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**Institute of Plant Protection
MNS-University of Agriculture,
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Everyday a plant faces plenty of challenges of biotic factors including insect pests, diseases, competition of weeds and several abiotic stresses. Smart Plant Protection is critical to secure and maintain crop productivity. Pesticide-dominated control strategies are threatened by the widespread evolution of resistance in many major crop pests, whilst regulation to limit the unintended environmental and human health impacts of pesticides is reducing control options therefore there is an urgent need for innovation in crop protection.

The Smart Plant Protection conference is designed to address these challenges by bringing the latest technology to bear on improved detection, monitoring, prediction, and control of biotic threats. We focus on understanding the mechanisms, genetics, ecology, evolution, and management of crop-pest interactions. The SPP platform would highlight the need for crop protection strategies that enable more targeted interventions, using a systems-based approach that integrates chemical, genetic and agroecological approaches. The participants would develop a vision to reduce pesticide use, limit evolution of pesticide resistance and to design integrated and evidence-based approaches that deliver innovation in crop protection, limit unintended negative environmental impacts and secure the long-term productivity of agroecosystems.



Aims & Objectives

The International Conference will provide insight into innovations and advances in Plant Protection, aiming to protect the plant resources from the invasion and infestation of insect pests, plant pathogens and weeds. The conference would provide a collection of innovative ideas and recent research undergone by students, academia and industrialists, world over. A pool of thought-provoking opportunities would enable networking and provide opportunities for collaborations and alliances on plant protection; stimulate and facilitate discussions and dialogues between stakeholders like scientists, researchers and practitioners including policy makers, business, civil society, and farmers.

Prospective authors across the globe have contributed through submissions of their research abstracts, papers, and e-posters. High quality research contributions describing original and unpublished results of conceptual, constructive, empirical, experimental, or theoretical work in all areas of Plant Protection are cordially invited for presentation at the conference. The conference solicits contributions of abstracts, papers and e-posters that address themes and topics of the conference, including figures, tables, and references of novel research materials.

MAIN THEMES OF SPP CONFERENCE

1. INSECT PEST MANAGEMENT

1. IPM - Integrated Pest Management
2. Migratory Pests and Biosecurity
3. Pesticide application and Management
4. Biopesticides/Microbial/Natural pesticides
5. Biodiversity of pests
6. Conservation of beneficial insects
7. Innovative techniques in Plant protection
8. Climate change and **insect pest management**
9. Resistance

2. PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

1. Innovative techniques
2. Population's genetics
3. Induced Plant Immunity
4. Invasive and Emerging Plant Diseases under changing climate
5. Plant-microbe interactions
6. Recent trends in Plant Disease Management
7. Role of Plant Pathology in Global Economy
8. Disease modeling
9. Resistant sources
10. Postharvest pest management

3. WEEDS MANAGEMENT

1. Weeds as risk to food security
2. Alien invasive weeds
3. Weeds role in conserving pathogen and insects
4. Weedicide Resistance
5. Allelopathic weeds

4. BIOTECHNOLOGY FOR PLANT PROTECTION

1. Biotechnological tools for pest management
2. Endophytes and plant protection
3. Genome editing
4. Innovative approaches for plant protection

KEYNOTE SPEAKERS



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CEO RiseAG

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Department of Entomology
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Prof. Dr. Tariq Mukhtar
Chairman, UAAR

Dr. Naveed Malghani
IUB

Dr. Muhammad Inam-ul-Haq
Professor, Department of Plant Pathology,
PMAS Arid Agriculture University Rawalpindi

Dr. Azhar Iqbal
Chief scientist, institute of plant protection,
Ayub Agriculture Research Institute, Faisalabad

INTRODUCTION TO

Institute of PLANT PROTECTION

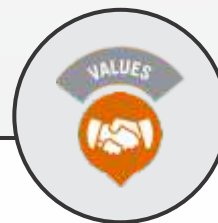
The foundation of teaching and research in Entomology and Plant Pathology in Southern Punjab was laid with the establishment of the MNS-University of Agriculture Multan in 2012. Based on Plant Pathology, Entomology and Weed Science, Institute of Plant Protection (IPP) was established in 2019. We owe to our distinction, the dedication to excellence in research and teaching, therefore attracting many students at undergraduate as well as postgraduate and doctoral levels. The main thrust of IPP is the application of plant protection measures and techniques in identification, characterization of newly emerging and reemerging pests and to devise their management strategies for food security. The Institute has inherited ties with local research institutes like CCRI, CRS, MRI, AMRI, Agri. Extension, Pest Warning and Quality Control of Pesticides etc. These links will pave the path in grooming the students at the Institute in a professional and practical way. Several research projects have been submitted to renowned funding agencies of National and International like USAID, Higher Education Commission (HEC), Pakistan Science Foundation, Pakistan Agriculture Research Board (PARB), International Foundation for Science (IFS), ACIAR and JICA. Moreover, five research projects have been funded by PARB, HEC and IFS on Cotton Whitefly and Pink bollworm, Mango Fruit and Shoot Borer and Mango Fruit Fly, and viruses of onion, garlic, and cucurbits respectively. Currently, active programs are B. Sc. (Hons.) Agriculture (Entomology & Plant Pathology), M. Sc. (Hons.) Entomology, M. Sc. (Hons.) Plant Pathology, Ph. D Entomology and Ph. D Plant Pathology.



Developing an integrated system of research and outreach for plant protection.

Mission of Institute of Plant Protection

Uplifting the agricultural community through enhancing agricultural productivity by minimizing losses caused by insect pest complex and diseases using modern and environmentally friendly measures, stabilizing the natural ecosystem.



Goals of Institute of Plant Protection

- Development of human resources equipped with modern innovative technologies to manage and control insect pests and disease-causing organisms.
- Introducing eco-friendly approaches for effective management of biotic stresses.
- Offer diagnostic services to public and private sector organizations and farming communities.
- Ensuring sustainability of the natural agro-ecosystem promoting biological control of insect-pest complexes and diseases.

Patron in Chief

Prof. Dr. Asif Ali (T.I.)
(Vice Chancellor)

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Prof. Dr. Shafqat Saeed
Prof. Dr. Muhammad Ashfaq

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Responsibilities:

Designing of Publishing material (brochures, invitation cards, folders, and other relevant material)

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Dr. Amar Matloob	A.P. Agronomy
Dr. Abdul Razzaq	Dir. IT
Dr. Akhtar Hameed	A.P. IPP
Mr. Mahr Riaz	PRP
Dr. Mirza Abdul Qayyum	A.P. IPP Secretary

Invitation Committee:

Responsibilities:

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Dr. Amar Matloob	A.P. Agronomy
Dr. Zulqarnain Khan	A.P. IPBB
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Responsibilities:

To arrange tools (software and hardware) and facilitate for online activity on the day of conference

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Prof. Dr. Muhammad Ashfaq	Professor IPP
Dr. M. Arshad Shakeel	Subject Expert
Dr. Mirza Abdul Qayyum	A.P. IPP
Dr. Naeem Iqbal	A.P. IPP
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Responsibilities:

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Dr. Muhammad Zeshan	A.P. IPP
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Responsibilities:

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Ms. Hafiza Tahira. Gul Lec. IPP
Dr. Fawad Zafar Ahmad Khan A.P. IPP
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Prof. Dr. Shafqat Saeed Dean FAES Convener
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Dr. Unsar Naeem-Ullah A.P. IPP
Dr. Fawad Zafar A. Khan IPP Secretary

KEYNOTE SPEAKER'S TALK

Safe control of red palm weevil

Fatma A. Mostafa

Senior Researcher , Integrated Pest Management, Plant Pathology Research Institute, Agriculture Research Center, Egypt

ABSTRACT

BACKGROUND: Date palm *Phoenix dactylifera* L is an important fruit crop in the palm family (Arecaceae) cultivated in the arid regions of the world including the Arabian Peninsula, Middle East, and North Africa since pre-historic times where it is closely associated with the life and culture of the people. Red palm weevil, *Rhynchophorus ferrugineus* (Olivier) is a key pest of date palm *Phoenix dactylifera* L and continues to spread among and within date palm plantation countries. In view of the loss of the date crop as a result of the infestation of the palm weevil, researchers do not hesitate to search for effective measures to control this dangerous pest. In view of the dangers that chemical pesticides pose to the environment, in addition to the development of pest immunity as a result of excessive use of pesticides, resorting to the integrated control method may become the best solution, starting with agricultural quarantine and agricultural operations to the use of biological control in which some fungi such as *Beauveria bassiana* mushrooms are used. *B. brongniartii*, *Metarhizium anisopliae*, *Purpureocillium lilacinum*, and recently *Lecanicillium (Verticillium) lecanii*. *Bacillus thuringiensis* var *Kurstaki*, as well as nematodes of the genus *Heterorhabditis bacteriophora*. Although biological control showed good results in combating this pest by using fungi, bacteria, and nematodes, whether the treatments were single or combined, the researchers always search for the best. The use of pheromones that attract insects to collect and kill them is one of the best measures so far. For the success of the use of pheromone traps, one must take into account the selection of the type of pheromone, as well as the type of bait that is appropriate for the insect, as well as the use of the appropriate color to attract the pest.

CONCLUSION: One study showed that using a black pheromone trap containing 100 g of dates can significantly enhance *R. ferrugineus* control efforts and can help considerably in reducing the red palm weevil's deleterious impact on date palm production. Scientists and researchers are still studying the best means of control to eliminate pests and preserve the environment.

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**2nd International
Conference on
Smart Plant
Protection**

THEME-1:

**INSECT PEST MANAGEMENT
Oral Presentation**

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-101

Role of Pakistani Students Graduated from Chinese Institutes in the Transfer of Technology under BRI with respect to Emerging Entomological Challenges and their Green Control in Agriculture

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ABSTRACT

BACKGROUND: Since the foundation of the Belt and Road Initiative (BRI), the world has witnessed a significant contribution of this flagship project in reaching the global sustainability goals of no poverty, zero hunger, good health, quality education, decent work, climate action, peace, justice, and strong institutions. Being a fundamental part of BRI, China Pakistan Economic Corridor (CPEC) is playing a vital role in poverty alleviation, educational upgradation, transfer of technology and business promotion, besides fighting against locust plague and COVID19 in Pakistan. Such remarkable cooperation between two brotherly countries and to benefit from a wide array of researchers and scientists motivated me to present an overview of current challenges in entomology and their green control under the umbrella of BRI in Pakistan. Moreover, how the Pakistani students graduated from Chinese institutes can play a crucial role (i) by acting as a bridge between Chinese and Pakistani peers (students, researchers, and teachers) to transfer technology and exchange faculty and students; (ii) future collaborative opportunities with Chinese organizations; and (iii) to fight against the invasion of insect pests through modern monitoring techniques in Pakistan.

CONCLUSION: The current situation of Fall Armyworm in Pakistan is a major threat to food security. For this, technology transfer pertinent to green control and sustainable approaches between BRI countries can play a crucial role in combating the emerging challenges and issues through collaboration with Chinese peers at respective organizations under the umbrella of CPEC, a flagship project of the Belt and Road Initiative. Overall, this work will highlight the importance of CPEC in terms of scientific research and academic exchange programs not only for the students at university but also for the newly appointed faculty.

Keywords: BRI, CPEC, Students, Exchange program, Mutual benefits, Working environment spirit

SPP-IPM-102

Chemotaxis response and age-stage, two-sex life table of the *Cheilomenes sexmaculata* (Fabricius) (Coccinellidae: Coleoptera) against different aphid species

Hafiz Muhammad Safeer¹, Aimen Ishfaq¹, Syed Muhammad Zaka¹, Alia Tajdar², Ahmad Saood¹, Zuraiz Ali Shah¹, Muhammad Shah Zaib¹, Khalid Abbas¹, Adeel Mukhtar¹, Muhammad Usama Altaf¹

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THEME-1:

INSECT PEST MANAGEMENT

ABSTRACT

BACKGROUND: The predacious coccinellid, *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae), is one of the most beneficial and identifiable predators of numerous soft-bodied and sucking insect pests of several crops.

METHODS: Biological parameters and the olfactory response of *C. sexmaculata* were investigated under laboratory conditions by providing three different aphid species i.e., mustard aphid (*Lipaphis erysimi*), citrus black aphid (*Toxoptera citricida*), and peach aphid (*Diuraphis noxia*) as a food source, by using an age-stage, two-sex life table.

RESULTS: The developmental period of immature stages of *C. sexmaculata* was shorter on *D. noxia* as compared to other tested aphid species. The adult longevity was longer on *D. noxia* and *T. citricida* while shorter on *L. erysimi*. Female fecundity was highest on *D. noxia* while lowest on *L. erysimi*. Life table parameters i.e., intrinsic rate of increase (r), finite rate of increase (λ), net reproductive rate (R_0), and gross reproductive rate (GRR) were maximum on *D. noxia* while minimum on *L. erysimi*. The mean generation time of *C. sexmaculata* was 20.90, 23.69, and 26.2 days on *D. noxia*, *L. erysimi*, *T.* and *citricida*, respectively. These results showed that the most preferred prey for the development of *C. sexmaculata* was *D. noxia*.

CONCLUSION: These findings were further confirmed from the olfactory experiment where *D. noxia* proved to be the most preferred prey as compared to other prey species. This study provides necessary information for mass-rearing of *C. sexmaculata* in relation to its prey which would be ultimately helpful for control of sucking pests in an environmentally friendly way.

Keywords: Zigzag beetle; *Diuraphis noxia*; *Toxoptera citricida*; *Lipaphis erysimi*; life table; olfaction

SPP-IPM-103

CCHamide2-receptor regulates feeding behavior in the pea aphid, *Acyrtosiphon pisum*

Sohaib Shahid, Yan Shi, Chunhong Yang, Jiangjie Li, Muhammad Yasir Ali, Guy Smagghe, Tong-Xian Liu,

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ABSTRACT

BACKGROUND: Neuropeptide CCHamide-2 is a recently discovered peptide presents in many arthropods and it is the ligand of the CCHamide-2 receptor (CCHa2-R), which is playing a regulatory role in diverse physiological processes, such as feeding, insulin production, lipid metabolism, growth, and reproduction, however, the function of this gene in aphids is still unknown.

METHODS: Here, we characterized and determined the presumed role of CCHa2-R signaling in the wingless pea aphid, *Acyrtosiphon pisum*. Quantitative real-time reverse transcription-PCR (qRT-PCR) revealed the expression levels of CCHa2-R transcripts in different development stages and different tissues, which indicates that the CCHa2-R expression was high in the first instar as compared to the upcoming nymphal instars and adult and was predominantly high in the brain.

RESULTS: The CCHa2-R transcript levels were significantly upregulated in starved aphids as compared to fed aphids. Moreover, RNAi knockdown by the injection of dsRNA— CCHa2-R significantly reduced the expression and reduced their food intake in adult aphids, as revealed by electrical penetration graphs (EPGs) results. CCHa2-R-silencing was also shown to reduce reproduction but not survival in *A. pisum*. These observations suggest a role for the CCHa2-R pathway in the response of wingless parthenogenetic aphids to their nutritional status, and this role involves the regulation of the

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expression of CCHa2-R.

CONCLUSION: Overall, the results of these experiments indicate that CCHa2-R plays a dominant role in the regulation of feeding in *A. pisum*.

Keywords: Neuropeptide, *Acyrtosiphon pisum*, feeding behavior

SPP-IPM-104

Newly reported genera in the planthopper tribe Delphacini from Pakistan

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ABSTRACT

BACKGROUND: The delphacid fauna of Pakistan has been poorly studied, with only 15 species in 9 genera previously recorded from this country (Bourgoin, 2021). This figure, comprising about 0.6% of the world's described species, most likely largely underrepresents the actual diversity of delphacids in this country.

METHODS: Specimens were collected from the Khyber Pakhtunkhwa Province of Pakistan and are deposited at the Entomological Museum of Northwest A&F University (NWAUFU) Yangling, Shaanxi, China.

RESULTS: Members of the genera *Rhombotoya* Fennah (1975) and *Queenslandicesa* Koçak & Kemal (2010) in the



subfamily Delphacinae are here reported from a 2018-2019 survey of delphacids from the Khyber Pakhtunkhwa Province of Pakistan. Both genera are represented by a single species *Rhombotoya pseudonegripennis* (Muir, 1918) and *Queenslandicesa fennahi* Bellis & Donaldson (2016).

CONCLUSION: Two genera i.e., *Rhombotoya* and *Queenslandicesa* are reported for the first time from Khyber Pakhtunkhwa Province. Identification keys to the tribe and all known genera from Pakistan are provided. Habitus photographs of these newly recorded genera are also provided.

Keywords: Fulgoroidea, taxonomy, morphology, distribution, Pakistan

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SPP-IPM-105

Nest preference and ecology of cavity-nesting bees (Hymenoptera: Apoidea) in Punjab, Pakistan

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ABSTRACT

BACKGROUND: Among bees, 85.00 % are solitary species, most of them are ground-nesters and some are cavity-nesting and construct their nests in pre-existing cavities. This work was conducted to evaluate the substrate preference and nest architecture (acceptance, occupation percentage, seasonality, and parasitism) of cavity-nesting bees in different substrates.

METHODS: Trap nests offered comprised five different materials (drilled cavities in wood, bamboo, cardboard tubes, plastic soda straws, and mud blocks). These were installed in four districts for two years. The nesting cavities of five different diameters (6, 8, 10, 12 and 14 mm) were provided in each nesting material with an average length of 180 ± 9.92 mm. In all the materials, 5400 nesting cavities were offered, out of which 628 were colonized by bees from two families (Megachilidae and Apidae) and six species (*Megachile cephalotes*, *M. lanata*, *M. bicolor*, *Xylocopa basalis*, *X. fenestrata* and *Ceratina smaragdula*), including one parasitic bee (*Euaspis carbonaria*).

RESULTS: The bee species differed significantly in occupying five nesting materials. The most preferred diameters were 8 mm and 10 mm, with 52.20% and 29.45% of colonization, respectively. Nesting was done throughout the year except in winter.

CONCLUSION: This study will serve as a baseline for future studies and conservation programs of cavity-nesting bees in Pakistan.

Keywords: Trap nests, Bee hotels, Megachile, Xylocopa, Ceratina.

SPP-IPM-106

Molecular Characterization of Whitefly (Hemiptera: Aleyrodidae); Mitotypes and Associated Cotton Leaf Curl Disease in Punjab, Pakistan

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ABSTRACT:

BACKGROUND: Whitefly (*Bemisia tabaci*) has emerged as a serious pest of cotton, ornamentals, vegetables, and oilseed crops. It causes huge losses in many crops by sucking cell sap, excretion of honeydew and being the vector of Cotton Leaf Curl Disease (CLCuD) caused by a complex of begomoviruses (Family Geminiviridae). The present study is aimed to explore the diversity of whitefly mitotypes composition and associated begomoviruses species in the whitefly mitotypes

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complex collected from throughout the cotton growing area in Pakistan from 2018 to 2019.

METHODS: Whitefly mitotypes complex were identified by using phylogenetic analysis of the mtCOI-3' gene sequence. This work provides the latest information for identification of native whitefly mitotypes and complex geographic distribution in Pakistan which is important for pest management. The single whitefly was characterized based on mitochondrial cytochrome oxidase-I (mtCOI) gene (800 bp) sequence which amplified by PCR by using molecular markers pairs COI (Bt-shF:5'-TGRTTTTTGGTCATCCRGAAGT-3') and (Bt-shR: 5'-TTTACTGCACTTTCTGCC-3').

RESULTS: The mtCOI gene sequences were identified for 448 samples of adult whiteflies and found three mitotypes of whitefly Asia II-1, Asia-5 and MEAM1. However, begomoviruses coat protein were amplified in all whitefly mitotypes samples by using molecular marker pair AV core F 5'-GCCHATRTAYAGRAAGCCMAGRAT and AC core R 5'-GGRTTDGARGCATGHGTACANGCC while betasatellites were amplified by using molecular marker pair Beta01F 5'-GRWACCWCTACGCTACGCAGCAGCC and Beta02 R 5'-GGTWYCTACCCTCCCAGGGGTACAC. Thus, we detected the begomovirus profile in 3 whitefly mitotypes using insect-vector based virus PCR amplification technique. This study provides significant information on begomoviruses' geographic distribution in Pakistan also the relationship potential between whitefly mitotypes complex and begomoviruses. Results indicated that overall diversity of Asia II-1 mitotypes is high as compared to the Asia II-5 mitotypes and MEAM1 while cotton leaf curl viruses were more persistent in Asia II-1 and Asia II-5 as compared to the MEAM1.

