2) was comprised of 30% banana pulp and 7% honey presented at the top bar of the hive to each colony every 3 days for 20 weeks.

Results: The results revealed that there was a marked increase in sealed brood areas and adult bee population sizes in colonies provided with F2 diet as compared to F1 diet and control colonies.

Moreover, colonies fed with sugar syrup only (control group) fluctuated throughout the study period and by the end sealed brood areas and adult bee population sizes were between the colonies fed supplemental diet for different periods.

Conclusion: The results suggested that artificial Banana diet is an ideal protein supplement formulation, which could effectively replace pollen, has the potential to improve brood development and their health during winter. Beekeepers and other stakeholders of beekeeping sector to overcome the losses of honey bees in winter due to nutritional deficiencies. Further work is needed to understand in more detail the relationship between nutrition and stressors in honey bee.

Key words: *Apis mellifera*, supplementary diet, banana pulp, soya bean flour, honey

BEE-BK-409

Small Hive Beetle (SHB), *Aethina tumida* Murray: An Invasive Pest of Honey bee

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Abstract

Introduction: Small hive beetle (SHB), *Aethina tumida* Murray, (Coleoptera: Nitidulidae) is an invasive pest of honeybees colonies in South Korea. Temperature is one of the dominant abiotic factors determining survival, development, and reproduction of the insects. This information can be used to predict an insect's geographic distribution and potential outbreak.

Methods: Development and reproduction of SHBs were tested against a range of constant temperatures.

Results: Analytis-3/Briere-1 and Sharpe and DeMichele model best described immature's development and longevity of adults, respectively. Polynomial models were best suited for the survival of immatures and fecundity of adults.

Conclusion: Moderately higher temperatures are most suitable for the performance of SHB's immatures and adults which matches with temperature inside honey bee's hive.

Keywords: Invasive pest, developmental model, developmental threshold, and degree days.

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BEE-BK-410

Correlation of Greater Wax Moth (*Galleria mellonella* L.) in Colonies of Honeybees (*Apis mellifera* L.) with Weather Factors

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Abstract:

Introduction: Destruction of honeybee colonies has been increased alarmingly in recent past years round the world. Reason for this loss is not sole. Several factors and their interactions have been considered responsible. Despite abiotic factors, few biotic factors like predators and parasites plays a significant role in destruction of honey bee colonies. The greater wax moth, *Galleria mellonella* L. causes significant losses to beekeeping industry.

Methods: This study was conducted to measure losses of this pest and its relation to different environmental factors. Seasonal incidence of *G. mellonella* in colonies of honeybees is determined all through the year.

Results: Seasonal abundance revealed that maximum infestation was recorded during dearth period i.e. November to mid of March in contrast to the other seasons of the year. The peak incidence (14.8 ± 3.90) was recorded in August. Multiple correlation analysis was selected to estimate association between explanatory variables (weather factors) and incidence of the wax moth and stepwise regression analysis was used to find best explanatory variable. Minimum and maximum temperature had a highly significant regression coefficients of 1.042 and -0.802. These both were selected in the stepwise (backward and forward) regression analysis as the best suited explanatory variables.


Conclusion: The results of the study can be used in designing an integrated pest management strategy against the greater wax moth by knowing about active and inactive period.

Keywords: Greater wax moth, seasonal incidence, seasonal abundance, stepwise regression, and weather factors.

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BEE-BK-411

Problems and Challenges in Scaling up Apiculture Sector in Pakistan

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Abstract:

Introduction: Honeybees are the only insects which produce human food of therapeutic, medicinal, nutritional and cosmetic value and have been quoted in Holy Quran as “There emerges from their (Honeybees) bellies a drink, varying in colors, in which there is healing for people. Indeed, in that is a sign for a people who give thought” (16:69). Beekeeping is an important entrepreneur in Pakistan engaging 35000 beekeepers. There are more than 30,000 beekeepers, producing 12,000 metric tons of honey annually. In 1970s, Italian bees were imported from Australia in Pakistan, acclimatized in local conditions and people were trained to do beekeeping under different projects. Honeybees produce a lot of products like honey, pollen, royal jelly, bee venom and propolis. However, beekeeping is not flourishing in the country at rapid pace due to many reasons. These reasons include; lack of modern processing equipment, tools, machinery and testing equipment across the value chain especially at producer/processor side damage the quality, purity and physical characteristics of honey at very initial stage, poor product standardization, packaging and access to market efforts, lack of food safety, organic and quality assurance standards restricting our exports to low-end trader's markets where most of the honey sold at wholesale price, lack of strategic marketing of this high-value sector carrying tremendous economic potential and employment opportunities and lack of formal exports to international markets (most of the honey exported to GCC countries under animal feed code as a molasses).