CONCLUSION: Current research finding advances our understanding to explore the whitefly mitotypes and associated cotton leaf curl viruses' risk and develop the management strategies to reduce the crops damage in Pakistan.

Keywords: Whitefly Mitotypes, mtCOI, Begomovirus, CLCuD, Coat Protein, Betasatellite

SPP-IPM-107

Biodiversity of Oxyinae and Oedipodinae subfamilies of short horned grasshoppers from district Dadu Sindh, Pakistan

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ABSTRACT

BACKGROUND: District Dadu is agriculture field their temperature is suitable for rapid multiplication of insects short horned grasshoppers' family Acrididae and long horned grasshoppers' family Tettigoniidae have economic importance to consider pest of different crops in District Dadu, so that proper diagnosis can be made, because locust is notorious member of the above said family is a major pest of the various cash crops.

METHODS: Sampling was carried out during the year 2021 monthly visits was made in different localities, and samples/Specimens were collected by insect-nets and by hand picking method from various agricultural fields of Maize, Rice, Cotton, Wheat, Grasses, Sugar cane and other vegetation from different ecological areas of District Dadu. Specimens were brought to Advanced Entomological Laboratory Department of Zoology university of Sindh Jamshoro, and Zoology lab of Govt. Ustad Bukhari Degree College Dadu. Specimens were examined in the lab, samples pinned and examined their important Morphological characteristics such as head including antennae, Thorax (Pronotum, Prosternum, Mesosternum) and abdomen (Cerci, Sub genital Plate, Supra anal Plate) with help of taxonomic key and Scientific literature.

RESULTS: We have collected 173 specimens belonging to two famous subfamilies of Acrididae from different localities of District Dadu namely village Qazi Arif, Village Ghulam Hussain Gadhi, Village Phaka, Village Muhammad Ibrahim Panhwar and Village M. Bachal Bouk. We have collected the following 10 species namely *Oxya hyla hyla*, Serville 1831, *Oxya*

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fuscovittata, Marshal 1836, *Aiolopus thalassinus thalassinus* Fabricius 1781, *Aiolopus thalassinus tamulus*, Fabricius 1798, *Acrotylus insubricus*, Scopoli 1786, *Acrotylus fischeri*, Azam 1901, *Locusta migratoria*, Linnaeus 1758, *Sphingnostus savingnyi*, Saussure 1884, *Trilophidia anulata*, Thunberg 1815, *Hilethera aeolopoides* Uvarov 1922.

Keywords: grasshopper; morphology; acrididae; oxyinae

SPP-IPM-108

Comparative efficacy of green synthesized Nanoparticles of different plant extracts against Tetranychid mites (Acari: Tetranychidae)

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ABSTRACT

BACKGROUND: Pest infestation is a serious concern nowadays in the field. Among these different types of pests such as insects and mites cause heavy damage to the field crops. Traditional pesticides are being used to control these pests. Non-judicious use of pesticides is a common factor which affects the human health and environment. Nano technology is getting popular in pest management around the globe nowadays. Green synthesized nanoparticles found effective in pest management.

METHODS: The current study was planned to evaluate the toxic effect of plant extracts of (*Eucalyptus camaldulensis*, *Azadirachta indica* and *Zingiber officinale*) alone and their different metals (silver, copper, and iron). Bioassays were done to check the efficacy against Tetranychid mites by leaf dip method under laboratory conditions.

RESULTS: In petri dishes 30 adults were released on the treated leaves dead and live mites were counted under stereomicroscope after 24, 48, 72 and 96 hours. Results indicated that all the nanoparticles showed mortality (60-89%) at maximum concentration (125ppm) after 96 hours of exposure time. It was noted that increase in concentration and exposure time, mortality also increased. Plant extracts were also tested alone. Maximum mortality (78%) was recorded in neem as compared to eucalyptus (75%) and ginger (73%) at maximum concentration of (25%) after 96 hours.

CONCLUSION: It was concluded that all the plant extracts alone and in combination with green synthesized nanoparticles found potentially effective to control Tetranychid mites and have no effect on the environment as well as on human health.

Keywords: Nanoparticles, Tetranychid, Plant extracts

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SPP-IPM-109

Lethal and behavioral effects of selected novel pesticides on adults of *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae)

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ABSTRACT:

BACKGROUND: Growing demand for reduced chemical inputs in agricultural systems requires more effective integration of biological control with pesticides. The egg parasitoid *Trichogramma pretiosum* Riley is an important natural enemy of lepidopteran pests, used in biological control. In an investigation of the interaction of *T. pretiosum* and pesticides, we studied the acute toxicity of 19 pesticides (insecticides, miticides, fungicides and herbicides) to adult parasitoids and the behavioral effects of 11 pesticides on foraging parasitoid females, including host antennation, stinging and host feeding.

RESULTS: At recommended field doses, fipronil, dinotefuran, spinetoram, tolfenpyrad and abamectin induced nearly 100% adult mortality within 24 h of exposure to treated cotton leaves by comparison with controls. Acetamiprid was also toxic, but significantly less so than the former materials. The other pesticides had no significant toxic effects. Only glufosinate ammonium exhibited increased toxicity among the non-toxic materials when increased two- or fourfold over recommended rates. The foraging behavior of parasitoids was affected only by tolfenpyrad among the materials tested.

CONCLUSION: Most novel pesticides, except for several insecticides, exhibited little to no acute toxicity to the parasitoid. Parasitoid foraging behavior was only affected by tolfenpyrad, indicating that parasitoids could successfully forage on eggs treated with most pesticides evaluated. Therefore, many of these pesticides may have good compatibility with *Trichogramma*.

Keywords: Novel pesticides; *Trichogramma pretiosum*; toxic effect

SPP-IPM-110

Micronutrients can reduce the herbivory and larval fitness in a polyphagous insect pest

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ABSTRACT:

BACKGROUND: Host plant selection in most herbivorous insects is vital for the survival and reproduction of their offspring especially to neonates because they are susceptible to plant defenses and must cope with a variety of obstacles to successfully colonize a host. Survival and reproductive success of insects are closely associated with their ability to use chemical information and this chemical sensing is crucial for fundamental processes such as locating food and mates or avoiding natural enemies and suboptimal environmental conditions. *Spodoptera frugiperda* Fabricius (Noctuidae: Lepidoptera) is a famous cosmopolitan poly-phytophagous devastating pest of more than 300 economically important cash crops such as cotton, soybean, sweet potato, groundnut, tomato, and other crops throughout the world. It has been hypothesized that integrated fertilizer management can help in integrated pest management.

METHODS: Three different levels (high, recommended, and low) of two micronutrients: Zn and Br, were applied in the soil, either alone as well as in all possible combinations. The plants grown with different treatments of these micronutrients and

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control having no micronutrient were subjected to larval feeding of 2nd instar larvae of *S. frugiperda*.

RESULT: The larva fed on cotton foliage treated with the recommended dose of (Zn+B) mixture of micro-nutrients gained less weight with minimum consumption of plant foliage and took a long time to complete larval development. The larvae fed on cotton plant foliage treated with a high dose of Br gained more weight with a maximum consumption of plant foliage and took the shortest time to complete larval development.

CONCLUSION: Our study concluded that recommended doses of micronutrients provide less effectiveness in the management of *S. frugiperda* when applied alone but the application of recommended mixtures of micronutrients provided the maximum control of *S. frugiperda*. This study also revealed that changes of micronutrient in the host plants may play an important role in the performance (growth and food utilization efficiency) of *S. frugiperda*. The purpose of this study is to boost the quality and quantity of agricultural crops by adopting a sustainable strategy to control insect pests that are harmful to agricultural crops.

Keywords: Herbivory; Larval fitness; Micronutrients; *S. frugiperda*

SPP-IPM-111

Deltamethrin resistance testing in *Ommatissus lybicus* (Homoptera: Tropiduchidae) populations collected from Omani date palm orchards

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ABSTRACT

BACKGROUND: *Ommatissus lybicus*, the Dubas bug, is a sap-sucking bivoltine insect pest found only in date palm plantations. Despite considerable aerial and ground spraying, severe infestations of palms are recorded every year. Resistance to insecticides developing in field strains subjected to heavy pesticide treatment might be a factor in its failure to control.

METHODS: Biochemical analyses and residue film bioassays of deltamethrin resistant, *Ommatissus lybicus* field populations collected from date palm orchards in Oman were used to investigate glutathione s-transferase, cytochrome p-450 reductase, and the synergistic activities of an enzyme inhibitor, piperonyl butoxide.

RESULTS: The probit analysis findings showed a higher LC₅₀ value (1.39 mg/L) against the Del-Sel population of *O. lybicus* with a 10.88-fold resistance ratio (RR) and was classified as having a low degree of resistance to deltamethrin. When compared to the Lab-Sus *O. lybicus* population, insects obtained from A'Subaykhah (ASH-population), Al-Mahal (AMH-population), and Hubabiyah (HBB-population) showed a low degree of resistance (RR 5.45 - 6.84-folds). A highest Cytochrome p-450 reductase (CPR) activity 291.85 ± 6.18 mU/mg was detected in ASH-population with 3.89-fold enzyme ratio. A highest Glutathione s-transferase (GST) activity (82.67 ± 3.06 nmol/min/ml) was detected in Del-Sel-population and was followed by ASH (81.56 ± 3.53 nmol/min/ml), Seih Al-Zahir (SAZ) (79.91 ± 2.48 nmol/min/ml) and Suroor (SRR) populations (76.33 ± 3.45 nmol/min/ml). A synergistic ratio of 1.09 to 1.64 was revealed when *O. lybicus* nymphs were exposed to a mixture of deltamethrin and PBO. Highest synergistic ratio (1.64) was observed when deltamethrin and PBO mixture was applied against ASH-population and was followed by Del-Sel population (1.45).

CONCLUSION: The study reports resistance development in Dubas bug against very commonly used insecticide, deltamethrin.

Keywords: Insecticide resistance, deltamethrin, dubas bug, piperonyl butoxide, glutathione s-transferase, cytochrome p-450

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SPP-IPM-112

Role of RNAi in plant protection and its application

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ABSTRACT

BACKGROUND: To reduce the use of pesticides for food safety purposes and the protection of crop plants, and maintain the yield there is a need for advancement in genetics. The transgenic crops having insecticidal proteins from *Bacillus thuringiensis* (Bt) has been used for years for pest control, but now pests have become resistant to Bt. RNA interference (RNAi) is a natural phenomenon, and it has been proven helpful in crop plant protection for crops like wheat, maize, potato, tomato, barley and tobacco.

METHODS: RNAi involves the regulation of gene expression in several manners: effective post-transcriptional gene silencing (PTGS), translational inhibition, RNA destabilization, or transcriptional gene silencing (TGS) by directing DNA methylation. In RNAi, the effect of the gene goes down, and protein formation is stopped by the interference of double stranded RNA (dsRNA) through the formation of a complex called RNA induced silencing complex (RISC). dsRNA is introduced into insects through injection, soaking or an artificial diet. Synthetic dsRNA is derived from pathogens or pest genes and applied as a foliar application on the crop in sprayable pesticides, i.e., spraying of dsRNA molecules derived from *Phytophthora infestans*, for the management of potato late blight. dsRNA can also be applied via insecticidal baits, nanoparticle trunk injection and root soaking for woody plants, such as fruit trees. Another method to produce dsRNA in the host plant is recombinant microbes such as viruses and bacteria, i.e., the viral vector was engineered using Tobacco Rattle Virus (TRV) to deliver dsRNA into *Nicotiana attenuata*.

RESULTS: Food security is all dependent upon the safety of crops or plant protection so modern genetic technology or RNAi need to be adopted on a large scale for pests' control and can be proved helpful.

CONCLUSION: The uptake of dsRNA by pests enhances the chance of plant protection. Cost-effective massive production of dsRNA is required to control pests on a large scale. The use of RNAi is the start of a new era of pest control for crop protection.

Keywords: RNAi, dsRNA, plant protection

SPP-IPM-113

Need for growing non-Bt cotton refugia to overcome Bt resistance problem in targeted larvae of the cotton bollworms, *Helicoverpa armigera* and *Pectinophora gossypiella*

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ABSTRACT

BACKGROUND: The effectiveness of *Bacillus thuringiensis* (Bt) cotton against target arthropod larvae is decreasing day by day.

METHODS: The feeding behavior of the larvae could be the main reason in this regard. Monophagous feeding larva repeatedly feed on the same crop and based on fitness of the fittest model has more chance to deplete the effectiveness of transgenic/ Bt cotton.

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RESULTS: In the present study also, larval mortality of *H. armigera* was higher than *P. gossypiella* among selected Bt cultivars. Similarly median lethal concentration (LC₅₀) values were 8.91, 13.4, 14.0, and 36.4 for *P. gossypiella*, while 5.91, 4.04, 2.37, and 8.26 for *H. armigera* of FH-142, MNH-886, IR-3701, and FH-Lalazar, respectively. These values depicted that *P. gossypiella* had more Bt resistance problems than *H. armigera* larvae. It was concluded that farmers be advised to follow the practice of growing non-Bt as a refuge crop to reduce the problem of Bt resistance in the target arthropod species. Because the host range of both targeted insect larvae was different from each other due to the polyphagous feeding nature of the larvae of *H. armigera* that feed on different host plants, but *P. gossypiella* attacked only cotton with monophagous feeding habit. So, the former had the maximum chance of resistance due to repeated exposure to Bt.

Keywords: Cry1Ac, ELISA, Insecticidal protein, Herbivory behavior, Lepidopterous larvae, Refuge crop

SPP-IPM-114

Host-Plant Variations Affect the Biotic Potential of *Spodoptera frugiperda* (Lepidoptera: Noctuidae)

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ABSTRACT

BACKGROUND: Fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), is a migratory and polyphagous insect pest of many important crops. It originated from the American continents and is widely spread in other areas of the world.

METHODS: To evaluate the influence of host plants on the biology and survival rate of *S. frugiperda*, maize, sorghum, wheat, and rice were selected in this study.

RESULTS: The results indicated a significant ($P < 0.05$) impact of host plants on life table parameters of *S. frugiperda*. The development rate was significantly higher on maize crops than three other host plants. Different larval diets affected the development time, pupation rate, survival rate, adult emergence, and fecundity. *Spodoptera frugiperda* attained the fastest larval development (16 days) on maize and the slowest development (32.74 days) on rice. Different larval diets affected the female fecundity as females from maize fed larvae laid 1088 eggs/female, 591.6 eggs/female from sorghum fed larvae, 435.6 eggs/female from wheat fed larvae, and 49.6 eggs/female from rice fed larvae. Age-stage specific parameters also indicated the higher fecundity, higher life expectancy, higher survival of *S. frugiperda* on maize plants than the other three hosts.

CONCLUSION: Larval diets had a great varying effect on the finite and intrinsic rate of increase, reflecting maize as the most suitable diet. The findings of the present study are useful in developing sustainable IPM strategies for this important pest.

Keywords: Fall armyworm, IPM,

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Assessment of Yield Related Traits of Rice Cultivars and Efficacy of Different Pesticides Against *Scirpophaga incertulas* Walker (Lepidoptera: Pyralidae)

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ABSTRACT

BACKGROUND: Rice (*Oryza sativa* L.) is an essential food. *Scirpophaga incertulas* Walker, (yellow stem borer of rice) is considered as important pest of rice crop.

METHODS: The current study was conducted to assess yield related traits of different rice cultivars and efficiency of different pesticides against yellow stem borer (YSB) of rice under field conditions. Seven cultivars C₁ (Chenab Basmati), C₂ (PK-386), C₃ (KSK-133), C₄ (KSK-434), C₅ (Super Basmati), C₆ (KSK-282), C₇ (Kissan Basmati) were acquired from the Rice Research Institute, Kala Shah Kaku and assessed for comparative yield related traits. Another rice variety PK 1121 Aromatic was transplanted at Madina colony Mcleod Gunj, Bahawalnagar during the year of 2020 to study the infestation and management of YSB.

RESULTS: The results of yield related traits revealed that main yield contributors are the number of tillers per plant, the number of grains per panicle, the weight of 100 grains (g) and spike length (cm). Maximum yield potential was observed in C₇ > C₃ > C₆ > C₄ > C₁ > C₅ > C₂ respectively. The efficacy assessment of Neem extract (30ml/L), Chlorpyrifos (1ml/L) and *Metarhizium anisopliae* (2ml/L) along with control was conducted against YSB. Minimum number of dead hearts was recorded in T₂ (Chlorpyrifos) as 20.00%, 13.33% and 13.30% after every 14 days of 1st, 2nd and 3rd application respectively. Similarly, the minimum white heads were also recorded in T₂ as 23.66%, 20.33% and 19.00% after every 14 days 1st, 2nd and 3rd application respectively. Neem extract and *M. anisopliae* were less effective than chlorpyrifos but significantly effective than control treatment. Minimum dead hearts were recorded in T₁ (Neem extract) as 33.33%, 22.11%, and 20.99%. Similarly, white heads were recorded in T₁ (Neem extract) as 28.99%, 24.99% and 22.85%. In T₃ (*M. anisopliae*) dead hearts was recorded as 28.66%, 20.67% and 19.75%. Similarly, white heads were recorded in T₃ (*M. anisopliae*) as 26.21%, 23.23% and 22.57% respectively as compared to control where dead hearts as 40.33, 39.54, 42.11% and white heads was recorded as 37.12%, 38.23% and 40.14% respectively.

CONCLUSION: It was concluded that the number of tillers per plant, the number of grains per panicle, the weight of 100 grains (g) and spike length (cm) played a vital role in yield of rice crop and neem extract, *M. anisopliae* reduced the damage infestation of rice stem borer we can be used as alternative to chemical pesticides.

Keywords: Rice, Pesticides, *Scirpophaga incertulas*

SPP-IPM-116

Biopesticidal assessment of entomopathogenic fungus *Trichoderma viride* coated zinc nitrate nanoparticles against cabbage aphid (*Brevicoryne brassicae*)

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ABSTRACT

BACKGROUND: Insect pests pose a significant threat to agriculture. They suck the plant sap and transfer different diseases and make the plant unhealthy. Pesticides are effective but excessive use of pesticide causes environmental

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pollution and damage to biodiversity. The control of agricultural pests through eco-friendly pesticides is a challenge.

METHODS: The present study was performed to check the individual and combined biopesticidal activity of entomopathogenic fungus *Trichoderma viride* and zinc nitrate nanoparticle against the cabbage aphid. Potato dextrose broth (PDB) media was used for the culturing of fungus. The cultivated fungal culture was centrifuged at 8000 rpm at 25°C for 15 minutes and the supernatants were used for synthesis of Zn (NO₃)₂. The zinc nitrate salt and trisodium citrate was used for the synthesis of Zn (NO₃)₂. The equal volume of *T. viride* supernatant was mixed in Zn (NO₃)₂ nanoparticles and placed on a shaker for 3-5 days to prepare a homogenous mixture. The biocidal efficacy was assessed by performing bioassay studies against cabbage aphid. Leaf dip bioassay and sprinkler bioassay was performed. Different concentrations (0.75%, 1%, and 1.25%) of zinc nitrate nanoparticles with fungus were employed to check the toxicity. The data from leaf dip bioassay was collected after 1, 2, 3, 5, 6 and 7 days and data from the sprinkler method was collected after 24hours, 48h, 72h, 5, 6 and 7 days of intervals.

RESULTS: In experiment the *Trichoderma viride* fungus showed the 3.66%, 8.66%, 4% mortality in 1st day at all concentrations of 1×10⁵, 1×10⁶, 1×10⁷ and in 7th day the *Trichoderma viride* fungus showed 64%, 65% and 68.3% mortality in all concentrations (1×10⁵, 1×10⁶, 1×10⁷). Zinc nitrate nanoparticle alone showed the 5.75%, 4.75% and 5.66% mortality in 1st day at all concentrations (0.75%, 1% and 1.25%) and in 7th day they showed 45%, 52.3% and 56.39% mortality at all concentrations (0.75%, 1% and 1.25%). The combined mixture of fungus and nanoparticles proved to be more effective. The highest dose 1.25% of fungus and nanoparticles caused the 87% mortality after exposure of 7 days respectively in leaf dip method. In the sprinkler method the highest mortality was recorded 87.33% at 1.25% concentration. Alone doses of zinc nitrate nanoparticles showed 68.77% mortality in sprinkler method mortality against cabbage aphid and 62.88% mortality recorded from fungus. When they are used in combination, we get highly significant results.

CONCLUSION: Among the nanoparticles and fungus zinc nitrate and *Trichoderma viride* showed more toxicity in combine treatment. This is the first report on entomotoxic effect of fungus mediated zinc nitrate nanoparticles against the cabbage aphid.

Keywords: nanoparticles, entomopathogenic fungus, biopesticides

SPP-IPM-117

Monitoring resistance of pink bollworm (*Pectinophora gossipella*) against different Advance chemical insecticides

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ABSTRACT

BACKGROUND: The Pink bollworm, *Pectinophora gossipella*. (Lepidoptera: Gelechiidae) is primarily a mid- and late-season pest of cotton. This species is one of the most destructive pests of cotton in most of the cotton-producing countries in the world. The pest activity was reported to be continuing even after harvest causing up to 35 percent yield loss. Conventional chemical insecticides are the sole reliance of farmers to combat this pest. All species of *Pectinophora* are potential pests because they feed upon the buds, flowers, and seed capsules of malvaceous plants. The main objective of the study was to determine the susceptibility of Pink Bollworm populations to Lambda-Cyhalothrin and Chlorantraniliprole in various areas of Punjab, Pakistan.

METHODS: Susceptibility of Pink bollworm population was evaluated against various concentrations of Lambda-

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Cyhalothrin and Chlorantraniliprole. The experiment was conducted on F₁ of tested population, while lab strain acted as control treatment. Experimental conditions were maintained at 25 ± 2 °C, 60 ± 5% relative humidity (RH) and a 12:12 (D:L) hours photoperiod.

RESULTS: Among the tested populations, Rahim Yar Khan population was highly susceptible to both insecticides followed by Bahawalpur, Lodhran and Multan as compared to the control. Mortality of adult pink bollworm increased as the dose rate of insecticides increased for both pesticides. Lambda-Cyhalothrin was more effective than Chlorantraniliprole against all tested populations.

CONCLUSION: The study revealed that the use of Lambda-Cyhalothrin is more effective, as compared to Chlorantraniliprole, to control pink bollworm in the Cotton crop. Hence, it can be recommended for effective control of pink bollworm for sustainable Cotton yield.

Keywords: *Pectinophora gossypiella*, Lambda-Cyhalothrin, Chlorantraniliprole.

SPP-IPM-118

Taxonomic diversification of insect pests (Cicadellidae: Typhlocybinae) infesting Cotton fields of Division Multan

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ABSTRACT

BACKGROUND: Cicadellidae is one of the largest families of order Homoptera. It is considered the 10th largest family of class Insecta. According to an estimate about 35000-45000 extant species are present in the family. Only 22600 species have been described worldwide. *Amrasca* species are major pests of different cultivated crops such as cotton, okra, eggplant. *Amrasca* species can be distinguished from others by having apophysis slightly curved in the apical part. The first step in Smart Plant Protection is the recognition of the species infesting host plant. Taxonomic identification is very crucial in plant protection because control measures vary with each different species.

METHODS: Leafhoppers were collected from different cotton fields of Multan Division with the help of a sweep net. Samples were preserved in 70% ethanol. Permanent mounted slides were prepared and are preserved in the Ecology Lab, MNSUAM.

RESULTS: In present study, identification of *Empoasca* complex has been done by following authentic keys. It was an old thought that the identity of cotton jassid is solely dependent on the presence of brown dot on the forewing. But this work has resulted that identification of *Amrasca* species is based on internal structures i.e., both apical and tergum VII apodemes, internal ridges of tergum VIII, 1st and 2nd abdominal sternum with 5-8 setae along with, fringes of microtrichia on 1st abdominal sternum and chaetotaxy of subgenital plates.

CONCLUSION: As a way forward, it is advisable to spread study on large areas for exploration of biodiversity of these leafhoppers.

Keywords: Systematics, *Empoascini*, Cotton, *Amrasca*

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SPP-IPM-119

Performance of different Mungbean genotypes against *Megalurothrips distalis* (Thysanoptera: Thripidae) under agro ecological zone of Bhakkar, Pakistan

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ABSTRACT

BACKGROUND: The experiment was conducted at Arid Zone Research Institute (AZRI), Bhakkar, Pakistan during 2018 and 2019 on different mungbean genotypes to find out the resistance to thrips and impact of weather factors on the *Megalurothrips distalis* population. In 2018 twenty-five mungbean genotypes were screened against *M. distalis*.

METHODS: For further investigations three genotypes each of resistant (13TM-04, AZRI-06, NM-16), susceptible (Dera-M, Sawat-I, NM-98) and intermediate reaction (NM-06, 12TM-03, NM-11) towards thrips infestation were chosen for final screening during 2019 based on per flower thrips population density. Thrips data was recorded in each treatment at 4 days interval commencing from the first appearance of thrips up to maturity stage of the crop. Maximum HPSI, 15% was recorded in Dera –M which was more susceptible to thrips infestation while the minimum HPSI (%) was recorded on 13TM-04 and NM-16 with 8% of each and showed the resistant response towards thrips. Role of different genotypes on the yield and the yield contributing characters were also assessed in which NM-16 and 13TM-04 behaved statistically similar results and produced highest yield 935 and 902.8 kg/ha respectively under natural conditions.

RESULTS: During both study years and on cumulative basis thrips population fluctuation resulted positive and significant correlation with maximum and average temperature. During 2018, 2019 and both year's average basis thrips resulted in non-significant correlation with minimum temperature while negative and highly significant correlation was observed with average relative humidity and rainfall.

CONCLUSION: The regression model regarding the impact of abiotic factors on thrips population in mungbean genotypes resulted that maximum temperature was most important factor which contributed maximum i.e., 51.1% and 55.8% role followed by rainfall which showed 14.8% and 4% role during 2018 and 2019 respectively in the fluctuation of thrips population.

Keywords: Effect, weather factors, thrips population, HPSI (%), mungbean yield.

SPP-IPM-120

Taxonomic Study of Noctuid Moths with Brief Account of Their Genitalia and Molecular Characterization Base on COI Gene Sequence

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ABSTRACT

BACKGROUND: Taxonomy plays a vital role in the classification and identification of insects and their morphological, molecular, ecological, behavioral, and reproductive characteristics. Accurate identifications and detections of economically important insect pests play a key role in integrated pest management (IPM) to select the most appropriate techniques for insect pest's management to improve the productivity of crops. Noctuidae Larvae are voracious feeders for agronomic and horticultural crops in Pakistan.

METHODS: In present study subfamilies of Noctuidae family were identified and classified. Noctuid moths were

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collected, with the help of light traps, from various localities of Multan, Southern Punjab, Pakistan. Potassium cyanide jars are used to kill the samples, wet butter paper used to soften the insect body in petri dishes for maximum two hours and spread on a stretching board. The abdomen of the specimen separates from the body with forceps upward jerk and dipped in 10% potassium hydroxide solution overnight. The abdomen was dissected carefully with fine forceps and needles under stereo microscope.

RESULTS: In current research, 7 species of 5 genera which belong to different subfamilies including Amphipyridae, Noctuidae, Catocalinae and Hadeninae of the family Noctuidae were described on genital attributes. Among these species, three species *Spodoptera litura*, *S. exigua* and *S. littoralis* belong to Amphipyridae, two species *Agrotis ipsilon* and *Earias vittella* of Noctuidae, one species *Achaea janata* from Catocalinae and *Hadena jahangiri* from Hadeninae. Two species *S. litura* and *A. janata* of subfamily Amphipyridae and Catocalinae were reconfirmed by molecular characterization using COI gene for the first time from Multan, Punjab, Pakistan.

CONCLUSION: Molecular characterization by the COI gene allows an accurate identification and plays a vital role in pest management.

Keywords: COI, molecular characterization, Noctuid

SPP-IPM-121

Host Plant Association of Aphids in Kaghan Valley of District Mansehra

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ABSTRACT:

BACKGROUND: With a view to record host plant associations of aphid fauna inhabiting Kaghan valley of district Mansehra, a study was planned recording host plant associations of aphids. Aphids were recorded from various host plants and each host was sampled during different times of the year.

Methods: Host plants and aphid samples were identified up to the lowest possible taxa. For identification, in addition to taxonomic literature, help was taken from the reference collection of National Insect Museum and National Herbarium Department at NARC Islamabad.

Results: A total of 398 individuals were recorded from 26 host plants. Being a pest group, host plant range for aphids is important to explore.

CONCLUSION: Present study brought forward some new host plant records for few of the recorded species.

Keywords: Aphididae, Host plant, Kaghan valley.

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Life History Traits and Host Plants Preference of Fall armyworm, *Spodoptera frugiperda*

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ABSTRACT

BACKGROUND: The fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is an invasive insect pest, recently reported in Pakistan. It attacks the foliage of different host plants and destroys cereal crops. Host plant studies could play an important role in insect pest management.

METHODS: The present studies were carried out to assess the life cycle, consumption rate during larval growth, fecundity, and ovipositional preference of *S. frugiperda* on different crops like maize, sorghum, cotton, spinach and cauliflower. The fall armyworm was reared on selected host plants by using leaves of plants grown in the lab. The consumption rate was checked by providing weighed food (leaves) of each host plant. Ovipositional preference was examined by releasing adult male and female *S. frugiperda* with small plants of respective host species in cages. These studies were carried out under laboratory-maintained conditions at temperature 26-28°C, relative humidity 70-80%, and photoperiod 12:12 (Light:Dark) hours.

RESULTS: Results revealed that larval duration was shorter (21.00) on maize and longer on cotton (28.42). Total longevity was relatively higher on maize hosts (8.98) and lower on spinach (8.46). Similarly, higher fecundity was observed on maize (1573.74) whereas lower on cauliflower (1396.27 eggs/female). Age-stage specific life expectancy (exj), Age-specific survival rate (lx), age-stage specific fecundity (fxj), age-specific fecundity (mx) and age-specific maternity (lxmx), Age-stage specific survival rate (sxj) and Age-stage specific reproductive rate (vxj) were all greater on maize as compared with other tested host plants. The consumption rate of 3rd, 4th, 5th and 6th instar larvae were maximum on maize but minimum on cotton crop.

CONCLUSION: It was concluded that the host plant and ovipositional preference of *S. frugiperda* were higher on maize (grass family) than other tested host plants. Plants other than grass family are least preferred by this notorious pest. These Findings could help to devise the management strategies against *S. frugiperda*.

Keywords: *Spodoptera frugiperda*, Host plants, Consumption rate, Ovipositional preference

SPP-IPM-123

Impact of Altitudinal Clines over Species Composition and Distribution of Aphidoidea in Kaghan Valley of District Mansehra, Khyber Pakhtunkhwa – Pakistan

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ABSTRACT

BACKGROUND: With a view to record aphid fauna of Kaghan valley in district Mansehra, surveys were conducted during the years 2020-21.

METHODS: Specimens were collected from 26 host plants including trees, bushes, grass, vegetables, fruits, and

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ornamental plants.

RESULTS: A total of 398 individuals were recorded yielding 23 species under 13 genera. Data for the geographic coordinates and altitudes were recorded and correlated with the fauna recorded. The data presented a strong relationship between altitudinal gradients and aphid species complex.

CONCLUSION: The study came up with interesting results and thirsts for further surveys to come up with more important records from the area.

Keywords: Aphid, Altitude, Kaghan valley

SPP-IPM-124

Chemosterilant effect of different Insect Growth Regulators on *Bactrocera zonata* (Diptera: Tephritidae)

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ABSTRACT

BACKGROUND: The Peach Fruit Fly, *Bactrocera zonata*, is a serious economic pest attacking a wide range of fruits and vegetables worldwide. The pest has developed resistance against commonly used insecticides applied to control it. Thus, searches for alternate new and ecofriendly chemical products with low mammalian toxicity such as insect growth regulators as chemosterilant is therefore desperately needed. The aim of this work was to evaluate and explore the potential of IGRs (lufenuron, pyriproxyfen, novaluron, buprofezin and flubendiamide) as chemosterilant for the control of *B. zonata* fruit fly.

METHODS: Ten newly emerged adults fly *B. zonata* of each sex was ingested with different concentrations 0.05, 0.10, 0.15, 0.20, 0.25 and 0.30ppm / 5 mL diet of different IGRs. On the first day, a single dose application was applied in plastic polypropylene cages, and continuously on the sixth day under laboratory bioassay. Conspecific crosses (TM x TF, TM x UF, and UM x TF of each sex being handled (0.30ppm / 5 mL diet) to check the effect on fecundity, adult emergence and mortality was also analyzed.

RESULTS: Newly emerged adults were ingested with concentrations ranging from 0.05 to 0.30ppm of five IGRs in a 5mL diet. Chemo Sterility effect of five IGRs indicated that lufenuron, pyriproxyfen, novaluron, buprofezin and flubendiamide reduced fecundity approximately 73.12, 77.53, 81.73, 85.26 and 88.57 laying eggs/female as compared to control 99.44%, respectively. Similarly, pronounced effect was also observed on adult emergence 71.40, 76.46, 80.76, 85.15 and 88.46% reduced hatchability, respectively as compared to control treatment 1.48% hatchability. Lufenuron showed mortality 1.72%, followed by pyriproxyfen, novaluron, buprofezin and flubendiamide having 1.88, 2.82, 3.07 and 4.04 %, respectively. Intraspecific crosses between the sexes treated with lufenuron at dose 0.30ppm / 5mL from one to six times was a highly significant effect on *B. zonata* reduced fecundity (83.09%), fertility (81.99%), and mortality (3.21%). Irrespective to no of application, the highest fecundity reduced in crosses TM x TF (84.91%), followed by in UM x TF (71.09%) and in TM x UF (66.23%) was observed.

CONCLUSION: Lufenuron at a dosage of 0.03ppm / 5mL of diet reduced fecundity, fertility, and mortality significantly. The results showed that lufenuron is a promising candidate for controlling *B. zonata*, and that it can help farmers and researchers to improve IPM models to minimize direct and indirect losses to fruit crops by fruit fly *B. zonata*.

Keywords: *B. zonata*, bioassay, chemosterilization, fecundity, fertility, mortality, IGRs.

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SPP-IPM-125

Technology development for management of mango hopper *Idioscopus clypealis* (Lethierry) and its population abundance with reference to meteorological parameters in South Punjab Pakistan

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ABSTRACT

BACKGROUND: Mango is an important, exportable fruit crop of Pakistan. Pakistan is occupying 6th position based on mango production in almost 90 mango producing countries of the world. The mango hopper *Idioscopus clypealis* is the most destructive insect pest of mangoes in Pakistan and causes economic loss to the crop due to its abundance and high population in mango orchards. Among which, mango hopper, *Idioscopus clypealis* is the most serious insect pest. This pest may cause serious yield losses (up to 80 %) in dense traditionally managed orchards.

METHODS: Keeping in view the importance of the pest, a study was designed with an objective to determine comparative efficacy of four different insecticidal spray modules for the effective management of mango hopper on cultivar Sufaid Chaunsa in the research orchards of Mango Research Institute, Multan during 2019-2021. Another objective was to determine the population dynamics of mango hoppers and the effect of weather factors on the population of mango hoppers.

RESULTS: The infestation of mango hopper was examined by observing nymphs and adults in a single panicle/inflorescence (10-inch long) from each cardinal direction of the selected trees visually counted during the flowering season on a weekly basis. In module 1, Thiamethoxam (Actara 25 WG) was sprayed after the fruit harvest. In module 2, the insecticide Thiamethoxam (Actara 25WG) was sprayed after the fruit harvest, followed by a second spray of Clothianidin (Trunk 20SC) only on tree trunks in the month of December. In module 3, first spray of thiamethoxam was done after fruit harvest, second spray of Clothianidin (Trunk 20SC) only on tree trunks in the month of December followed by a third spray of Spinetoram (Delegate 25 WG) was done on mango trees before flowering season in the month of January. The population of mango hoppers was significantly lowest in module 3 and higher population of hoppers was recorded in control. Population dynamics studies revealed that the mango hopper population reached its peak in the 2nd week of April during 2020 and 3rd week of March in 2021. The maximum population was observed during the mango flowering period and later the population of mango hoppers declined.

CONCLUSION: The effect of weather factors on population abundance of mango hopper revealed that significantly positive correlation and regression was observed with relative humidity and wind while negative correlation was observed with increased temperature and rainfall.

Keywords: Mango, hoppers population, Sufaid Chaunsa, spray modules, insecticides

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SPP-IPM-126

Biosystematics of aphid fauna in district Buner

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ABSTRACT:

BACKGROUND: With a view to record aphid fauna of district Buner, surveys were conducted throughout the study area during summer season of the year 2019-2020. S

METHODS: Specimens were collected from 29 various host plants including grass, bushes, vegetables, ornamental plants, trees.

RESULTS: A total of 554 specimens were recorded yielding 24 species under 20 genera. The specimens were identified through taxonomic literature.

CONCLUSION: The study came up with important results from the area and further surveys are recommended.

Keywords: Aphid, district Buner, specimen

SPP-IPM-127

Biological control of *Conogethes punctiferalis* L. (Crambidae: Lepidoptera) in mango orchards

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ABSTRACT

BACKGROUND: Mango *Mangifera indica* L. (Family: Anacardiaceae) is the major fruit crop of Pakistan, susceptible to almost 400 species of insect pests and attacked by many diseases. Among these insect pests, mango fruit borer is a major limiting factor in achieving the full yield potential of mango varieties.

METHODS: The present study was designed to carry out a survey about mango fruit borer in different orchards of South Punjab. Other objectives were to assess the efficacy of entomopathogens and insecticides against the mango fruit borer in the.

RESULTS: Our results revealed that maximum farmers were unaware of the attack of mango fruit borer. Survey results showed that its peak infestation rate was during the months of June and July as compared to other months. Among the entomopathogenic bacteria and fungi, maximum effect *B. bassiana* was observed followed by *T. viridae*, *T. harzanium*, S3, S2, and S1. Among the insecticide treatments, the most effective treatment was proclaiming who gave the better results as compared to other treatments. Then Coragen, Match, Karate, Volume flexi, and Talstar were effective. As far as entomopathogens and insecticides interactions are concerned, the most effective treatment was *B. bassiana* which showed maximum (62.22) results followed by *T. viridae* (55.55) and *T. harzanium* (48.88) as compared to other treatments. While insecticide proclaim showed highest (42.22%) mortality as compared to other insecticides but lower than entomopathogenic fungi.

CONCLUSION: So, these results showed that biological control is also an effective treatment against the mango fruit borer which should be improved with further investigations.

Keywords: Mango fruit borer, Entomopathogenic fungi, Coragen, Biopesticide, Insecticides, Bioassay SPP-IPM-128

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Sublethal Effect of Temephos and Lambda-cyhalothrin on Life History Traits of Dengue Vector, *Aedes aegypti*

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ABSTRACT

BACKGROUND: In Pakistan, dengue fever has risen to the level of a serious public health problem in the last decade. As a primary dengue vector, *Aedes aegypti* plays a critical role in the dissemination of dengue in humans. Due to a lack of effective vaccination, vector control is the only way to manage this disease. Sublethal doses are effective at reducing mosquito populations and disease transmission by lowering the mosquito's reproductive fitness.

METHODS: This study investigated how sublethal doses of two insecticides, temephos, and lambda-cyhalothrin, affect mosquito life-history traits. The laboratory-reared larvae of the Multan strain were exposed to a sublethal dose of LC₂₀ through a larval bioassay, after which their fecundity, survival, egg-laying behavior, and fertility were assessed.

RESULTS: Substantial reduction in fecundity, hatchability, and lifespan using sublethal doses of temephos and lambda-cyhalothrin were observed. The results suggest that sublethal doses may have a negative effect on *Ae. aegypti*.

CONCLUSION: This study demonstrates the potential of temephos and lambda-cyhalothrin for controlling *Ae. aegypti* and highlights the importance of analyzing the sublethal effects for better management of *Ae. aegypti*.

Keywords: *Aedes aegypti*, Life Table, Management Strategy, Multan, Sublethal dose

SPP-IPM-129

Aphid attacking pines plantation of district Battagram, Khyber Pakhtunkhwa, Pakistan, recorded new to aphids fauna of country

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ABSTRACT

BACKGROUND: Pakistan is a geographically diverse country which possesses four geographical regions of the world. It occupies a transitional position with respect to flora and fauna. There are many pockets of the country that remain unexplored due to various geopolitical issues and social barriers. District Battagram of Khyber Pakhtunkhwa province is one of these areas. Despite having a thick coniferous forest cover, it has never been surveyed for aphids; the most common pest of pine plantations worldwide.