Conclusion: We need an integrated approach involving all stakeholders to improve whole value chain of beekeeping in Pakistan.

Keywords: Beekeeping, honey, honey bee, royal jelly.

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BEE-BK-412

Contribution of Beekeeping in Sustainable Development Goals: A Review

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Abstract:

Introduction: Beekeeping is an activity that maintains the honeybee colonies in man-made bee hives. Beekeeping is a great source of income for many beekeepers all around the world. Sustainable development goals (SDGs) are designed to benefit the human beings from the available natural resources.

Methods: The present study aims to review the contribution of beekeeping towards Sustainable development goals (SDGs) from the published literature.

Results: Beekeeping significantly contributes in achieving all sustainable development goals (from 1 to 17) (agreed upon by all the countries of the world). Honeybees contribute a lot in feeding the population of world. Beekeeping provides benefits to the farmer, agriculture and also for the environment. Beekeeping helps in maintaining the biodiversity which contributes towards maintaining the ecosystem. It also helps in providing new jobs to poor and small scale farmers which creates a great source of income for backward families which elevate poverty in local areas. Furthermore, it also helps in growing good quality food and plays a great role in zero hunger. Beekeeping also promotes gender equality by women empowerment through beekeeping.

Conclusion: Beekeeping contributes towards all sustainable development goals (from 1 to 17) as honeybees are an important part of our ecosystem. From maintaining biodiversity to food security, beekeeping is very beneficial for the environment and humankind. It is important to understand and appraise their role towards benefiting our ecosystem.

Keywords: Biodiversity, honeybees, poverty Elevation, zero hunger, women empowerment

 **May 20, 2021**

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BEE-BK-413

Aptness of Some Basic Factors Affecting the Results of Instrumental Insemination of Honeybee Queens *Apis mellifera* under Lab Conditions

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Abstract:

Introduction: In Pakistan very little number of *Apis mellifera* L. queens is inseminated annually. In rest of world more 12000 queens are instrumentally inseminated. Many factors influence the number of spermatozoa entered in the spermatheca. These factors include the age of the queen, semen dosage, and the pre and post-insemination care of queens during mass production, after insemination, queens are generally kept in mailing cages with a low number of workers. In some countries, during the pre- and post-insemination periods, queens are stored in nursery colonies in screened cages without workers. Though not optimal for sperm migration, these practices substantially reduce costs

Methods: We analyzed 48 *A. mellifera* L. Larvae, less than 1 day old, were grafted to rear queens. The queens were stored in queen banks for the first 5 days following eclosion, in cages without bees. Subsequently, the queens were divided into the following five groups: 1. Queens held at 20 °C in mailing cages with 15 workers (15W-20 °C); 2. Queens held at 20 °C in mailing cages with 25 workers (25 W-20 °C); 3. Queens held in an incubator at 34 °C in mailing cages with 15 worker bees (15 W-34 °C); 4. Queens held in an incubator at 34 °C in mailing cages with 25 workers (25 W-34 °C); 5. Queens held in nursery colony banks, individually caged without bees. The queens were inseminated at the age of 7–9 days post emergence, with semen collected from *Lingusitica* drones. Some of the queens in each group were inseminated with semen only (8 µl), others were inseminated with semen and 2 µl of a saline solution (8 µl + 2 µl S). The saline contained 0.9 % NaCl.

Results: This study shows how the addition of a saline solution to drone semen and the pre- and post-insemination care of honey bee queens affect both the number of sperm in the spermatheca and the condition of the oviducts. Queens were instrumentally inseminated and stored under various conditions. These conditions included being held in mailing cages with 15 or 25 workers in which all were kept at 20 °C or 34 °C, and being held in nursery colonies in which the queens were caged without worker bees. Some of the queens in each group were inseminated with semen only; others were inseminated with semen and saline. The number of spermatozoa in the spermatheca did not significantly differ between the queens inseminated with semen only and those inseminated with semen and the saline solution.

Conclusions: The queens kept in mailing cages with workers had significantly more spermatozoa than those queens banked in cages without worker bees. The addition of a saline solution to semen, and the

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conditions the queens were stored in, did not significantly affect the condition of the oviducts.

Keywords: Honeybee queens, instrumental insemination, oviduct, spermatheca, spermatozoa.