METHODS: During 2019-20 several surveys were conducted throughout district Battagram to explore aphids attacking pine trees. Adult aphids were collected through camel hairbrush and through hand picking methods. Collected samples were preserved in 70% ethanol and bottles were tagged with complete information. Collected samples were identified in the Biosystematics laboratory of National Insect Museum (NIM) at National Agriculture Research Center Islamabad.

RESULTS: As a result, two species new to country records are brought forward. Details for Morphometry, taxonomic descriptions, host plant and global distribution are provided for each recorded species.

CONCLUSION: It is concluded that a diverse fauna of aphids is attacking a vast range of pine forest in district Battagram.

Keywords: Aphid, Pest, Pines, New, Pakistan.

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SPP-IPM-130

Field appraisal of EPF horizontal transmission devices for entomo-vectoring of *Beauveria bassiana* and *Metarhizium anisopliae* in bitter melon field against *Bactrocera cucurbitae* (Diptera: Tephritidae)

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ABSTRACT:

BACKGROUND: Present research work was carried out to appraise the efficiency of horizontal transmission devices (HTD) for entomo-vectoring *B. bassiana* and *M. anisopliae* against *B. cucurbitae* in bitter melon field.

METHODS: The Horizontal Transmission devices were installed during flowering stage of cucurbit. Highest mean age of entomo-vectoring fruit flies was recorded in plots treated with Butanone acetate + *B. bassiana* based HTD (70.50%) followed by plots treated with GF-120 + *B. bassiana* based HTD (66.18), Butanone-acetate + *M. anisopliae* based HTD (58.95) and GF-120 + *M. anisopliae* based HTD (54.78%). Maximum mean number of spores per fruit fly were recorded in plots treated with Butanone-acetate + *B. bassiana* based HTD (7.80 spores) followed by plots treated with GF-120 + *B. bassiana* based HTD (6.78), Butanone-acetate + *M. anisopliae* based HTD (5.94) and GF-120 + *M. anisopliae* based HTD (5.26 spores).

RESULTS: The results regarding percentage mortality of fruit fly revealed that maximum mean mortality percentage was recorded in plots treated with Butanone-acetate + *B. bassiana* based HTD (81.20%) followed by plots treated with GF-120 + *B. bassiana* based HTD (75.93), Butanone-acetate + *M. anisopliae* based HTD (67.33) and GF-120 + *M. anisopliae* based HTD (63.14%). Minimum fruit infestation was recorded in plots treated with Butanone-acetate *B. bassiana* based HTD (9.00%) followed by GF-120 + *B. bassiana* based HTD (11.75%), Butanone-acetate + *M. anisopliae* based HTD (14.00%) and GF-120 + *M. anisopliae* based HTD (16.50%). Minimum yield losses were observed in Butanone-acetate + *B. bassiana* based HTD (66.66 gm/plant) followed by GF-120 + *B. bassiana* based HTD (87.14 gm/plant), Butanone-acetate + *M. anisopliae* based HTD (101.91 gm/plant) and GF-120 + *M. anisopliae* based HTD (122.34 gm/plant). As for as marketable yield/ plant is concerned maximum yield was recorded in plots treated with Butanone acetate + *B. bassiana* based HTD (673.87 gm/plant) followed by GF-120 + *B. bassiana* based HTD (654.57 gm/plant). *Butanone-acetate* + *M. anisopliae* based HTD (639.22 gm/plant) and GF-120 + *M. anisopliae* based HTD (619.08 gm/plant). Among horizontal transmission devices Butanone-acetate based HTD proved very effective as compared with GF-120 device. In case different entomo-vector treatment (*B. baasinia* and *M. anisopliae*) against fruit fly, *B. bassiana* gave significantly better effectiveness as compared with *M. anisopliae* to control this pest.

CONCLUSION: Among different treatment, Butanone-acetate + *M. anisopliae* was found economically beneficial having maximum cost benefit ratio (14.9).

Keywords: *M. anisopliae*, horizontal transmission, *B. bassiana*

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SPP-IPM-131

Impact of different fungus-treated male and fungus free female ratio on intensity of horizontal transmission, infection, mortality and fecundity in *Bactrocera zonata* (Tephritidae: Diptera)

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ABSTRACT

BACKGROUND: Various techniques are being assessed and used for the application and dissemination of entomopathogenic fungal formulation. Auto-dissemination of entomopathogenic fungal spores is one way of entomovectoring techniques. However, there is need to investigate sex ratio of contaminated and contamination free individuals which assure an effective horizontal auto-dissemination of EPF spores. **METHODS:** Present study was carried out to study the effect of different fungus-treated male and fungus free female ratio on intensity of horizontal transmission, infection, mortality, and fecundity in *B. zonata*. Experiment consisted of three treatments including a ratio of five treated male (M_{epf}) and twenty untreated female flies (F_i) (T_1), ten treated male (M_{epf}) and twenty untreated female flies (F_i) (T_2) and twenty treated male (M_{epf}) and twenty untreated female flies (F_i) (T_3).

RESULTS: These ratios of flies were detained together in Plexiglas cages (25cm x 25cm) for 24 h to allow for mating. A ratio of 5 M_{epf} X 20 F_i *B. zonata* demonstrated maximum horizontal transmission of *M. anisopliae* spore to female *B. zonata* (67.4%) and chamber-surface (30.7%) followed by that in ratio of 10 M_{epf} X 20 F_i (55.3% and 29.1%, respectively) and 20 M_{epf} X 20 F_i (42.1% and 18.1%, respectively).

CONCLUSION: A ratio of 5 M_{epf} X 20 F_i *B. zonata* demonstrated maximum adult longevity of female *B. zonata* (21.1 days) followed by that in ratio of 10 M_{epf} X 20 F_i (19.2 days) and 20 M_{epf} X 20 F_i (17.4 days). A ratio of 5 M_{epf} X 20 F_i *B. zonata* demonstrated maximum fecundity of *B. zonata* (64.1 egg/female) followed by that in ratio of 10 M_{epf} X 20 F_i (74.2 egg/female) and 20 M_{epf} X 20 F_i (90.2 egg/female). A ratio of 5 M_{epf} X 20 F_i *B. zonata* demonstrated maximum reduction in fecundity of *B. zonata* (52.9%) followed by that in ratio of 10 M_{epf} X 20 F_i (48.9%) and 20 M_{epf} X 20 F_i (37.9%). A ratio of 5 M_{epf} X 20 F_i *B. zonata* demonstrated maximum adult mortality of *B. zonata* (65.1%) followed by that in ratio of 10 M_{epf} X 20 F_i (50.6%) and 20 M_{epf} X 20 F_i (39.4%).

Keywords: *B. zonata*, EPF, auto-dissemination

SPP-IPM-132

Diversity of the Anisoptera & Zygoptera (Odonata: Insecta) of State Biosphere Reserve Neelum (SBRN) of Azad Jammu and Kashmir, Pakistan

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ABSTRACT

BACKGROUND: The State Biosphere Reserve Neelum in Azad Jammu and Kashmir, Pakistan, represents an important geographical position being located at Line of Control. It shares its border with Indian occupied Kashmir and thus faced uncertain challenging ground conditions since its inception. It symbolizes key topography and ecology that support the diversity of Odonata.

THEME-1:

INSECT PEST MANAGEMENT

METHODS: Detailed surveys for exploring the diversity of Anisoptera and Zygoptera (insect order Odonata) were conducted for the first time from this area during the summer season of 2019. For this purpose, eight localities were selected based on topography, habitat potential and altitude.

RESULTS: The present study provides a record of 20 Anisopterous species under 13 genera of four families and 8 Zygopterous species under 4 genera of three families were recorded. Among these Zygopterous species were first time recorded from the State Biosphere Reserve Neelum (SBRN).

CONCLUSION: According to the results of surveys, the Libellulidae and Coenagrionidae families looked to be the most prominent. Besides this, distribution, richness, and abundance of the species were also recorded throughout seasonal surveys and temporal data collecting. The study area has healthy ecology that may support a large diversity of Odonata species. It is strongly proposed that the Odonata fauna of this area be thoroughly investigated.

Keywords: Biosphere, odonata species,

SPP-IPM-133

DNA Barcoding of Water Striders (Hemiptera: Gerridae) from Islamabad Capital Territory, Pakistan

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ABSTRACT:

BACKGROUND: The current study is based on DNA barcoding and Phylogenetic analysis of water striders comes under Gerridae family.

METHODS: Total 445 specimens were collected from several water bodies (lentic and lotic) of Islamabad capital Territory, Pakistan and ecological parameters were recorded to identify the species.

RESULTS: Six species belong to four genera were identified.

CONCLUSION: Molecular characterization was done using Cytochrome oxidase I through DNA extraction from the foreleg of specimens and PCR amplification. Sanger sequencing was used to extract sequences, which were then examined using BLAST in Genbank NCBI. BioEdit and MEGAX tools were used to create intra-specific relationships.

Keywords: Gerromorpha, Hemiptera, DNA Barcoding, Islamabad, Cytochrome Oxidase I (COI).

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-134

Taxonomic Studies of Aphid Fauna of District Gujranwala

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ABSTRACT

BACKGROUND: Present study was intended to explore the Aphid fauna of District Gujranwala.

METHODS: For this purpose, thorough surveys were conducted during active period of Aphids in 2021 from five Tehsils of District Gujranwala.

RESULTS: During this study, 480 specimens were collected from ten host plants which revealed 13 aphid species under 5 genera, including two species (*Aphis odinae* and *Brachycaudus persicae*) as new to Pakistan. Based on the findings from current study, it is concluded that the study region contains a diversified aphid fauna, attacking a wide variety of plants in District Gujranwala.

CONCLUSION: It is proposed that further extensive sampling should be performed in different seasons to explore more aphid species. This study can be helpful for pest management.

Keywords: Gujranwala, Aphid Fauna, Diversity, Taxonomy, Plants, winter

SPP-IPM-135

In vitro studies on the completion of life cycle of Blowfly *Chrysomya Megacephala* (Fabricius) (Diptera: Calliphoridae) in response to Temperature fluctuation, The Most Abundant Forensic Insect Species

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ABSTRACT:

BACKGROUND: The blowfly, *Chrysomya megacephala*, is the most abundant and predominant insect species which arrives and colonizes a cadaver. Therefore, precise developmental data for forensic indicator blowfly, are essential for accuracy in the estimate of the postmortem interval (PMI) and medical science. Its growth and development patterns have great implications in the estimation of the minimum postmortem interval (PMI).

METHODS: In the proposed work, *C. megacephala* were collected from the veterinary hospital of University of Agriculture, Faisalabad, Pakistan and reared at different constant temperatures ranging from 16 °C to 34 °C. The developmental duration and accumulated degree hours, larval body length and morphological changes of *C. megacephala* were examined.

RESULTS: Furthermore, developmental models were developed for the estimation of PMI. The Regression analysis were conducted to obtain equations of the variation in larval body length with time after hatching, and variation in time after hatching with body length.

CONCLUSION: The preliminary results of this study clarify the fundamental questions like development of *C. megacephala* under different temperature profile for the estimation of PMI.

Keywords: *Chrysomya megacephala*, Forensic Entomology, life cycle

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-136

Effect of silicon dioxide (SiO₂) on tritrophic interaction of wheat, aphids and green lacewing

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ABSTRACT

BACKGROUND: Silicon is known to induce resistance against insect pests of several agronomic crops including aphid population on wheat crop. Additionally, silicon also has ability to attract natural enemies on crop.

METHODS: A potted experiment was carried out to assess the effect of silicon dioxide (SiO₂) on wheat against aphids and its key natural enemy, *Chrysoperla carnea*. Silicon was applied by foliar and drenching methods. Different concentrations of silicon (400, 800 and 1200 ppm) were applied in both application methods. The first silicon application was applied after 15 days of seedling emergence, the second application was applied after 15 days of first application and the third application was applied after the emergence of aphid population on wheat plants. The data regarding aphid population and the natural enemy *Chrysoperla carnea* was recorded on regular basis. The recorded data was subjected to analysis for ANOVA using CRD layout and mean were compared using Tuckey HSD using Statistix version 8.1.

RESULTS: The results showed that minimum population was recorded in 1200 ppm concentration when 220 specimens followed by 453.3 aphids in 800 ppm concentration. The significant decreased in population of wheat aphids was noticed at 400 and 800 ppm which were recorded as 950.0 and 453.3 specimens respectively during 4th week of February. The lowest population of aphids were recorded 170 specimens after 1st march foliar application of silicon dioxide application at 1200 ppm. The significant lower population of aphid were recorded 293.3 specimens on wheat crop at the 1200 ppm concentration application of silicon dioxide during 2nd week of March. Similarly, significant decreased in population of wheat aphids was noticed at 800 and 1200 ppm which were recorded as 536.7 and 156.7 specimens, respectively, during 3rd week of March. The minimum population was recorded in 1200 ppm concentration when 93.3 species followed by 443.3 aphids in 800 ppm concentration during 4th week of March. It was also observed that silicon had no indirect effect on *Chrysoperla carnea* and less mortality seen when fed on aphid reared at 0 ppm silicon treated plants followed by 400 ppm when 1 and 1.5 % mortality seen respectively. While more mortality was observed in higher concentration 1200 ppm followed by 800 ppm when 2 and 1% mortality seen respectively.

CONCLUSION: It was concluded that the high concentration of silicon showed adverse effect on natural enemies.

Keywords: Silicon dioxide, Aphid, Wheat, Green lacewing, Tritrophic interaction

SPP-IPM-137

Lethal effects of selected novel pesticides on immature stages of *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae)

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ABSTRACT

BACKGROUND: *Trichogramma pretiosum* Riley is an important egg parasitoid and biological control agent of caterpillar pests.

THEME-1:

INSECT PEST MANAGEMENT

METHODS: We studied the acute toxicity of 20 pesticides (14 insecticides/miticides, three fungicides and three herbicides) exposed to recommended field rates. Egg, larval, and pupal stages of the parasitoid in their hosts were dipped in formulated solutions of the pesticides and evaluated 10 days later for percentage of host eggs with holes, number of parasitoids emerged per egg with holes, and stage-specific mortality of immature as well as adult wasps within the host eggs.

RESULTS: Seven insecticides (buprofezin, chlorantraniliprole, spirotetramat, flonicamid, flubendiamide) and miticides (spiromesifen, cyflumetofen), one herbicide (nicosulfuron), and three fungicides (myclobutanil, pyraclostrobin, trifloxystrobin + tebuconazole) caused no significant mortality to immature stages or pre-emergent adult parasitoids relative to controls. By contrast, seven insecticides/miticides (abamectin, acetamiprid, dinotefuran, fipronil, novaluron, spinetoram, tolfenpyrad) adversely affected immature and pre-emergent adult *T. pretiosum*, with tolfenpyrad being particularly lethal. Two herbicides had moderate (glufosinate ammonium) to severe (s-metolachlor) acute lethal effects on the immature parasitoids.

CONCLUSION: This study corroborates earlier findings with adult *T. pretiosum*. Over half of the pesticides – and all the fungicides – tested in the current study would appear to be compatible with the use of *T. pretiosum* in integrated pest management programs, with respect to acute parasitoid mortality.

Keywords: *Trichogramma pretiosum*, immature stages, egg parasitoid, biological control, pesticides.

SPP-IPM-138

Sublethal Effect of Temephos and Lambda-cyhalothrin on Life History Traits of Dengue Vector, *Aedes aegypti*

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ABSTRACT

BACKGROUND: In Pakistan, dengue fever has risen to the level of a serious public health problem in the last decade. As a primary dengue vector, *Aedes aegypti* plays a critical role in the dissemination of dengue in humans. Due to a lack of effective vaccination, vector control is the only way to manage this disease. Sublethal doses are effective at reducing mosquito populations and disease transmission by lowering the mosquito's reproductive fitness.

METHODS: This study investigated how sublethal doses of two insecticides, temephos, and lambda-cyhalothrin, affect mosquito life-history traits. The laboratory-reared larvae of the Multan strain were exposed to a sublethal dose of LC₂₀ through a larval bioassay, after which their fecundity, survival, egg-laying behavior, and fertility were assessed.

RESULTS: Substantial reduction in fecundity, hatchability, and lifespan using sublethal doses of temephos and lambda-cyhalothrin were observed. The results suggest that sublethal doses may have negative effects on *Ae. aegypti*.

CONCLUSION: This study demonstrates the potential of temephos and lambda-cyhalothrin for controlling *Ae. aegypti* and highlights the importance of analyzing the sublethal effects for better management of *Ae. aegypti*.

Keywords: *Aedes aegypti*, Life Table, Management Strategy, Multan, Sublethal dose

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-139

Field monitoring and insecticides susceptibility test of *Spodoptera frugiperda* population in South Punjab Pakistan

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ABSTRACT

BACKGROUND: Fall armyworm (FAW) *Spodoptera frugiperda* (Smith) (Lepidoptera: Noctuidae) is a polyphagous pest, particularly destructive to maize crops. It is native to America but has strong flying capability and is spread in many Asian and African countries. Fall armyworm was previously reported in the different areas of Upper Punjab and Sind in Pakistan.

METHODS: The current study was conducted in four different areas of South Punjab, Pakistan to determine the damage status of FAW in relation to cropping patterns, cropping seasons and temperature. Four synthetic insecticides belonging to different chemical groups were evaluated for their efficacy under laboratory conditions against different FAW populations.

RESULTS: Results showed that significantly higher damage of FAW was recorded in the autumn crops that were surrounded by other alternative hosts such as sorghum, potato, Jantar, rice chilies and cotton when compared to the spring crops (with no alternate host in its surroundings). Temperature seems to play an important role in the size of FAW population and damage they caused. The results showed that among the four tested insecticides, Emamectin benzoate and Lufenorun exhibited higher toxic effects while Chlorpyrifos and Lambda cyhalothrin showed lower toxicities against FAW.

CONCLUSION: The outcomes of this study provided valuable information for selecting alternative insecticides for the management of FAW.

Keywords: Fall Armyworm, damage, cropping season, temperature, insecticide

SPP-IPM-140

Insect biodiversity and assessment of post-harvest grain losses of stored cowpea (*Vigna aunguiculata* L.) in Dera Ismail Khan and its adjoining Punjab province areas

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ABSTRACT

BACKGROUND: Cowpea beetle (*Callosobruchus maculatus* L.) is a notorious pest of stored cowpea and is mainly managed by means of chemical insecticides in stored cowpea which cause severe environmental and health hazards. The research studies were conducted at the laboratory of Entomology, Faculty of Agriculture, Gomal University Dera Ismail Khan (Latitude: 31.8188°N, Longitude: 70.8971°E).

METHODS: The main purpose of the current study was to collect information on the distribution, relative abundance, and biodiversity of major insect pests of stored cowpea in Dera Ismail Khan and its adjoining Punjab province areas for assessment of post-harvest grain losses and to evaluate some local botanicals for the effective management of Pulse

THEME-1:

INSECT PEST MANAGEMENT

beetle. The areas selected for biodiversity study were Paniala, Mankera, Bhakkar, Paharpur, Kulachi, Ramak, Dera ismail khan, Darya khan, Notak and Behal. A vast survey of godowns was conducted to find out population dynamics of insect pests of stored cowpea and to explore the % grains damage and weight losses in above-mentioned areas. For the collection spear sampler used to collect 500-gram samples from the top, middle and bottom portion of the bags. Samples were preserved in plastic containers and after 30 days, were sieved out with the help of 2mm mesh sieve to remove dead and alive insects.

RESULTS: The maximum infestation (26.98%) and weight loss (28.91%) of cowpea was recorded in Darya khan followed by Dera Ismail khan (22.70% and 26.33%), Notak (21.59% and 24.19%), Paharpur (20.85% and 24.09%), Paniyala (20.75% and 22.51%), Behal (20.52% and 21.66%), Mankera (20.38% and 21.03%), Ramak (20.03% and 20.90%) and Kulachi (19.88% and 20.01%), while minimum % infestation and weight loss was recorded in Bhakkar (16.91% and 17.14%).

Keywords: Cowpea, Post-harvest grain losses, Storage, infestation, Biodiversity

SPP-IPM-141

Implication of Insecticides, Biopesticides and Abiotic Factors against Sucking Insect Pests of Brinjal (*Solanum melongena*)

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BACKGROUND: Brinjal (*Solanum melongena*) is the main crop in South Asia and around the world. Various sucking insect pests such as *Bemisia tabaci* invaded the brinjal crop.