BEE-BK-414

Hemolytic Activity of Pathogenic Bacteria, Erythrocyte Membrane Protection and Immune-Stimulatory Effects of Saudi Honeys

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Abstract:

Introduction: Bacterial pathogens are a challenge to humans by spreading numerous diseases and have become a serious threat to immune-compromised patients in recent years, and are getting resistance against commercial medicines. Honey is a well-documented natural substance with high medicinal properties, and these benefits are due to the presence of polyphenols and flavonoids. The present study was designed to investigate; (i) the hemolytic activity of pathogenic bacteria, to measure (ii) the red blood cell (RBC) membrane protection effect, and to investigate (iii) the immunostimulatory effects of Saudi honeys.

Methods: Hemolytic activity of pathogenic bacteria and erythrocyte membrane protection effect was measured by liquid hemolysis assays while the immuno-stimulatory effect of a honey sample was

 **May 20, 2021**

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tested in murine splenic cells by measuring cell viability.

Results: All the studied bacteria exhibited hemolytic activity on cow RBCs higher than 10%. Hundred percent erythrocyte membrane protection was observed for each tested honey sample through diluted (20% v/v), and concentrated honey samples. All the tested bacteria had hemolytic activity and were pathogenic. Saudi honey samples exhibited 100% erythrocyte membrane protection effects.

Conclusion: Saudi honey has an immunostimulatory effect and could boost the immune system.

Keywords: Bacteria, immunity, hemolysis, RBC membrane protection

BEE-BK-415

Reproduction of *Tropilaelaps clareae* Mites in Worker Brood Cells of Honey Bee (*Apis mellifera*) Colonies

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Abstract:

Introduction: The honey bee apiaries are the most suitable habitat for the reproduction of the *Tropilaelaps clareae*. The successful and fast life and serious damage of this mite species is reviewed and their losses to honey bee colonies (apiculture) are increasing day by day. Similarly, the diseases which are caused by the mites are also in increasing trends in bee hives. The mites in the genus *Tropilaelaps* are parasites of honeybee brood. Feeding on bee larvae and pupae causes brood malformation, death of bees and subsequent colony decline or absconding. Development requires about 1 week, and the mites are dispersed on bees.

Methods: To study the reproduction of the mites in apiaries, females both (founders and sisters) were

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collected from the apiaries and categorized into different groups (founders and daughters) and inoculated immediately (one person collected mites while another inoculated mites) into a frame of brood containing 4th instar larvae and capped with gelatin caps.

Results: Overall, 78% of the new daughters that had no egg-laying experience and 84% of the foundresses that had or had not laid previously reproduced. Both inoculum daughter and founders' mites were collected from tan-bodied pupae and inoculated immediately. So it is concluded that phoresy is not required for reproduction in *Tropilaelaps* mites. The ability of virgin females to lay both males and females (deuterotoky), and to reproduce without spending a phoretic period on adult bees may play major roles in *Tropilaelaps* mites' competitive advantage over *Varroa* mites in *Apis mellifera* colonies.

Keywords: Apiaries, *Apis mellifera*, honey bee pests, mites, *Tropilaelaps*

BEE-BK-416

Susceptibility of Honeybee, *Apis mellifera* to some Neonicotinoid Insecticides under Laboratory Conditions

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Abstract:

Introduction: Susceptibility of European honeybee, *Apis mellifera* L. to commonly used neonicotinoids were observed under controlled laboratory conditions. Neonicotinoids are most commonly used insecticides in almost all kind of field crops, also visited by insect pollinators especially honeybees.

Methods: Wet surface and oral feeding methods were used to test the susceptibility of newly emerged *A. mellifera* worker bees under laboratory conditions. Honeybee workers were collected from unexposed honeybee colony during the study period which was kept in University premises for three months prior to experiment.

Results: Imidacloprid was the most toxic insecticide when applied through wet surface method followed by Thiamethoxam and Acetamiprid. Nitenpyram and Thiachloprid were the least toxic insecticides with no dead bees found after 3 hours of exposure to thiachloprid and 6 hours of exposure, respectively. Acetamiprid and Imidacloprid were more toxic to the worker bees after 24 and 48 hours wet surface exposure than Thiamethoxam whereas Nitenpyram was the least in all. The oral application of Thiamethoxam, Imidacloprid and Acetamiprid proved them more toxic followed by Thiachloprid and Nitenpyram after 3 and 6 hours exposure period. However, Thiamethoxam was the most toxic after 24 and 48 hours followed by Thiachloprid, Imidacloprid, Acetamiprid and Nitenpyram.

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Conclusion: Wise and timely use of these commonly used neonicotinoid insecticides is getting more importance because of their increased applications for the control of different sucking insect pests on different crops.

Keywords: Neonicotinoid insecticides, worker bees, susceptibility, dry and wet surface exposure

BEE-BK-417

The Livelihood Impacts of Apiculture Integrated with Aquaculture

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Abstract:

Introduction: There is link between the pond and surrounding land for house hold farming. Apiculture and integrated aquaculture systems has potential towards improving livelihoods and poverty alleviation. Apiculture (or beekeeping) is the practice of honeybee management in hives for pollination and the production of honey and other products, such as wax, royal jelly and pollen. Lack of knowledge is a particular problem for farmers growing fish, honey bee and vegetables in the rural areas. Fish and honey bee disease, high price of input, lack of money are identified as constraints by producers. Ponds are relatively more important as a source of irrigation water in rural than in peri-urban communities.

Methods: The adoption of BMBs is the foundation of all disease control programs, irrespective of the animal species. Training programs are needed for females for the improvement of economic situations.

Results: The role of the pond for family use, which is a major objective for pond construction, was found to be significantly different between rural and peri-urban areas. Aquaculture and apiculture for households irrespective of their focus on vegetable, orchard or fish production and they are utilized less for general domestic use.

Conclusion: If biosecurity measures are properly implemented, it is possible to reduce the incidence of disease and, hence the need to apply treatments, to an absolute minimum. Economically, beekeeping and aquaculture may increase income of low income families. Training had to be gender based for sustaining livelihood.

Keywords: Disease management, aquaculture, apiculture, livelihood

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BEE-BK-418

Impact of Low Temperature on Honey bee Developmental Stages

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Abstract:

Introduction: Pollinators are becoming increasingly vulnerable as a result of human actions and global warming. According to some estimates, the world's average temperature would rise by 0.3°C to 4.8 °C during the twenty-first century. The importance of the pollen activities of beekeepers and their products is well known. Honey bee colonies, on the other hand, are currently facing numerous challenges. These difficulties are caused by both biotic and abiotic causes. Internal activities of honey bees, i.e. inside the colony, include brood parental care, food storage, and homeostasis, which regulate the internal colony temperature to a comfortable level.

Methods: To determine the effect of different temperatures levels at different life stages, the honey bee's colony was exposed to 20-25°C for 24, 48, 72 and 96 hours. This experiment was carried out at different developmental stages of honeybees under laboratory conditions.

Results: The results showed that duration was significantly affected with the temperature changes while mortality showed no significant effect. Life durations were longer at minimum temperature with worker adult's longevity increased and mortality was observed maximum.

Conclusion: Effects revealed that larvae and pupae stages showed resistance against low temperature while pre pupae stage was the most vulnerable. These results suggested that effect of low temperature on honeybees could be provided important information about management of honeybees.

Keywords: Honeybees, temperature, adult longevity, development

BEE-BK-419

Determination of Oral and Dermal Toxicity of Different Concentrations of Acetamiprid on Mortality of *Apis mellifera*.L (Hymenoptera, Apidae)

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Abstract:

Introduction: Among insects, the honey bees are very important because of their multi beneficial functions like pollination and honey production. They are also known as environmental indicators of high sensitivity. In addition to honey production, they are also economically and ecologically important in their contributions as pollinators of crops. In agriculture fields, honeybees are readily exposed to insecticide applications during their foraging activities. It is important to study the effect of insecticides on bees to make a judicious policy for insecticide applications.

Methods: The research study was directed to check the dermal toxicity and oral toxicity of different concentrations of acetamiprid on mortality of *Apis mellifera* (Hymenoptera, Apidae). For this study honey bees were collected from the colonies of research area and transported to the laboratory and kept in experimental cages in a proper way avoiding them contamination to other diseases also. In laboratory tests were conducted using cages of 20x20x30 cm with the bottom and four opposing walls. Once equipped with the necessary materials for the tests, the cages were closed with a nylon net lid, which were never detached during the test. Honey bee release and all other activities were done through a circular opening in a wall net of cages.