METHODS: Current research was conducted to evaluate the comparative efficacy of insecticides (Imidacloprid and Lambda cyhalothrin), biopesticides (*Beauveria bassiana* and *Metarhizium anisopliae*) and abiotic factors against brinjal insect pests with three different techniques like root dipping of nursery plant, foliar application, and root dipping+ foliar application. The nursery of variety Punjab Bahar was transplanted for sowing. Randomized complete block design (RCBD) was used with application of insecticides and biopesticides. Fungus formulation was prepared in the IPM laboratory. Among the application techniques, root+foliar application proved more efficient. However, the whitefly population was observed from 2nd week of April in brinjal crop.

RESULTS: Data regarding pest infestation was recorded during different time intervals till crop maturity. Abiotic factors also affect the population of whiteflies. After 9 weeks of applications of treatments In root dipping application methods whiteflies infestation was recorded In contrast to control group (28.33 whiteflies /plant), the minimum whitefly infestation (12.667 whiteflies/plant) was recorded in *M. anisopliae*. After 9 weeks of applications of treatments in foliar applications methods whiteflies infestation was recorded. In control (25.33 whiteflies /plant), the minimum whitefly infestation (0.333 whiteflies/plant) was recorded in *B. bassiana* while maximum infestation was on L. cyhalothrin (8.667 whiteflies/plant) and Imidacloprid (1.29/ plant) and *M. anisopliae* (0.667/plant) infestation. After 9 weeks of applications of treatments in root+foliar application methods whiteflies infestation was recorded. In control (42.667 whiteflies /plant), the minimum whitefly infestation (0 whiteflies/plant) was recorded in *M. anisopliae* on plants while maximum infestation was on L. cyhalothrin (5.667 whiteflies/plant) and Imidacloprid (0/ plant) and *B. bassiana* (0.667/plant) infestation.

Keywords: insecticides; biopesticides; sucking insect pest; EPF

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-142

Potential of different aqueous plant extracts as a natural insecticide against *Spodoptera frugiperda*

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ABSTRACT:

BACKGROUND: The fall armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera: Noctuidae) is an invasive pest species that was first reported in 2019 in Pakistan. Fall armyworm is widely distributed and causes significant damage to maize.

METHODS: Aqueous plant extracts of *Nicotiana tabacum*, *Ocimum basilicum*, *Moringa oleifera*, *Piper nigrum*, *Carica papaya* and *Eucalyptus camaldulensis* (botanicals) were tested for their efficacy against second instar of FAW under laboratory conditions. Leave dip method was used for bioassay.

RESULTS: Tested botanicals exhibited the significant ($F = 10.32$; $df = 7$; $p < 0.0001$) larval mortality after 24h of treatment, *Nicotiana tabacum* showed highest larval mortality (38%) followed by *Ocimum basilicum* (16%) and *Zingiber officinale* (16%). Significant result ($F = 59.01$; $df = 7$; $p < 0.0001$) was observed after 72h of treatment *Nicotiana tabacum* showed highest larval mortality (60%) followed by *Ocimum basilicum* and *Zingiber officinale* that caused 56 and 52% larval mortality, respectively. *Carica papaya* extract exhibited no larval mortality after 24 and 72h of treatment.

CONCLUSION: The botanicals of *Nicotiana tabacum*, *Ocimum basilicum* and *Zingiber officina* showed high efficacy against FAW larvae that can be used as components for integrated pest management (IPM) plans for FAW.

Keywords: Botanicals, Bioassay, Susceptibility, aqueous extracts.

SPP-IPM-143

Feeding behavior of *Antilochus coquebertii* (Hemiptera: Pyrrhocoridae) on *Dysdercus koenigii*

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ABSTRACT

BACKGROUND: Red cotton bug, *Dysdercus koenigii* F., is becoming one the major problems in the various field crops of Pakistan. The predatory *Antilochus coquebertii* F. (Hemiptera: Pyrrhocoridae) can be successfully used to control the population of *D. koenigii* under field conditions.

METHODS: Therefore, the experiment was designed to check the feeding behavior of adult male and female of *A. coquebertii* on *D. koenigii* under laboratory conditions. The experiment was replicated 100 times consisting of both male and female (50 each).

RESULTS: Results showed that male preferred to feed on head, thorax, and abdomen (24 %) than females which feed on head, thorax, abdomen, and legs (36 %). Male showed maximum pre-feeding and paralysis time (21.97 and 0.49 minutes, respectively) than females (7.62 and 0.45 minutes, respectively). While the maximum feeding time of both male and female was observed on the abdomen (9.10 and 5.46 minutes, respectively). Similarly, the feeding frequency of both male and female was maximum on head and thorax respectively (3.34 and 3.19 times).

THEME-1:

INSECT PEST MANAGEMENT

CONCLUSION: The complete understanding of feeding behavior of *A. coquebertii* would be helpful in the biological control program of *D. koenigii* under field conditions.

Keywords: Behavior, *Antilochus coquebertii*, feeding, *Dysdercus koenigii*

SPP-IPM-144

Predatory potential of two ants species *Messor himalayanus* and *Camponotus compressus* against *Bactrocera zonata*

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ABSTRACT

BACKGROUND: Fruit Fly, *Bactrocera zonata* S. (Diptera: Tephritidae), is the major pest species of many fruit crops all over the World especially in Pakistan. It causes serious losses of fruits and vegetables in Pakistan.

METHODS: The present study investigated predatory effect of two ant species *Messor himalayanus* F., *Camponotus compressus* F. (Hymenoptera: Formicidae), on fruit fly under laboratory conditions at $26 \pm 2^\circ\text{C}$ and $60 \pm 5\%$ R.H. Studies included number of landings, time spent and ovipositional rate, behavioral response and predatory response of fruit flies. Bananas *Musa paradidica* L. (Musaceae: Zingiberales), were exposed to various numbers of ants. Gravid females of *B. zonata* were observed for landing, oviposition, and time spent on treated and untreated banana fruits. Predation of third instar larvae and pupae as treated and untreated with ants in dry and wet soils was checked. In a Y-tube glass olfactometer, gravid females of *B. zonata* responses towards bananas that were exposed and unexposed to the ant species were observed.

RESULTS: The results showed that the highest number of landings, time spent, and oviposition was observed on those bananas which are unexposed to the ants than exposed. Behavioral response of *B. zonata* was reduced towards ants unexposed bananas. Percentage of predation was increased in the dry soil as the third instar larvae and pupae of *B. zonata* were exposed to the ants.

CONCLUSION: By monitoring these results, it was concluded that both ant species have a significant predatory potential against *B. zonata*, considered as an excellent biological control agent.

Keywords: Ants, Tephritidae, Oviposition, preference, predation.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-145

Effect of short-term cold temperature stress on development, survival and reproduction of *Dysdercus koenigii* (Hemiptera: Pyrrhocoridae)

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ABSTRACT:

BACKGROUND: Red cotton bug *Dysdercus koenigii* F. (Hemiptera: Pyrrhocoridae), is found as a destructive pest in various cotton growing areas. Under natural conditions, insects are highly subjected to thermal stresses.

METHODS: In present work, the developmental duration and survival rate of all immature stages, adult longevity, and reproduction of *D. koenigii* by exposure to rapid changes in very low temperatures were studied.

RESULTS: When the 3h short stress of low temperatures (12 to 0°C) was given to different stages of *D. koenigii*, the results revealed that the survival rate of all stages was significantly reduced. The survival rate of females was significantly higher than male after exposure to cold temperature stress. Mating percentage, fecundity, and hatching percentage were decreased significantly with the decrease in short-term temperature stress.

CONCLUSION: Based on these results, we concluded that the developmental duration, survival rate and reproduction of *D. koenigii* significantly affected when they were exposed to short term cold temperature stress.

Keywords: *Dysdercus koenigii*, Cold shock, Developmental duration, Survival, Reproduction

SPP-IPM-146

Effect of temperature fluctuation on biological parameters of *Dysdercus Koenigii* (F.)

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ABSTRACT:

BACKGROUND: Under natural environmental conditions insects are highly affected due to heat stresses. The studies on the effect of these heat stresses on the life history of *Dysdercus Koenigii* are scarce.

METHODS: This study investigated the effect of short-term high temperature stress on developmental duration, survival rate of all stages and reproduction of *D. koenigii* adults. Eggs, nymphs, and adults were exposed to 28°C, 31°C, 34°C, 37°C and 40°C for 2 h and returned to the laboratory condition to check all above aspects.

RESULTS: The developmental duration and survival rate of all stages were decreased with the increase of temperature. Longevity and survival rate of females was significantly higher than male after exposure to heat stress. Fecundity and hatching percentage were significantly decreased with the increase of temperature.

CONCLUSION: As the short-term high temperature stress response is vital for all stages of *D. koenigi* living in a variable environment, our findings can be used to develop a more profound understanding on the potential for this insect to evolve in response to environmental changes.

Keywords: Heat shock, *D. koenigii*, Developmental duration, Survival rate, Reproduction

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-147

Chemotaxis response and age-stage, two-sex life table of the *Cheilomenes sexmaculata* (Fabricius) (Coccinellidae: Coleoptera) against different aphid species

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ABSTRACT

BACKGROUND: The predacious coccinellid, *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae), is one of the most beneficial and identifiable predators of numerous soft-bodied and sucking insect pests of several crops.

METHODS: Biological parameters and the olfactory response of *C. sexmaculata* were investigated under laboratory conditions by providing three different aphid species i.e., mustard aphid (*Lipaphis erysimi*), citrus black aphid (*Toxoptera citricida*), and peach aphid (*Diuraphis noxia*) as a food source, by using an age-stage, two-sex life table.

RESULTS: The developmental period of immature stages of *C. sexmaculata* was shorter on *D. noxia* as compared to other tested aphid species. The adult longevity was longer on *D. noxia* and *T. citricida* while shorter on *L. erysimi*. Female fecundity was highest on *D. noxia* while lowest on *L. erysimi*. Life table parameters i.e., intrinsic rate of increase (r), finite rate of increase (λ), net reproductive rate (R_0), and gross reproductive rate (GRR) were maximum on *D. noxia* while minimum on *L. erysimi*. The mean generation time of *C. sexmaculata* was 20.90, 23.69, and 26.2 days on *D. noxia*, *L. erysimi*, *T. citricida*, respectively. These results showed that the most preferred prey for the development of *C. sexmaculata* was *D. noxia*.

CONCLUSION: These findings were further confirmed from the olfactory experiment where *D. noxia* proved to be the most preferred prey as compared to other prey species. This study provides necessary information for mass-rearing of *C. sexmaculata* in relation to its prey which would be ultimately helpful for control of sucking pests in an environmentally friendly way.

Keywords: Zigzag beetle; *Diuraphis noxia*; *Toxoptera Citricida*; *Lipaphis erysimi*; life table; olfaction

SPP-IPM-148

Insecticidal activity of plant-derived cysteine protease against two coleopteran pests

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ABSTRACT

BACKGROUND: Stored grain is the major source of food for humans. Acquiring food security and reducing post-harvest losses can create a sustainable solution to food scarcity. The indiscriminate use of conventional chemical controls is interlinked with a wide range of challenges such as toxicity to living organisms, environmental pollution, and resistance to insect pests. Thus, alternative tools such as eco-friendly biopesticides are being excessively researched to replace the old chemical means.

METHODS: The current study involves the development of an ecofriendly biodegradable biopesticide against two key insect pests of stored grain. Entomo-toxic proteins such as 25kDa cysteine protease extracted from the seed coats of

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Albizia procera (ApCp) and *Albizia lebbek* (A/Cp) have shown effective insecticidal activity against many serious insect pests.

RESULTS: The ApCp and A/Cp were tested at three different concentrations (10, 5, and 2.5 mg/g) against two stored grain insect pests, *Callosobruchus maculatus*, and *Trogoderma granarium*. ApCp and A/Cp completely inhibited egg-laying in *C. maculatus* at all concentrations. *Trogoderma granarium* was fed with ApCp and A/Cp treated diet and observed for life cycle parameters. The life span of *T. granarium* was prolonged and the highest concentration (10 mg/g) exhibited the least adult emergence in F1, while in F2 all concentrations resulted in fewer population numbers.

CONCLUSION: 25kDa cysteine protease as a biopesticide has the potential to control the insect pest and it can serve as an alternative for many chemical insecticides.

Keywords: *Callosobruchus maculatus*, *Trogoderma granarium*, *Albizia procera*, *Albizia lebbek*, Cysteine protease, Biopesticide, Stored grain pests.

SPP-IPM-149

Efficacy of Different Insecticides against Cotton Jassid, *Amrasca biguttula*

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ABSTRACT

BACKGROUND: Cotton is one of the major crops of Pakistan it contributes about 10-15% of the national gross domestic product (GDP). There are many sucking insects' pests of cotton which can cause major loss in cotton crop production; cotton jassid is one of them. The present study is carried out to test the efficacy of different insecticides against cotton jassid.

METHODS: Five insecticides were used in this experiment i.e., Thiamethoxam, Flonicamid, Acephate, Thiocyclam hydrogen oxalate, and Acetamiprid, and three replications of each. One hundred and fifty nymphs of jassid were collected from the cotton field. After making the solutions 15 experimental plants were dipped in the solutions of insecticides. After 5 min jassid was exposed to these plants with the help of a clip cage. These plants were put in the lab for 24 hours for observation.

RESULTS: After 24 hours mortality rate of Jassid or effectiveness of insecticides was observed. All the nymphs were dead in clip cages which showed that these insecticides are effective against jassid nymphs.

CONCLUSION: Insecticides were 100% effective against Jassid nymphs and *Amrasca biguttula* did not show resistance against these insecticides.

Keywords: Cotton, Insect pest, Jassid, Insecticides

SPP-IPM-150

Influence of *Metarhizium anisopliae* and diatomaceous earth alone and in combination against *Tribolium castaneum*

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THEME-1:

INSECT PEST MANAGEMENT

ABSTRACT

BACKGROUND: Wheat, *Triticum aestivum* L. (Poaceae: Poales) is a staple food of many people across the globe. During storage, the wheat is ravaged by several insect pests which cause both qualitative and quantitative losses, hence threatening world food security.

METHODS: Mortality of *Tribolium castaneum* Herbst (Coleoptera: Curculionidae) was checked for *Metarhizium anisopliae* and Diatomaceous Earth (DE) alone and in combination at different dose rates under laboratory conditions. The environmental conditions were maintained at $27 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ relative humidity (R.H.) in an incubator.

RESULTS: After 5 days of exposure, a significant difference in mortality was recorded among all the treatments. Highest mortality was recorded for combined treatments of *M. anisopliae* + DE at highest dose rate, while the lowest was recorded for *M. anisopliae* at lowest dose rate. Likewise, a significant difference in mortality was also observed after 10 days of exposure. Highest mortality (100%) was recorded where *M. anisopliae* + DE were applied at highest dose rate, whereas the lowest was recorded for *M. anisopliae* at lowest dose rate. Similar trend in mortality was also recorded for the last count.

CONCLUSION: Our study suggested that combined application of *M. anisopliae* and DE can effectively control the stored product pests, hence can be recommended in integrated stored products protection

Keywords: *Triticum aestivum*, *Tribolium castaneum*, *Metarhizium anisopliae*, diatomaceous earth.

SPP-IPM-151

Role of micronutrients as a yield enhancer in American cotton (*Gossypium hirsutum* L.)

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ABSTRACT

BACKGROUND: Cotton, *Gossypium hirsutum* L. is a vital cash crop of Pakistan which is called as white gold. Number of biotic and abiotic factors involved in low production of cotton, particularly, deficiency of micronutrients at flowering stage may cause shedding of flowers and buds.

METHODS: Field experiment was conducted to check the role of macro- and micro-nutrients (MgSO_4 , ZnSO_4 , Boric acid, FeSO_4 and Urea) on growth parameters (plant height, monopodial branches, sympodial branches, number of flowers per plant, number of open squares per plant, number of bolls per plant and seed cotton yield) and population of natural enemies. Three combinations of nutrients were selected at different dose rates and a control.

RESULTS: The results revealed that highest plant height, number of monopodial and sympodial branches, number of flowers per plant, number of open squares per plant, number of bolls per plant and highest seed cotton yield was recorded in combination 3 where highest dose of nutrient was applied compared to the control. Similarly, the highest number of natural enemies were also observed in combination 3.

CONCLUSION: Application of micronutrients enhance the plant growth, help in producing more branched, flours bolls and increase yield. Moreover, the population of natural enemies increases significantly compared to the control. Henceforth, can be included in the IPM program for sustainable cotton production.

Keywords: *Gossypium hirsutum*, micronutrients, white gold, seed cotton.

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INSECT PEST MANAGEMENT

SPP-IPM-152

Susceptibility of houseflies (*Musca domestica* L.) populations to deltamethrin and thiamethoxam

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ABSTRACT

BACKGROUND: The housefly, *Musca domestica* L. (Diptera: Muscidae) is cosmopolitan in nature and acts as carrier of various disease-causing pathogens in human and livestock. They are found in unsanitary conditions and badly maintained livestock farms. Conventional chemical insecticides are the sole reliance of farmers to combat this pest. They transmit a variety of lethal disease causing agents in humans and livestock. The main objective of the study was to determine the susceptibility of housefly populations to deltamethrin and thiamethoxam in various livestock farms of Punjab, Pakistan.

METHODS: Susceptibility of four house fly population was evaluated against various concentrations of deltamethrin and thiamethoxam. The experiment was conducted on F₁ of tested population, while lab strain acted as control treatment. Experimental conditions were maintained at 25±2 °C, 60±5% relative humidity (RH) and a 12:12 (D: L) hours photoperiod.

RESULTS: Among the tested populations, Rahim Yar Khan population was highly susceptible to both insecticides followed by Bahawalpur, Lodhran and Multan as compared to the control. Mortality of adult house flies increased as the dose rate of insecticides increased for both pesticides. Deltamethrin was more effective than thiamethoxam against all tested populations.

CONCLUSION: The study revealed that the use of deltamethrin is more effective, as compared to thiamethoxam, to control houseflies in livestock farms. Hence, it can be recommended for effective control of houseflies for sustainable animal production.

Keywords: *Musca domestica*, deltamethrin, thiamethoxam, livestock farms.

SPP-IPM-153

Screening of susceptible and resistance chickpea (*Cicer arvense* L.) varieties against pod borer (*Helicoverpa armigera* H.) In Bahawalpur, Pakistan

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ABSTRACT:

BACKGROUND: Chickpea (*Cicer arvense* L.) is a major food in Pakistan. It is easy to grow as its production is very inexpensive and can be done even in unfavorable environmental conditions. The only challenge to chickpea is the pod borer (*Helicoverpa armigera*), which causes severe damage to this crop. Due to the developing trend of insecticide resistance in pod borer, it is becoming difficult to control it.

METHODS: In this experiment, ten chickpea varieties (D-14005, D-13011, CH44/12, CH9/12, D-16011, 6005, 6010, 6015, 7021, 8020 and Chakwal-11) were sown in 2019 in the farm area of The Islamia University of Bahawalpur, in Randomized Complete Block Design (RCBD) with three replications. Screening of all these varieties was done against the infestation of pod borer under non-sprayed conditions. Pod borer populations were counted along the one-meter length of

each row from germination to harvesting. The data were statistically analyzed using Analysis of Variance (ANOVA), and the means were separated using Least Significant Difference (LSD) at a 5% probability level.

RESULTS: It was found that 6005 and 8020 showed a highly resistant response against pod borer with the least damage percentage (7.577%, 9.352%) respectively, as compared to all other tested varieties. Chakwal-11 showed a higher percentage of pod borer damage (21.242 %) than all other varieties.

CONCLUSION: It was concluded that due to high variations among the varieties in the present study, results support that the pod borer infestation, larval population, and grain yield could be used as a selection criterion of resistant varieties as an integral part of the management program against *H. armigera*.

Keywords: Chickpea, Insecticide resistance, Pod borer, Screening.

SPP-IPM-154

Population of aphid on different varieties of Mustard under climate condition of Jaffarabad

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ABSTRACT:

BACKGROUND: The aphid is considered the major important pest of Mustard plant, for causing severe injuries to the plants in all phenological crop stages, being able even to cause plant death. The objective of this study is the population fluctuation of insect pests on mustard cultivars. Data were observed in morning time. At that time Green Aphid was present and the research was conducted on the four varieties of wheat under the Randomized Complete Block Design (RCBD) experiment with 3 replications of all four varieties. In present result we observed that the data show that maximum overall mean population in AH-201 (2.30 ± 0.47) followed by S-9 (2.01 ± 0.47), Sindh Raya (1.92 ± 0.46) and Agati Sarahh (1.90 ± 0.45) were recorded, respectively.

METHODS: The present study was conducted at the experimental field of Agriculture Development Institute Jaffarabad, during the month of December 2020 to February 2021 for determining the population fluctuation of aphid on mustard cultivars in field conditions. Four varieties of mustard viz Agati Sarnh, Sindh Raya, S-9 and AH-201 were sown in a Randomized Complete Block Design (RCBD) with four treatments and three replications, having plot size of 15m x 25m (375m²). The observations on aphid population were taken from (25) randomly selected plants from each variety. After 25 days of sowing the sampling was started.

RESULTS: Mean population of aphid, *Lipaphis erysimi* per plant on different varieties of mustard crop from December 2020 to February 2021.

CONCLUSION: The data in Table-1 indicate that all the varieties were infested by the pest aphid. Maximum mean numbers of aphid population were increased in the 4th week of January (2.13) and 2nd week of February (2.56) per plant on all varieties. The data further show that maximum overall mean population in AH-201 (2.30 ± 0.47) followed by S-9 (2.01 ± 0.47), Sindh Raya (1.92 ± 0.46) and Agati Sarahh (1.90 ± 0.45) were recorded, respectively. The ANOVA results showed that treatment mean of all varieties were found significant at ($P < 0.05$) level indicating that almost aphid population behind similar on all varieties of mustard

Keywords: mustard; green aphid; climate

THEME-1:

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Effect of Neem Oil (*Azadirachta indica*) on Mealy Bug, *Dysmicoccus brevipes* (Cockerell) Under Laboratory Conditions

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ABSTRACT

BACKGROUND: Mealy bug, *Dysmicoccus brevipes* is a major and serious pest of field crops. There are almost 300 host plants of mealy bug of which almost 140 plants are its major host. In present study, neem seed oil (*Azadirachta indica*) was used to control mealy bug by using different doses such as 10, 20 and 30ppm respectively. Thirty nymphal stages of mealy bug were used with three replications. Significantly increased (DF=3,8, F= 24.50, P=0.000) mortality were observed on 30ppm as compared to other treatments, while there was no significant difference were seen among 10, 20ppm and control groups. A significantly increased (DF=3,8, F=62.25, P=0.000) mortality were found by 30ppm, whereas no significant difference were seen among 10,20ppm and control groups. A significantly increased (DF=3,8, F=62.25, P=0.000) mortality were found by 30ppm, whereas no significant difference were seen among 10, 20ppm and control groups. No significantly (DF=3,8, F= 1.22, P=0.36) mortality were found between treatments and control groups. No significantly (DF=3, 8, F= 0.66, P=0.59) mortality were observed between treatments and control groups. A highest mortality (%) were observed on 30PPM as compared to other groups while a lowest mortality (%) were observed by control groups.

METHODS: Preparation of 10, 20 and 30 ppm:

10 ppm: 2.25 ml of neem seed oil mixed with 25 ml of ethanol (48 hours).

20 ppm: 4.50ml of neem seed oil mixed with 25 ml of ethanol (48 hours).

30 ppm: 6.75ml of neem seed oil mixed with 25 ml of ethanol (48 hours).

RESULTS: A significantly increased (DF=3,8, F= 24.50, P=0.000) mortality were observed on 30 as compared to other treatments, while there was no significant difference were seemed among 10,20ppm and control groups

CONCLUSION: Efficacy of biopesticides show significant difference against sucking insect pests. In present research, studies were carried out to assess the effect of neem oil against mealybug. The results revealed that significantly increased mortality was recorded using 30ppm dose of neem seed oil as compared to other doses like 10ppm, 20ppm and control groups. Moreover, it is recommended that a 30ppm dose of neem seed oil may be used to suppress the population of mealy bugs.

Keywords: biopesticides; mealy bug; sucking insect pest; neem oil

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-156

Screening of Different Maize Varieties against maize stem borer, *Chilo partellus* Swinhoe (Lepidoptera: Pyralidae) in Bahawalpur

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ABSTRACT:

BACKGROUND: Maize (*Zea mays* L.) (Poaceae: Poales) is the highest yielding cereal crop in most of the countries like Pakistan. The current study was designed to investigate the screening of different maize varieties against maize stem borer, *Chilo partellus* Swinhoe (Lepidoptera: Pyralidae) in Bahawalpur. The damage caused by maize stem borer in terms of grain yield was also evaluated.

METHODS: Maize varieties were sown in Randomized Complete Block Design (RCBD) with six replications at the Entomological Research Area of the Agricultural Farm of the Islamia University of Bahawalpur during kharif season of 2021. Fifteen plants were selected randomly from each plot for observing different symptoms of maize stem borer (leaf holes, whorl damage/dead heart, larval presence) as criteria for the extent of infestation. The symptoms of maize stem borer infestation (leaf holes and whorl damage/dead heart) were visually observed, and the larval population of maize stem borer was counted by opening the infested plants. The data were analyzed statistically by using analysis of variance (ANOVA) and means were separated by least significance difference (LSD) test at 5 % probability level.

RESULTS: The results of the study indicated that the highest pest population of *C. partellus* were recorded from SZ 686 (maximum 6.30 dead hearts) and lowest from DK 6724 throughout the growing season of the maize crops among six varieties (SZ 686, DK 6724, P1543, P1429, DK 6317 and DK 7024) five cultivars were resistant against *C. partellus* except SZ 686 that highly susceptible during whole growing season.

CONCLUSION: It is concluded by the study that *C. partellus* is a serious pest of most of the maize cultivars and warrants strict control measures but some of the varieties were found resistant against stem borer and recommended for cultivation.

Keywords: Maize, Screening, Stem borer, Varieties

SPP-IPM-157

Evaluation of plant extract against Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)

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ABSTRACT

BACKGROUND: Chemical insecticides are the sole weapon to combat fruit flies in the country which pose a serious threat to the environment, human health, and non-target organisms. Botanical insecticides are considered potent alternatives to the residual chemical insecticides, as they are eco-friendly and have no adverse effect on environment, human health, and non-target organisms.

METHODS: The repellent and oviposition deterrent activity of selected botanical extracts at different concentrations were examined against oriental fruit fly, *Bactrocera Dorsalis* (Hendel) (Diptera: Tephritidae) under laboratory conditions. The experimental conditions were set at 27 ± 2 °C temperature and $65 \pm 5\%$ relative humidity (r.h).

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RESULTS: Results of the current study indicated that all the plant extracts proved to be repellent and oviposition deterrent against fruit fly. The highest repellent and oviposition deterrent activity was recorded in tobacco leaf extract followed by aloe vera, neem leaf extract, eucalyptus leaf extract, garlic, and castor. The repellency and ovipositional deterrent efficacy were enhanced with the increase in the concentration for each extract.

CONCLUSION: Our study suggested that application of plant extract against oriental fruit fly as a repellent and ovipositional deterrent can be used effectively as an alternative to the conventional chemical insecticides, hence can be recommended in integrated pest management (IPM) in the fruit orchards and vegetable fields.

Keywords: Weapon, *Bactrocera dorsalis*, plant extracts, repellent, ovipositional deterrent

SPP-IPM-158

Combined effect of plant extract and chemical insecticides against peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae)

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ABSTRACT

BACKGROUND: The peach fruit fly, *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) is an economically important insect pest of various fruit crops in Pakistan. They cause substantial losses in fruit production, hence affecting the export of the country. Their control mainly relied on the use of conventional chemical insecticides which are harmful for humans, animals, and the environment.

METHODS: Integrated application of neem leaves extract and coragen was evaluated against peach fruit fly under laboratory conditions. Neem leaves extract was applied @ 200, 400 and 600 ppm, and coragen was applied @ 10 and 20 ppm. The environmental conditions were maintained at 28 ± 2 °C, $75 \pm 5\%$ relative humidity (R.H) and a photoperiod of 12:12h (L: D).

RESULTS: After last count highest mortality (100%) was recorded for integrated application of neem leaf extract @ 600 ppm and coragen, while lowest was recorded for neem leaf extract @ 200 ppm. In the same treatment highest pupation adult emergence and egg eclosion was recorded as compared to the control.

CONCLUSION: Our study suggested that combined application of coragen and plant extract showed significantly higher mortality compared to their sole application against peach fruit fly to prevent fruit damage and make it healthy for humans.

Keywords: *Bactrocera zonata* (Saunders), neem leaf extract, coragen, pupation, egg eclosion

SPP-IPM-159

Pathogenicity of Mycoproteins of *Beauveria bassiana* against *Bactrocera zonata*

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ABSTRACT

BACKGROUND: *Bactrocera zonata* is the invasive species of the family Tephritidae that causes high economic losses to horticultural crops including mango, peach, and citrus worldwide. The researcher carried out many monitoring and

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management practices.

METHODS: These management practices are installation of pheromone traps, bagging of fruits, or fine netting of the whole tree having the smallest mesh size net. Many control strategies and multiple tactics are used to overcome *B. zonata* like batting technique, attract and kill methods, cultural and physical control measures. Chemical control methods are somewhat restricted due to residual effects on fruit quality and insecticides resistant problems. However, the use of biological control agents like predators, parasitoids, and entomopathogens has the potential to mitigate the target insect pests. Entomopathogenic fungi like *Beauveria bassiana* show pathogenicity against many insect pests. *B. bassiana* have cuticle degrading enzymes and Mycoproteins that cause huge damage to insect integument and digestive system of *B. zonata* respectively. The recent study is to determine the pathogenicity of mycoproteins of *B. bassiana* against *B. zonata* species of fruit fly under laboratory conditions having temperature 26 ± 2 C° and relative humidity 65 ± 5 .

RESULTS: The data was recorded after 48 hours of bioassay. The result shows that the mortality of *B. zonata* was concentration dependent.

CONCLUSION: The treatment having more concentration of mycoproteins shows more mortality as compared to low concentrated treatments.

Keywords: EPF; mycoproteins; *B. zonata*; *B. bassiana*

SPP-IPM-160

Incidence of predatory mite population on eggplant (*Solenum melongena* L.) in relation to temperature and its feeding potential against spider mites (Tetranychidae) in laboratory.

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ABSTRACT

BACKGROUND: Vegetable crops are often attacked by many sucking insect pest and mite species throughout the world especially in Pakistan. Among these pest species, spider mite populations severely affect the vegetable crops particularly eggplant that causes a serious reduction in its yield. The larvae and adults of spider mites feed on young leaves and flowers. Many spider mite species were initially controlled by using different chemicals but as the pest has become resistant to different groups of acaricides, the trend has now shifted towards biological control agents. Predatory mites are among those hunters, which can feed on both larvae and adults of red spider mites. The main objective of this trial was to check the population fluctuation of predatory mites on eggplants and their predatory efficacy against both nymph and adult of plant feeding mites under laboratory conditions.

METHODS: In the assessment of feeding potential of a single predatory mite against both nymph and adults of spider mites in laboratory conditions, there were four treatments (T1, T2, T3, T4) that were used by taking different number of spider mites (both nymph & adult separately) in each cell of a predator with one as control. Four to sixteen individuals of each stage of spider mites (nymph and adult) were provided in each cell of the predator.

RESULTS: According to the results achieved, the maximum population of predatory mite on per leaf basis (3.71) was observed in the 3rd week of May, while the minimum population was observed (1.44) during the 4th week of March and (1.54) 2nd week of April, which was most probably due to some rainfall. Overall, there was a gradual increase in predatory mite population in the field condition with an increase in temperature in eggplants. From the laboratory findings, it was seen that the predation rate of each predatory mite inclined to decrease when feeding from nymph mites to adults. In the

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case of T_3 , maximum average predatory behavior was observed against the nymph population of spider mites 9.31 that tend to decrease 2.87 against adult ones for 24 hours. The feeding potential of predatory mites against nymph in T_1 and T_2 were recorded less 3.33 and 5.12 as compared to T_3 and T_4 due to fewer number of spider mites were given as 4/cell and 8/cell respectively. Similarly, the feeding potential of predators against adult stages of spider mites in T_1 and T_2 were also recorded less 1.03 and 2.01 as compared to T_3 and T_4 respectively.

CONCLUSION: It is concluded here that predatory mites can be used as potential biocontrol agents and feed voraciously against the nymph stage of red spider mites as compared to the adult population under laboratory conditions.

Keywords: Red spider mites, predatory mites, eggplant, population dynamics, feeding potential.

SPP-IPM-161

Insect pests under changing climate and Climate-smart pest management

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ABSTRACT

BACKGROUND: A significant problem for agriculture globally is climate change, via its effects on the distribution, biology, and potential of spread of diseases and pests in all ecosystems, climate change is already influencing agriculture. Climate change influences the distribution and severity of crop pests, i.e., "any animal, plant or pathogenic species, strain, or biotype harmful to plants or plant products" directly and indirectly. Up to 40 per cent of the world's food supply is already endangered by pests and the decrease in pest impact is of prime concern than ever for ensuring global food security, reduction in greenhouse gas emissions and decreased application of inputs. Climate-smart pest management (CSPM) is a multisectoral strategy aimed at reducing crop losses caused by pests, improving ecosystem services, reducing the level of greenhouse gas emissions per unit of food produced and enhancing the resilience of agricultural systems to climate change. CSPM should not be understood as a stand-alone solution to be successful, but as part of a larger CSA (Climate Smart Agriculture) intervention that considers pest management to be one of its main components. Effect of climate change is more in temperate insects which affect their range expansion, host enemy synchrony and interspecific competition. CSPM strongly stresses the need to establish and introduce more reliable diagnostic techniques to classify pests and their natural enemies to be able to make decisions on pest control in the future. Climate change is because of human activities and can also be minimized by human activities. Therefore, there is a need to look after the effects of climate change on crop protection and ultimately safeguard food security.

CONCLUSION: Climate smart pest management (CSPM) can play a vital role in insect pest management under changing climate. **Keywords:** Climate, crop protection, ecosystem, food security, natural enemies. Climate change and climate smart pest management (CSPM)

Keywords: Climate smart pest management, pest management

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-162

Molecular Phylogenetics of Grasshopper Fauna of District Buner, Khyber Pakhtunkhwa-Pakistan

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ABSTRACT

BACKGROUND: Present work is based on molecular and phylogenetic analysis of grasshoppers under the family Tettigoniidae recorded from District Buner. A total of 200 specimens were collected and identified morphologically using taxonomic literature. Ten species under ten genera were identified. Molecular characterization of all the recorded species was undertaken.

METHODS: For this, DNA was extracted from a single leg of grasshopper, and the amplification of the 16sr region was done using polymerase chain reaction. The Sanger sequencing was also performed.

RESULTS: The successfully sequenced samples were further analyzed by BLAST in GenBank NCBI and phylogenetic analysis was made using MEGA 6 software.

CONCLUSION: The evolutionary relationships were discussed with reference to molecular similarities. Molecular Phylogenetic analyses showed similarities among phylogenetic clades and the variations were found at genus level with slight differences in bootstrap values.

Keywords: Tettigoniidae, Grasshopper, Molecular phylogenetic, District Buner

SPP-IPM-163

Predatory potential and biology of insecticides selected strains of *Chrysoperla carnea* (Stephens) on wheat aphid in vivo

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ABSTRACT

BACKGROUND: *Chrysoperla carnea* is a well-known and very important biocontrol agent used in integrated pest management for soft-bodied insect pests. In the modern scenario, many insect pests have developed resistance to insecticides, and biological control agents are also undesirably affected by insecticides. English grain aphid, *Sitobion avenae* is a pest of wheat and other cereal crops, causing damage by sucking plant sap directly from xylem and phloem, secreting honeydew which disturbs the process of photosynthesis and as a vector of Barley Yellow Dwarf Virus.

METHODS: Predatory potential and other life-history parameters of bifenthrin, flonicamid, chlorantraniliprole selected and unselected strains of *C. carnea* on second nymphal instars of *S. avenae* were evaluated under laboratory conditions.

RESULTS: Results showed that there was a non-significant difference in the consumption rate of *C. carnea* larvae on nymphs of *S. avenae*. All the life history parameters of flonicamid, bifenthrin, and chlorantraniliprole selected strains of *C. carnea* studied in this experiment were significantly different ($P < 0.05$) when compared with unselected strain except fecundity ($P > 0.05$). The intrinsic rate, net reproductive rate, number of next-generation larvae, relative fitness, biotic potential and mean relative growth rate of *C. carnea* selected strains were significantly high as compared to the

unselected.

CONCLUSION: It can be concluded that these resistant populations can effectively control pest species and perform best in the natural environment and could be used in integrated pest management programs.

Keywords: Toxicity, *Chrysoperla carnea*, *Sitobion avenae*, feeding potential, fitness parameter.

SPP-IPM-164

Management of rice leaf folder with different insecticides

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ABSTRACT

BACKGROUND: Rice leaf folder a notorious pest, causing up to 25% yield loss by leaf-folding and blade-streaking.

METHODS: The data was recorded at AARI under field conditions using manual count method

RESULTS: The results showed that pretreatment data ranged 3.824 to 5.59 percent infestation in all plots. The higher concentrations exhibited maximum potency followed by succeeding lower concentrations that showed minimum effectiveness.

CONCLUSION: The data also indicated that Virtako proved the best followed by Proaxis and Flubendiamide. Carbosulfan. However, lambda cyhalothrin revealed least effectiveness against leaf folder infestation. The control infestation remained higher (over 6% infestation). These chemicals might be included in the rice folder management program.

Keywords: Field conditions, insecticides, leaf folder, percent infestation

SPP-IPM-165

Mass Rearing of Egg Parasitoids of *Trichogramma* for Biological Control

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ABSTRACT

BACKGROUND: *Trichogramma* species is the most parasitoid group that is used for biological control programs worldwide. It is natural enemies of Lepidopteran pest such as Cotton bollworm (*Helicoverpa armigera*), The Angoumois grain moth, *Sitotroga cerealella* and European corn borer (*Ostrinia nubilalis*) of agricultural crop. Some of them have a small body range between 1/25 inches (1 mm) or less and yellow to brown color with short antennae. The *Trichogramma minutum* is commonly found in Europe that was first introduced to mass rearing techniques on egg of *Sitotroga cerealella*.

METHODS: Temperature oscillated between 17- 23 C and relative humidity between 55-75% with mean values of around 20 C and 65%, respectively Photoperiod was 16L: 8D. The diet was infested with *E. kuchniella*, previously disinfected in 15 minutes wash with 6% formaldehyde solution, to minimize the risk of bacterial contamination. For each log of diet, around 1000 eggs were used. After period of around 2 months *Trichogramma pretiosum* Riley reared on *Diatraea grandiosely* Dyer eggs, when compared to constant temp The evaluation of the rearing technique's quality was done by: (1)s estimating the fecundity of a group of 45 females, Kept together with 46 males, throughout their first five days of life. The eggs were collected daily, weighed, and using the regression equation, the number of eggs produced was estimated; and (2) determining the sex ration of the laboratory population from a sample of RRO individuals, collected in 10 consecutive days temperature of 30 C.

RESULTS: *Trichogramma* spp determination of the emergence rate of the adults in six egg cards, 4070 parasitized eggs were observed, from which 3813 were viable and 257 unviable, resulting in an emergence rate of 92.69±2.8% several authors have reported, for different *Trichogramma* species, under similar physical conditions, emergence rates ranging from 95.2% to 100% on *E. kuchniella* eggs.

CONCLUSION: *Trichogramma* adult emergence seemed slightly lower than desirable although it was still over 90%. This can be easily avoided by adjusting the number of host eggs per parasitoid female, it appears that the biological features studied for both *Trichogramma* spp. And *E. kuchniella* remain overall unaffected by possible negative side effects of the rearing methods.

Keywords: Mass Rearing, *Trichogramma*, *Sitotroga cerealella*

SPP-IPM-166

Detection of insect pests and plant diseases by using deep learning

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ABSTRACT

BACKGROUND: Yield and quality of plants depends on many factors among which insect pests and plant diseases are two major factors. Losses caused by these factors reach approximately 20-40 % globally. Timely identification and forecasting of insects and diseases is necessary to overcome these losses, but currently traditional methods utilized for detection of diseases and pest are laborious and time consuming. These issues can be overcome by modern techniques like using deep learning models which will not only save time but can accurately detect the cause of disease and pest species. Deep learning is classified as a subset of machine learning, a science in which computers are taught to replicate organism behavior using algorithms, learning, and improving on their own, such as detecting disease and pest attack from image or video of plant or part of plant. These deep learning models use different neural networks like CNN (Convolutional Neural Networks). Identification can be done in three steps; first classification is done then detection and at last segmentation is done which gives more accurate results than the traditional ones. With the advances in technology in recent years, deep learning models' application in different fields like traffic detection, medical imaging recognition and face recognition has been successfully done.