The stock solution of acetamiprid was prepared with three concentrations 25 ppm, 50 ppm, and 100 ppm. Each concentration was replicated three times for dermal as well as oral test.

a) For dermal evaluation, the concentrations of acetamiprid were applied as a contact poison. For this it was sprayed directly on the walls of cages for contact purpose. Sucrose solution was added in petri dishes along with soaked cotton swab for dermal feeding purpose. Additionally, moisture content was maintained by providing water in petri dishes along with cotton swab in each replication and control treatment. The diet was changed after 12, 24, 48, and 72 hours of application. The data was recorded after 12, 24, 48, and 72 hours of application. Mortality percentage was determined against all three concentrations of acetamiprid and data was preceded for further statistical analysis. b) For oral evaluation, the amount of prepared solution was mixed with sucrose and applied on cotton buds placed in experimental cages and the equal number of bees was left to feed. Each experimental cage was consisted of 12 individuals. The concentrations of acetamiprid were applied as a systemic poison. Additionally, moisture content was maintained by providing water in petri dishes along with cotton swab in each replication and control treatment. The diet was changed after 12, 24, 48, and 72 hours of application. The data was recorded after 12, 24, 48, and 72 hours of application. Mortality percentage was determined against all three concentrations of acetamiprid and data was preceded for further statistical analysis.

Corrected percent mortality of honey bee was calculated by Abbott's formula. $\text{Corrected \% mortality} = (1 - n \text{ in T after treatment} / n \text{ in Co after treatment}) \times 100$ Two factor factorial under complete randomized

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design was used to analyse the data of mortality of honey bees. Means were compared by Tukey HSD all pairwise comparison test using statistics 8.1 software. $P < 0.05$ was considered as significant difference. LC_{50} were determined by using probit analysis and simple linear regression was performed.

Results: The aim of this study was to investigate the oral and dermal influence of different concentrations of acetamiprid on mortality of honey bees under laboratory conditions. Three concentrations of acetamiprid (25, 50 and 100 ppm) with three replications of each oral and dermal were applied and data was recorded after 12, 24, 48, and 72 hours of acetamiprid applications. The maximum dermal mortality having LC_{50} value of 77.090 with prolonged exposure of time (72 h) and with greater concentration of acetamiprid (100 ppm) was $84.44 \pm 3.95\%$ and $74.08 \pm 3.42\%$ respectively. While minimum dermal mortality with lower concentration of acetamiprid (25 ppm) was 42.19%. Similarly, the maximum oral mortality having LC_{50} value of 67.608 with prolonged exposure of time (72 h) and with greater concentration of acetamiprid (100 ppm) was $82.32 \pm 4.10\%$ and $71.27 \pm 3.56\%$ and the lowest oral mortality with lower concentration of acetamiprid (25 ppm) was 39.76% respectively. This study is helpful for the bee keepers that they should keep their colonies away from pesticides areas and minimize the direct exposure of bees to the chemicals.

Conclusion:

Present study showed that with the passage of time mortality of honey bee increases and with the exposure of greater concentration of acetamiprid the mortality was greater. It may include the novel mode of action of acetamiprid that blocks the nicotinic acetylcholine receptors which is the main cause of death. Results also showed that at least minimum exposure of acetamiprid to bee causes ultimately death of honey bee.

Keywords: *Apis mellifera*, acetamiprid, toxicity

BEE-BK-420

Toxicity of Some Insecticides to the Haemocytes of Domesticated Honeybee, *Apis mellifera* (Hymenoptera: Apidae) under Laboratory Conditions

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Abstract:

Introduction: Insect pollinator's population is influenced to a large extent by application of pesticides as well as changes in climate recently. Furthermore, contamination of bee flora with insecticides residue is

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an additional cause of bee mortality.

Methods: Current study was carried out to assess the toxicity of insecticides on the haemocytes of honey bee *Apis mellifera* under standard laboratory conditions. Quantitative analysis of total and differential counts of haemocytes as well as abnormalities were determined under laboratory conditions for larvae, pupae and adult workers of domesticated, *A. mellifera*. Haemolymph of *A. mellifera*. The samples of haemolymph were assessed immediately, half an hour and one hour after exposure of selected insecticides applied at recommended field doses.

Results: Total count of haemocytes was found significantly maximum in larval and pupal stages while lowest in adult workers but differential counts of haemocytes remained insignificant. Insecticides exposure, resulted in variation of total haemocytes count for tested insecticides such as increased in Diafenthiuron, Ethofenprox and Imidacloprid immediately after application however, these count dropped after sixty minutes of application for all tested insecticides. The granulocytes and plasmatocyte numbers increased in all stages of *A. mellifera* after application of insecticides for differential counts of haemocytes. Such studies may assist in type of defense mechanisms in insect when exposed to external dangers for example exposure to insecticide. Haemocytes immune response to insecticides exhibited abnormalities of various degrees such as denucleation, distortion of cell shape and agglutination.