CONCLUSION: There is a need to use modern techniques like deep learning in the field of agriculture to overcome different problems in insect pest and disease identification, classification and forecasting and to revolutionize the agriculture sector.

Keywords: Automated monitoring, Deep learning, Disease and pest management, Image-based identification.

SPP-IPM-167

Conservation of Cavity nesting solitary bees by using bee hotels

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ABSTRACT:

BACKGROUND: Pollination is essential for reproduction of plants in which bees play a significant role by transferring pollen from one flower to another. Out of 20,000 bee species present worldwide solitary bees account for over 70% of them. As compared to eusocial bees, solitary bees are more specialist pollinators and are more efficient for boosting

pollination. Solitary bees are frequent visitors in early blooming spring crops that are not attractive to honeybees because of their floral morphology or low nectar content. Many solitary bee species have their life cycles synced with the blooming pattern of their host plants. There are many examples where solitary bees outplay eusocial bees in pollination of some species like *Megachile rotundata* and *Nomia melanderi* in alfalfa, *Osmia cornifrons* in almonds, *O. cornuta* in orchards. Despite their importance, solitary bee populations are facing constant decline due to habitat loss, pesticide exposure and climate change. Recent advances in agriculture like mono-culturing is the primary driver of habitat fragmentation of solitary bees. 70% of solitary bees are ground nesting bees while 30% are cavity nesting bees that make their nest in tree holes and pithy stems. Due to extensive monoculture practices, cavity nesting bees are facing scarcity of nesting sites. Bee hotels are devised for trap nesting of bees to cope up with this issue. These bee hotels are often constructed from wrapped plant stems, paper tubes, or drill holes in wood or in molded plastic and they artificially increase the number of nesting sites accessible to solitary bees. Many solitary bees are managed at commercial level in US and Canada through these bee hotels. Holes leading up to tunnels of different diameters and materials support diversity of bees. These hotels are installed at the start of blooming season when bees' foraging activity is at peak, they lay eggs inside artificial holes that mimic natural nests. Adults emerge from these holes next season and this cycle continues resulting in augmentation of bee population.

CONCLUSION: The conservation of solitary bees through these hotels increases pollination of crops and has a significant impact on its yield.

Keywords: Pollination, solitary bees, nectar content, eusocial bees, habitat loss, cavity nesting bees, monoculture.

SPP-IPM-168

Major diseases and pests of maize and accessibility of control technology

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ABSTRACT:

BACKGROUND: Maize, also known as corn (*Zea mays*), is a grass family plant (Poaceae). It is grown all over the world and is amongst the most important cereals. Maize has far greater yield potential than in any other grain, which is why it is quite often termed the "miracle crop" or even the "Queen of Cereal". Pest species *N. viridula*, *A. oryzae*, *S. litura*, *A. exigua*, *H. armigera*, *Oxya* sp. *O. furnacalis*, *S. exmpta*, *O. nubilalis*, and attack maize plants in the pattern of imago and the larva active at all hours of the day and night. Pest attacks have resulted in perforated leaves, yellowing, epidermis leaves, slow growth that are transparent, rot, cobs that are open, and maize that is dead. *H. turcicum* Pass. causes leaf blight on maize, according to *P. Sorghi* Schwein. Culture insect and disease management technical of the maize with farming practices, varieties hold, numerous cropping of the maize with peanuts or soybean changes that occur of host plant, with not within proper time, fertilizing balanced, prevent planting all through rainy season, male trimming interest, sanitary conditions, and ecofriendly sustainable farming. *Helminthosporium turcicum* causes blight on the leaves of maize plants.

Boletus 2 type that really can cause infections or bulai blights caused by *Peronosclerospora maydis* and the *Peronosclerospora philippinensis* is currently present in Indonesia. All symptoms of the disease attack on maize plants of the grenade are similar and differ based on cultivars, while it can be adult and the climate. *P. philippinensis*, a fungus, causes this disease.

The analysis of pre-harvest control measures revealed that the main practices at the pre-harvest stage for control of the mycotoxins in the maize chain may include: preparation, of land such as land preparation, crop, covering and crop rotations (ii) the planting and anti - fungal mulch treatments, application of botanical extracts and intercropping, (iii) usage of fungal biological control to minimize aflatoxins, and the application of bacterial bioagents and the fungal controls 1 of

Critical Control Point (CCP) and 5 Control Points (CPs) have been identified for post-harvest operations. The CCP contains a treatment measure which can be used all through storage, including the use of volatile bioactive compound treatments, UV treatment, ozonisation, or cold plasma. Technical culture of *O. furnacalis* can be controlled biologically and chemically.

CONCLUSION: In culture of the technical control, cutting a few of the male flowers 4-6 lines of crops and for the which appropriate in multi cropping maize with soybeans or peanuts. Natural enemies of parasitoids are used to control biodiversity. *Trichogramma* spp., *Euborellia annulata* predators.

Keywords: maize, *Trichogramma* spp, predators, management

SPP-IPM-169

Evaluation of Entomopathogenic nematodes for the management of termites

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ABSTRACT

BACKGROUND: Termites are a major problem all over the world and have a great impact on agriculture crops. Chemical control of termites is harmful and not ecofriendly. Therefore, biological control is the best alternative for management of termites.

METHODS: In present study, entomopathogenic nematodes (EPNs) were isolated and evaluated for the biological control of termites. EPNs isolated by *Galleria* baiting technique and dead larvae transferred to the white trap, multiplied by using *Galleria mellonella* larvae for further experimental use. EPNs cultured and applied with three different concentrations i.e., C1 (50ljs), C2 (100ljs), C3 (150ljs) and C0 used for control (only distilled water). The experiment was conducted in a laboratory under complete randomized design with three replications by taking thirty termites in each box. Data regarding mortality percentage of termites was recorded after 12, 24, 48, 72 and 96hrs.

RESULTS: Results showed that mortality percentage of C1 after 12 hrs was 40%, C2 mortality percentage was 45%, C3 mortality percentage was 84% and C0 showed 21% mortality. Mortality percentage of C1 after 24 hrs was 42%, C2 mortality percentage was 47%, C3 mortality percentage was 87% and C0 showed 25% mortality. Mortality percentage of C1 after 48 hrs was 56%, C2 mortality percentage was 62%, C3 mortality percentage was 91% and C0 showed 33% mortality rate. Mortality percentage of C1 after 72hrs was 75%, C2 mortality percentage was 78%, C3 mortality percentage was 96% and C0 showed 44% mortality rate. Data recorded after 96hrs showed mortality percentage of C1 was 91%, C2 mortality percentage was 95%, C3 mortality percentage was 100% and C0 showed 64% mortality rate.

CONCLUSION: Entomopathogenic nematodes has potential to manage termite with no harm to environment

Keywords: Entomopathogenic nematodes, *Galleria mellonella*, termites

SPP-IPM-170

Management of Cotton Mealybug *Phenacoccus solenopsis* (Pseudococcidae; Hemiptera)

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ABSTRACT

BACKGROUND: *Phenacoccus solenopsis* (Pseudococcidae; Hemiptera) is an exotic polyphagous pest that primarily feeds on brinjals, maize, potato, okra, marigold, sorghum, ground nuts, pigeon peas, holly hock, sunflower, cucurbits,

beetroot, mulberry (*Amaranthus* spp.), and cotton. The mealybug's body is covered in very short waxy filaments. It spreads from the edges of the field. In the early stages, it can be seen in small pockets. There is more damage in dry weather. Ants are the primary vectors of their transmission, but they are also spread by humans, water, and air.

METHODS: To control this pest, insecticides from various groups were tested in both the laboratory and in the field. Acephate 75 SP@1gm/L, Malathion 50 EC@2ml/L, Buprofezin 25 SC @1ml/L, Quinolphos 25 EC@5.0ml/L, Chlorpyrifos 20EC@ 3.0ml/L, Profenofos 50EC@5.0 ml/L, and Thiodicarb 75WP@5.0gm/L were used in the laboratory when 10% infested plants observed (at least one stem completely colonized with mealybugs). In the field, the recommended application rates of various insecticides were used in 40 plants per acre for more effective and timely control.

RESULTS: The efficiency of chlorpyrifos, profenofos and buprofezin proved better and timely control against this sporadic pest.

CONCLUSION: The current study found that the insecticides tested, specifically chlorpyrifos, profenofos, and buprofezin, effectively control the cotton mealybug. Control of the insect pest complex throughout the cotton crop is primarily dependent on the prudent and justified application of these chemicals, necessitating the development of an integrated pest management strategy. To avoid severe crop losses, continuous monitoring of the population abundance and dynamics of the cotton mealybug is required. For the development of effective management strategies, large-scale pest surveillance must be practiced.

Keywords: cotton mealy bug, carbamate, organophosphate, pyrethroid.

SPP-IPM-171

Eco-Friendly Control of Citrus Leaf miner, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae) using the biological agents and pesticide oil: towards an integrative approach.

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BACKGROUND: The citrus leaf miner (CLM), *Phyllocnistis citrella* Stainton, (Lepidoptera: Gracillariidae) is an important pest in citrus growing regions worldwide. Adult leaf miners that attack the flushes of citrus, affect fruit development and cause canker disease.

METHODS: In this study, biological agents like *Chrysoperla carnea* and *Trichogramma chilonis* were used along with pesticide oil (Diver@95%) to control this pest by using an exclusive method. Apply treatment with pesticidal oil and with biological control agents with different concentrations at 3,6,9-day intervals.

RESULTS: Analysis revealed that maximum mortality was observed in 9 days by *C. carnea* larvae and *T. chilonis* adults. Results showed that cumulative mortality maximums in 9 days were 18.75 ± 0.85 as compared to 3, 6 days, and control with mean mortality 7.25 ± 0.85 , 8.5 ± 1.25 , and 0.25 ± 0.25 respectively. In addition, maximum mortality was observed in 9 days when combined 5 Larvae + 5 ml/L was used with mean mortality 18.00 ± 0.70 as compared to 3, 6 days, and control with mean mortality 6.5 ± 0.64 , 7.25 ± 0.47 and 0.75 ± 0.25 respectively. While in case of combined action of *T. chilonis* and pesticide oil, maximum mortality 15.5 ± 0.86 was observed in 9 day when combined 5adults +5ml/L was used as compared to 3,6day, and control with mean mortality 4 ± 0.40 , 5 ± 0.91 , and 0.25 ± 0.25 respectively.

CONCLUSION: Maximum mortality showed that biological control along pesticidal oil alternative control measures in pest management.

Keywords: *Phyllocnistis citrella*, biological agent, pesticide oil

SPP-IPM-172

Taxonomic study of Acarid mites of stored grains from district Chiniot, Punjab, Pakistan

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ABSTRACT

BACKGROUND: Stored cereals are attacked by several pests during storage because grain storage can fill the food gap and we can overcome this problem to a large degree. Among these, mites have a major contribution and have long been recognized as destructive pests of stored cereals, not only by the direct consumption of cereals but also by contamination thus causing huge losses.

METHODS: Severe infestation results in brownish tinge over the commodity called “mite dust” because of light brown coloring of the mite legs. This mite dust gives off a “minty odor” if the mites are crushed. For the identification and better management of stored cereal mites a comprehensive survey from public sector as well as private godowns from district Chiniot was conducted.

RESULTS: As a result of this study 5 species were collected and studied namely, *Acotyledon lalianensis* n. sp., *Acotyledon chiniotensis* n. sp., *Acotyledon maizus* n. sp., *Tyrophagus nawazi* n. sp., *Rhizoglyphus kanwanwalaensis* n. sp. in the Acarology research laboratory, University of agriculture Multan.

CONCLUSION: Cereal mites cause grocer itch in humans and endanger the public health by contamination of food with allergens.

Keywords: acarid mite, stored cereals

SPP-IPM-173

Mass production assessment of entomopathogenic fungi on different substrates and comparative bio efficacy against wheat aphid

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ABSTRACT

BACKGROUND: Aphid (Hemiptera: Aphididae) is known as a destructive pest of wheat in Pakistan. The research was conducted to assess the mass production of entomopathogenic fungi on different solid substrates (maize meal, wheat bran and rice husk) and their comparative bio efficacy against wheat aphid. Four entomopathogenic fungi (*Trichoderma viride*, *Metarhizium anisopliae*, *Lecanicillium lecanii* and *Piriformospora indica*) were grown on different solid substrates to screen out the best substrate for mass production. Standard formulation 1 10⁸ spores/ml was prepared. Four treatments of EPFs (T1=*T. viride*, T2=*P. indica*, T3=*M. anisopliae* and T4=*L. lecanii*) along with control were used. The treatments were applied by using three application techniques (seed treatment, foliar application, and combination of both) on wheat variety Faisalabad-2008. The data regarding pest infestation was recorded till crop maturity and comparative bio efficacy of EPFs was calculated. The study revealed that maximum growth of EPFs was observed on rice husk. Results revealed that all treatments were effective against the aphid population. Minimum aphid infestation was observed on T1 (1.959 number aphid) followed by T3 (2.434 number of aphid), T2(2.603 number of aphid) and T4 (5.242 number of aphid) as compared to control (39.042 number of aphid). Comparatively, the aphid population significantly reduced in treated blocks because of the effect of entomopathogenic fungi.

CONCLUSION: The minimum aphid infestation percentage over control group in seed, foliar and seed+foliar blocks occur due to application of *T. viride* (94.9%), *M. anisopliae* (93.7%), *P. indica* (93.3%) and *L. lecanii* (86.5%).

Keywords: Aphid, wheat, entomopathogenic fungi

SPP-IPM-174

Taxonomic Studies of Thrips species in Mango Nursery at Multan, Pakistan

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ABSTRACT

BACKGROUND: Mango, the king of fruits, is a very important orchard crop of the Indo-Pak region. Due to its various characteristics such as sweetness, aroma, multiple varieties and nutritional values it is considered most acceptable throughout the world. Living in a challenging ecosystem, mangoes are also affected by many abiotic and biotic factors. Among biotic, insect-pests are prominent in nature and cause serious damage to mango nursery plants. In which thrips both in green house and in open field conditions cause serious loss by sucking cell sap of leaves. Young flushes are more susceptible to this notorious pest which results in retardation of growth. Various mango thrips species are part of the mango ecosystem. But knowledge of accurate species which are causing damage to mango nursery plants in Multan, Pakistan was limited. Therefore, a study was devised to identify accurate thrips species in mango nursery plants.

METHODS: The study was conducted at Mango Research Institute Multan, Pakistan. The specimens were collected from mostly young flushes of mango in greenhouse tunnels. For preservation 70% ethanol was used. The preserved specimens of 70 ethanol solution were transferred to 60% ethanol solution for 2 hours. It makes an adult's body soft and clear to some limit as well. Approximately after 2 hours these specimens then again transferred to 5% NaOH solution for 30 minutes. After this specimen was transferred to the middle part of the slide which contained a drop of glycerin. Gently coverslip was added. The slides were examined under a light microscope of 100X power by using different taxonomic keys.

RESULTS: The results showed that mango thrips belong to the family Thripidae. The eight segmented antennae, Symmetry present in Pronotum, Hind angle contains long 1-2 setae only, 1-2 long setae present on hind pronotum, Comb presence, Micro setae present on abdominal segments. The 9th and 10th abdominal segments are long and pale in color. Finally, the identified genus was *Scirtothrips*. The species characters include 8- Segmented antennae, Abdominal tergite 10 in male with or without derpanae, Abdominal tergites pale with dark area medially, Posteroangular setae of pronotum no long as pronotum median length, Rows of microtrichia present completely across the median area from III–VI segments. So, the identified species was *Scirtothrips dorsalis* Hood.

CONCLUSION: The identified *Scirtothrips dorsalis* Hood is the serious pest of mango nursery plants in greenhouse tunnels. The new emerging leaves of mango are mostly attacked by this species. So, the exact management strategies can be used to control these insect-pests in future.

Keywords: Mango, Thrips, Identification, Seedlings, Pakistan

SPP-IPM-175

Assessment of cottonseed longevity and deterioration during seasonal storage at different seed moisture levels

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ABSTRACT

BACKGROUND: During Storage, seed deterioration is undesirable and irreversible attribute leads to reduction seed quality which ultimately affect viability and vigour. Moisture is a prime suspect of seed deterioration during post-harvest handling. Oil seeds are highly susceptible to moisture elevation during storage. Moreover, seeds with higher moisture contents are also prone to mechanical injuries and damages during processing. This study was conducted to investigate the efficiency of hermetic and cloth bag packaging to store cottonseed for 12 months at different seed moisture contents (6, 8, 10 and 12%) at Dera Ghazi Khan, Punjab, Pakistan. The effectiveness of packaging material was assessed on the bases of physiological and biochemical attributes at different moistures. At the end of storage, cotton seeds have maximum viability and vigour in hermetic bags at 6 or 8% moisture content. Similarly, this packaging material also equipped seed with higher concentration of antioxidants to limit the deterioration process.

CONCLUSION: Thus, cotton seed can be safely stored at low moisture in hermetic packaging but at high moisture in cloth packaging result in loss in viability, vigour and accelerate deterioration.

Keywords: Cottonseed, seed deterioration, hermetic and conventional storage, moisture isotherm

SPP-IPM-176

Measurement of optimum cotton seeds moisture method and to predict their role in viability during storage

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ABSTRACT

BACKGROUND: Seed insecurity has been reported among rural farmers due to inappropriate methods and poor facilities for seed storage. Poor quality cotton seed is the main reason for low field productivity in Pakistan. The role of seed moisture at the time of harvesting and at post-harvest stages is very important for preserving cotton seed quality. Equipment for measuring seeds moisture content is not accessible to the farmers. The present study elucidated to determine different methods for measurement of seeds moisture content at 30, 40, 50, 60, 70 and 80% relative humidity levels at Seed Physiology Lab, University of Agriculture, Faisalabad. Different moisture determination methods i.e., humidificator strips, humidicator meter box and digital moisture meter were compared with standard Oven method. Based on moisture, seeds viability during storage was predicted. Humidificator strips recorded moisture results were relatively closer to the Oven method at all humidity levels. Cromarty's equation predicts that cotton seed can be stored up to 60% Relative humidity level. With the increase in relative humidity (>60%) viability of cotton seeds quickly declines which is not good for storage.

CONCLUSION: Hence, post-harvest management during storage of cotton seed is an important aspect for maintaining seed viability. Humidificator strips are a low-cost approach for detecting moisture since they are commonly available to small-scale farmers, whereas the oven method (Standard method) is not affordable and accessible to the smallholder farmers. Because seed deterioration is quicker in storage at higher seed moisture level.

Keywords: cotton seed, relative humidity, seed moisture, viability

SPP-IPM-177

Assessment Of Host Plant Impact on The Susceptibility of Whitefly Against IGR's And Biopesticides

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ABSTRACT

BACKGROUND: Whitefly is the notorious agriculture insect pest with a wide host range. Host plants effects insects in a lot of ways, such as the impact on the morphology of both nymph and adult insect which ultimately affect their susceptibility against different compounds. The present study was conducted to assess the impact of host plants on the susceptibility of whitefly against entomo pathogenic fungi and insect growth regulators.

METHODS: Field population of whitefly was collected from different host plants (okra, tomato, brinjal and cotton). The agar media was used to maintain the moisture of leaves. The host plant leaves were placed on agar media and around 20 whiteflies (10 adults and 10 nymphs) per petri plate was released. Toxicological bioassay study was conducted by foliar applications of entomopathogenic fungi (*Beauveria bassiana* and *Metarhizium anisopliae*) and insecticides (pyriproxyfen, buprofezin and flonicamid). The mortality and adult emergence data was noted after different time intervals (24h, 48h and 72h) of post application. Data was subjected to Probit Analysis in Minitab-19 software for the calculation of LC₅₀ and LC₉₀ values. Mortality was directly proportional while adult emergence was inversely proportional to insecticide concentrations. IGRs (Buprofezin, Pyriproxyfen and Flonicamid) showed 100% mortality after 72 hours at all host plants taken (Okra, Tomato, Brinjal and Cotton). While in case of bio-pesticides *Beauveria bassiana* caused maximum mortality in whitefly of tomato, okra, and brinjal 91.06%, 90.03% and 86.66% respectively.