Conclusion: Findings of studies may help in possible identification of defense mechanisms of insects against their exposure to external hazards for instance insecticide exposure.

Keywords: *Apis mellifera*, haemocytes, insecticides, immune response

BEE-BK-421

Determination of Effect Processing and Time Period on Physicochemical Properties of Sedit and Acacia Honey from *Apis mellifera*

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Abstract:

Introduction: Honey is a sweet viscous fluid made mostly from the nectar of plants and is among the

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major bee products. Honey is widely used in the food, medicines, and sweetening. It is produced in a lot of countries of the world and it is important source of the energy. Honey composition and quality depends upon various factors such as weather condition during honey production, composition of nectar, beekeeping practices and handling method during honey extraction and storage.

Methods: The present study was conducted in the honey analysis laboratory Honeybee Research Institute, Islamabad on the following parameters. Water content, pH, Electrical conductivity, pollen test, reducing sugar, apparent sucrose and Ash determination by given methods. The official method of analysis of association of official analytical chemists, the harmonized method of the European honey commission and the moisture content of honey is the only compositional criteria, which has to be met as honey standard and is regulated for safety against fermentation for all world trade honeys. *Apis* bee operculate the combs only when the honey moisture content ranges between 17%-18%. The moisture content influences some important characteristics of honey, such as viscosity and Brix.

Results: From the analysis of different samples it is clear that the moisture content varies from 17 to 19%, brix 76 to 81%, density quality was 41 to 43, while taste was good and color was light to strong yellow. While when the emulsible concentration was checked it was found 0.63 to 0.81, which shows the good quality of the honey.

Keywords: Sedit, acacia, *Apis mellifera*, physicochemical properties

BEE-BK-422

Role of Beekeeping in Food Security: A Review

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Abstract:

Introduction: Pakistan, the world's sixth most populated nation, is located in South Asia. It has a variety of ecosystems and has a diversity of natural flora in different areas. Beekeeping has many relative advantages and provides help for farmers to develop their livelihoods and ensure food security in Pakistan. Beekeeping not only offers direct employment opportunities, cash revenue, and food in rural areas, but it also improves the agricultural production of diverse crops by honey bee pollination. It is essential not only for honey, but also for other hive products like bees wax, propolis, bee venom, and royal jelly and these products add essential nutrient, vitamins and minerals which are beneficial for the nourishment of human beings.

Results: Many vegetables, fruits and nuts crops benefit directly from their pollination services. Due to

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climate change, the health of honey bees colony and wild bees has deteriorated over the last decade, jeopardizing our food protection. Nearly 795 million people is infected with protein deficiency and chronically lack of adequate calories and 2 billion peoples are suffering with micronutrient deficiency which is commonly known as hidden hunger. These problems are arising due to bee's pollinator's reduction in worldwide. It also contributes to the feeding of many other species in the food chain, as well as the genetic diversity in flowering plants. Low honey production is caused by a combination of factors including i.e. weather condition are not suitable, heavy use of pesticides, climate change, air pollution, pathogen, habitat destruction of bees due to urbanization and global warming.

Conclusion: In order to overcome problems in beekeeping, provision of proper habitats to the beekeepers and creating awareness among the general public about the importance of beekeeping and its role in food security.

Keywords: Beekeeping, bee hive products, food security, weather condition

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Importance of Honey bees in Crop Pollination

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Abstract:

Introduction: In the USA, more than 100 crops are pollinated by bees. Crops and fruits that require pollinators are sunflowers, apples, watermelon, almond, kiwi, squash, plum, alfalfa, cucumber and many more cultivars of peach, apricot, citrus and strawberry. Insect pollinators are required for the successful development of hybrid seeds or seeds and fruits. Farmers import colonies of the honeybees for pollination requirements. Female workers of honeybees are one of the insect species that gather pollen for their larvae to eat. They have evolved physical characteristics that make it easier for them to gather pollen over time. Recently, scientists introduced honeybees into Brazil from Africa for the improvement of crop pollination. Lucky in Brazil, these honeybees were best suited in the environment and colonize and hybridize with the European honeybees and enhance their defense system against invaders. In the end, these bees now spread from South America to Central America and improve crop pollination and production. Studies have shown that the color of sepals and petals attract the pollinators and as a result the yield and productivity of crops is increased. A positive correlation is present between bee visitation, nectar production and yield.

Keywords: Pollinator, conservation, biodiversity, ecosystem services

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