RESULTS: After 72 hours, maximum mortality (80.19%) of whitefly caused by *M. anisopliae* in cotton. In case of adult emergence from nymph's minimum emergence (0.00%) caused after 24 hours at 0.8% and 0.24% concentration of pyriproxyfen and flonicamid in cotton, brinjal and tomato respectively. While in okra minimum emergence (10%) was observed at 2% concentration of buprofezin after 24 hours. In case of bio-pesticides, *B. bassiana* caused minimum adult emergence (9.66%) and (19.66%) after 24 hours in tomato and brinjal respectively. *M. anisopliae* caused minimum adult emergence (20.31%) and (14.66%) after 24 hours in cotton and okra respectively. Maximum adult mortality (91.06%) and minimum adult emergence (9.66%) caused by *B. bassiana* in tomatoes because of the presence of an allelochemical (Alpha Tomatine) in tomato leaves.

CONCLUSION: The study determined the effectiveness of insect growth regulators (pyriproxyfen, buprofezin and flonicamid), biopesticides (*B. bassiana*, *M. anisopliae*) and host plant impact on the susceptibility of whitefly.

Keywords: *B. bassiana*, whitefly, *M. anisopliae*, foliar application

SPP-IPM-178

Synthesis and entomotoxicity assessment of plant extract mediated zinc oxide nanoparticles

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ABSTRACT

BACKGROUND: The use of synthetic pesticides are effective tools against insect pests, but they cause environmental pollution, resistance, and damage to the biodiversity. Nanotechnology appears as an alternative way to fight against the

insect pests. Green synthesis of metal oxide nanoparticles makes them a better choice over traditional chemicals. The present study was conducted to evaluate the toxicity of *Datura stramonium* mediated zinc oxide nanoparticles (ZnO NPs) on different insect pests by using in vitro bioassay.

METHODS: Soxhlet apparatus was used for the preparation of plant extract. Five concentrations (5, 10, 15, 20 and 25mg/100ml in distilled water) were used and data was recorded after each 12, 24, 36, 48, 60, 72 hours and then after 7 days of post treatment. Analysis showed that percentage mortality increased by increasing concentration of plant extract mediated ZnO nanoparticles.

RESULTS: Results showed that synthesis of nanoparticles with the combination of botanical extract and sodium nitrate control the *Sitobion avenae*, *Brevicoryne brassicae* and *Spodoptera frugiperda* population effectively under controlled conditions.

CONCLUSION: From above mentioned results, it can be concluded that plant extract mediated nanoparticles can be used to manage different insect pests on agricultural crops.

Keywords: nanoparticles, synthetic pesticides, Nanotechnology

SPP-IPM-179

A study to find the resistance of new chemistry insecticides against cotton jassid (*Amrasca devastans*)

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ABSTRACT

BACKGROUND: Cotton Jassid, *Amrasca devastans* (Distant), is an important pest of various crops in Pakistan, mainly on cotton. It has the potential to develop resistance against commonly used insecticides due to the extensive use of insecticides.

METHODS: The resistance levels of five insecticides i.e., Fenprothrin (Danitol 30 % EC), Spirotetramat, Acetamiprid, Imidacloprid (Confidor 20% SL) and Nitenpyram (Sega 10% SL) against cotton jassid; *Amrasca devastans* collected from the different fields of district Faisalabad, Toba Tek Singh and Jhang was evaluated under laboratory conditions at 28 ± 2 °C and 65 ± 5 RH using leaf dip bioassays.

RESULTS: The results depicted the 10.41-46.64-fold resistance to Fenprothrin (Danitol 30 % EC), 11.92-34.76-fold to Spirotetramat, 36.44-74.42 fold to Acetamiprid, 102.43-162.23-fold to Imidacloprid and 105.11-272.21-fold to Nitenpyram (Sega 10% SL) in different field populations as compared to susceptible strain. *A. devastans* showed resistance to all the tested insecticides, so it may be suggested to discontinue the use of these insecticides and the use of those insecticides to which the cotton jassid is susceptible.

CONCLUSION: To prevent the development of resistance, dynamic resistance management strategies such as using insecticides judiciously with proper selection of dose, best time and method of spray should be adopted.

Keywords: Cotton jassid, Insecticides, resistance, IPM.

SPP-IPM-180

***Trichogramma chilonis*: an Effective Egg Parasitoid of *Spodoptera frugiperda* in Maize**

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ABSTRACT

BACKGROUND: Fall armyworm (FAW), *Spodoptera frugiperda* is a destructive pest with a polyphagous nature that feeds on various crops. It is an invasive species of armyworm on maize in Pakistan. *Trichogramma chilonis* an egg parasitoid of lepidopteran pests is commercially reared and available in biocontrol labs of sugar mills and Govt. owned biocontrol labs.

METHODS: The present study was aimed to evaluate the parasitism potential and performance of *T. chilonis* against *S. frugiperda*. About two hundred larvae of *S. frugiperda* were collected from the maize crop from Multan and reared on maize under laboratory conditions. To observe its parasitism potential, *T. chilonis* was reared on the eggs of *Sitotroga cerealella*. Egg densities were considered as different treatments / independent parameters i.e., 20, 40, 60, 80, 100 eggs. Adult female *T. chilonis* was introduced in plastic jars possessing different egg densities. Dependent parameters i.e., longevity, parasitism frequency and emergence were noted with respect to different egg densities of fall armyworm. To determine parasitism preference of *T. chilonis* on two hosts i.e., *S. cerealella* and *S. frugiperda* eggs were used. The parasitism of 24h and 48h aged females of *T. chilonis* on *S. frugiperda* eggs were evaluated. In a field experiment, there were five treatments: 1 card per week, 2 cards per 2 week, 2 cards per week and 2 cards per 2 weeks with control, replicated three times. Damage percentages were recorded on all treatments.

RESULTS: Parasitism rate was recorded up to 46 % on fall armyworm at eggs density of 100 eggs / female. Parasitism preference experiment demonstrated that *T. chilonis* had more parasitism on *S. cerealella* eggs (66.5%) than *S. frugiperda* (45.33%). Results further depicted that *S. frugiperda* eggs hatched on 3rd to 4th days. Maximum parasitism activity was noted on fresh eggs (57.75%) of *S. frugiperda* than two days old eggs (44%). Average longevity of *T. chilonis* was about 7.7 days. The parasitism of a 24-year-old female was 30% and 48h old female was 62%. Application of *Trichogramma* cards had a significant effect on population reduction of *S. frugiperda*. Minimum damage by fall armyworm was observed in treatment with 2 *Trichogramma* cards per week.

CONCLUSION: It is recommended that monitoring of FAW through sex pheromone traps should be done. *Trichogramma* cards @ 15-16 cards / acre should be installed after 3-4 days of moth's appearance to maximize the control of FAW. It could be used in IPM strategies at farmer's fields against fall armyworm with safe insecticides.

Keywords: Fall armyworm, *S. frugiperda*, *T. chilonis*, Parasitism, Emergence

SPP-IPM-181

Morpho-Molecular Identification of Bacterial Pathogens from Indigenous Weeds Associated with Citrus Orchards in Pakistan

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ABSTRACT

BACKGROUND: This study was accompanied to investigate the biodiversity of bacterial endophytes from indigenous weeds of citrus-associated orchards that can serve as a reservoir for pathogenic bacteria. **METHODS:** Fourteen different types of weeds were collected from surrounding citrus trees of two regions Sargodha and Lahore of province Punjab Pakistan. Twenty-two bacterial endophytes that belong to eleven different genera of bacteria were identified by biochemical tests and Morpho-molecular characterization.

RESULTS: Bacillus was found to have the largest prevalence percentage in weeds, according to RDP (ribosomal database project) classification, while Beta and Gamma Proteobacteria had lower distribution rates. The most abundant genus in the Firmicutes is Bacillus (21.73 percent), Staphylococcus (13.04 percent), Enterococcus (8.69 percent), and Lysinibacillus, Brevibacterium, and Paenibacillus (4.34 percent). Likewise, (Pantoea, Pseudoacidovorax, Escherichia, Enterobacter, 4.34 percent, and Pseudomonas 8.69 percent) constitute the phylum Proteobacteria based in this study. Formerly, the diversity of bacterial (endophytes) from indigenous weeds in Pakistan had not been documented, and this is the first time that endophytes biodiversity from nearby citrus orchard weeds has been documented.

CONCLUSION: This research will aid in understanding the microbial diversity of bacterial pathogens on weeds that can serve as a habitat for pathogens and spread the infection.

Keywords: 16srRNA, Endophytes, Weeds, Bacterial strains, Morpho-biochemical, Identification, Diversity,

SPP-IPM-182

Species composition and population dynamics of arthropod pests in cotton fields plots

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ABSTRACT

BACKGROUND: Cotton crop is attacked by a wide range of insect pests at its various phenological stages. Diverse pest fauna has been reported from cotton fields by different researchers. Humans and insects have intertwined faith, especially through the agroecosystems. The present study aimed to record seasonal dynamics and diversity of different insect pests in cotton agroecosystems.

METHODS: Two well-known cotton producing districts i.e., district Layyah and district Vehari were selected for this study from the cotton belt of Punjab, Pakistan. Sampling was done bi-weekly from July to October during 2018 and 2019. Sweep netting, visual counting, hand picking, wet finger method, beat sheets, aspirator and pitfall trapping methods were used for collection. Shannon-Wiener and Simpson indices were used to compute diversity while Menhinick and Margalef indices were used for the estimation of species richness.

RESULTS: A total of 94343 individuals representing 43 species, 40 genera, 28 families and 6 orders were recorded. Family Aleyrodidae dominated over other pest families. *Bemisia tabaci* (Gennadius, 1889) of family Aleyrodidae was the dominant species with 39.68% share among all pest species. Estimated species richness of all arthropod pest species belonging to both districts were about 94%. The densities of pests fluctuated with time. The peaks of sucking pest densities were observed in July and August while densities of chewing pests peaked in late September or early October each year. Population densities of Jassid, army worm and pink bollworm showed strong negative correlation with temperature, humidity, and rainfall while thrips population density showed positive correlation with these parameters.

CONCLUSION: The cotton growers must remain vigilant throughout cropping season as all these pests attack the crop in consecutive standard meteorological weeks. In agricultural fields, different insects respond differently to the weather parameters. Even different life stages of each insect also show varied response to same environmental factor. Minor loss due to pests are acceptable everywhere. But it is only possible when their populations remain below their economic threshold levels. Present study will aid to design pest management strategies in cotton growing areas round the globe.

Keywords: Cotton whitefly, population dynamics, agroecosystem

SPP-IPM-183

Integration of *Beauveria bassiana* and *Steinernema carpocapsae* against six major coleopterans insect species

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ABSTRACT

BACKGROUND: Among the different stored grain insect pest the red flour beetle *Tribolium castaneum*, the khapra beetle *Trogoderma granarium*, the sawtoothed grain beetle *Oryzaephilus surinamensis*, the rice weevil *Sitophilus oryzae*, the lesser grain borer *Rhyzopertha dominica*, and *Cryptolestes ferrugineus* are considered as major pest of stored grain.

METHODS: In this study first time we have tested alone and combined application of entomopathogenic nematode *Steinernema carpocapsae* at two different concentrations (50 and 100 IJs cm⁻²) and entomopathogenic fungi *Beauveria bassiana* at rate 1 × 10⁶ conidia ml⁻¹.

RESULTS: In alone comparison, both concentrations of *S. carpocapsae* caused greater mortalities as compared to *B. bassiana* alone application. The combination of treatments produced greater mortality as compared to alone application of each agent. The maximum mortality was observed against the highest concentration of *S. carpocapsae* (100 IJs cm⁻²) and *B. bassiana* (1 × 10⁶ conidia ml⁻¹). The mortality was found in a dependent manner over the period as lowest mortality was observed at a three-day interval while the maximum mortality was observed at fourteen day of exposure period. Among the different insect species tested, the highest mortality 96% in *R. dominica*, 90% *S. oryzae*, 87% in *T. castaneum*, 82% in *C. ferrugineus*, 76% in *O. surinamensis* and 70% in *T. granarium*.

CONCLUSION: In present study we have concluded that both *B. bassiana* and *S. carpocapsae* caused greater mortality of above-mentioned insect pests when applied in combination. This study concluded that both pathogens application could be used in storage structure to manage insect pest attack.

Keywords: Entomopathogenic Nematode, Entomopathogenic Fungi, Stored Grains Insect Pests.

SPP-IPM-184

Development of resistance against deltamethrin, lambda-cyhalothrin and chlorpyrifos in six coleopterans insect pests

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ABSTRACT

BACKGROUND: Current study tested the different level of resistance of different insecticides against the khapra beetle, *Trogoderma granarium* Everts (Dermestidae: Coleoptera), red flour beetle *Tribolium castaneum* (Herbst) (Tenebrionidae: Coleoptera), rice weevil *Sitophilus oryzae* (L.) (Tenebrionidae: Coleoptera), sawtoothed grain beetle *Oryzaephilus surinamensis* (L.) (Silvanidae: Coleoptera), *Cryptolestes ferrugineus* (Stephens) (Laemophloeidae: Coleoptera), and lesser grain borer *Rhyzopertha dominica* (F.) (Bostrichidae: Coleoptera).

METHODS: In this study, the different insecticides include deltamethrin, lambda-cyhalothrin and chlorpyrifos were tested at seven different discriminating concentrations against aforementioned insect pests.

RESULTS: Five different locations were selected for determination of resistance including Muzaffargarh (MFG), Lodhran (LDR), Layyah (LHY), Rahim Yar Khan (RYK), Lahore (LHR) and susceptible laboratory population. Among the different insecticides the maximum level of resistance was observed against deltamethrin followed by lambda-cyhalothrin and chlorpyrifos while among the different population irrespective of insecticides used the maximum level of resistance was observed from district Muzaffargarh (MFG) population while least level of resistance was observed against the Lahore (LHR) population. Against deltamethrin maximum (8.07-fold) and minimum (3.86-fold) level of resistance was observed against MFG and LHR population respectively. In case of lambda-cyhalothrin (6.12 and 3.22-fold) and chlorpyrifos (2.58 and 1.25-fold) maximum and minimum resistance respectively was observed against the MFG and LHR population. Among different insect pests the resistance level was followed as *T. granarium* > *R. dominica* > *S. oryzae* > *T. castaneum* > *O. surinamensis* > *C. ferrugineus*. Regarding population the MFG population found most resistance followed by LDR, LHY, RYK and LHR populations.

CONCLUSION: In this study, we have concluded that all the pests have gained resistance towards deltamethrin, lambda-cyhalothrin and chlorpyrifos from distant populations.

Keywords: Insecticides Resistance, Deltamethrin, Lambda-cyhalothrin, Chlorpyrifos, Different Locations, Stored Grains Insect Pests.

SPP-IPM-185

Compatibility of spinosad and alpha-cypermethrin against *T. castaneum*, *T. granarium*, *O. surinamensis*, *S. oryzae*, *R. dominica*, and *C. ferrugineus*.

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ABSTRACT

BACKGROUND: The storage insect pests are major factors for the deterioration of storage wheat and among them

Rhyzopertha Dominica, *Sitophilusoryzae*, *Triboliumcastaneum*, *Cryptolestes Ferrugineus*, *Oryzaephilus Surinamensis* and *Trogoderma Granarium* are the major stored grain insect pests.

METHODS: In this study, first we have tested the combined efficacy of Spinosad and alpha-cypermethrin against the insect pests under laboratory conditions. The Spinosad was tested at two different concentrations (0.05 and 0.1 mg kg⁻¹) while alpha-cypermethrin was tested at 0.05 mg kg⁻¹.

RESULTS: In the mortality bioassay, combination of treatments caused greater mortality as compared to alone application of each agent. Treatment not only produced the significant mortality but also reduced the subsequent progeny production over the time. In the persistence bioassay, treatments were found very effective over the period of four months. Irrespective of insect species tested, the maximum mortality was observed over the period of zero day of storage period. The mortality was found with the progression of time intervals. Treatment was also found to decrease the production of F1 individuals over the period of four months. Among the different treatments, combination of Spinosad at highest rate 0.10 mg kg⁻¹ and alpha-cypermethrin at 0.05 mg kg⁻¹ caused greatest mortality and also the reduction of F1 progeny. Combinations of treatments caused greater mortality as compared to alone application of each treatment.

CONCLUSION: Among different insect pests, the *R. dominica* found most susceptible followed by *S. oryzae*, *T. castaneum*, *C. ferrugineus*, *O. surinamensis* and *T. granarium* was found most resistant species. This study concluded that the combined application of alpha-cypermethrin and Spinosad could be used as a grain protectant against insect pests.

Keywords: Efficacy of Insecticides, Spinosad, alpha-cypermethrin, Stored Grains insect Pests.

SPP-IPM-186

IPM Approach for Varroa Mite (*Varroa destructor*) Control: A Review

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ABSTRACT

INTRODUCTION: Varroa mite, *Varroa destructor* (Acari: Varroidae), is the destructive mite of the honeybee, *Apis mellifera* L. (Hymenoptera: Apidae), with a great importance in economics. Varroa mite is one of the main deadlocks in the developmental route of apiculture around the world. The ectoparasitic Varroa mite, causing major economic losses to the beekeepers and is a serious threat to honeybees. It attacks on the haemolymph of pupae and adults causing weakening, killing of the bees and transferring viral pathogens such as DWV (Deformed Wing Virus). RNA virus is responsible for wing malformations in bees that causes flying disabilities, which leads to failure in collection of food for the colony resulting in the decline and death of the bee population, as well as a threat to pollination. Cultural practices for managing Varroa mites include removal of comb frames while drones are capped, increase colony spacing with few honey supers, screening of bottom board, use of hygienic bees, requeening and caging of the queen. Biological control such as *Beauveria bassiana*, *Metarhizium anisopliae*, *Bacillus thuringiensis* and Natural predators like pseudoscorpions, *Nesochernes gracilis* or Chelifer cancrioides and predatory mite *Stratiolaelaps scimitus*. Essential oils for managing Varroa mites are salvia oil (*Salvia officinalis* L.), thyme oil (*Thymus vulgaris* L.), hyssop oil (*Hyssopus officinalis* L.), *Rosmarinus officinalis* L., *Zataria multifera* Boiss., *Lavandula officinalis* L., *Origanum vulgare* L., *Mentha spicata* L., *Saturea hortensis* L., *Anethum graveolens* L., savoury oil, spearmint oil, neem oil, eucalyptus oil, menthol oil and hop plant leaves extract are highly effective against Varroa mite. Organic acid such as formic acid, oxalic acid dehydrates, hops beta acids, caustic acid and oleic acid are used for Varroa mite management. Synthetic chemical: formamidine amitraz (Inhibits neurotransmission leading to paralysis), tau-fluvalinate pyrethroid (Changes kinetics of the voltage-

gated sodium channel), Flumethrin (pyrethroid) and organophosphate coumaphos deliver successful results for the effective control of Varroa mites in honeybees colony.

CONCLUSION: The result of study shows that natural predators like pseudoscorpions, essential oils extracted from different plants and organic acids are effective alternatives for integrated pest management of varroa mite in honeybee's colonies. Combining effects of all control measures proves to be a pest management tool for sustainable apiculture.

Keywords: Honeybees, varroa mite, integrated pest management, essential oils, organic acid

SPP-IPM-187

Parasitism & Alfalfa Leafcutter bee: A Review

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ABSTRACT

INTRODUCTION: Alfalfa, also called lucerne, is flowering plant in the legume family cultivated as forage crop around the world used for grazing, silage, hay, cover crop and green manure. Alfalfa cannot self-pollinate, leaf cutter bee *Megachile rotundata* is an important pollinator for this crop. Solitary bees account for fifty percent pollination in alfalfa seed production and Native to Europe. Larval development can be affected by increasing temperature in the nest cells, pathogens, cleptoparasites, fungal diseases, predator, and parasitoids. These all are the major concerns as they can produce in bee boards, can prey on developing larvae and if not controlled increase mortality. Most parasitoid wasp ovipositor into the nest cell, pierce developing larvae and deposit their eggs on the surface of larvae. After 24 to 48hrs eggs hatch and wasp larvae begin to feed on bee larvae. These can damage bee health resulting in brood loss, causing decrease in pollination. Many fungal diseases can occur like chalkbrood resulting from *Ascosphaera* spp. Parasitic wasps like Chalcid wasps and Sapygid wasps can affect pollinators and reduce pollination. Thus, there is a need to reduce parasitism. Emergence of adult parasitoids are managed with the use of yellow sticky traps.

CONCLUSION: Health of *M. rotundata* is crucial for achieving maximum pollination of alfalfa to increase seed for growers. Novel techniques and approaches like X-ray and PCR amplification should be used for detection in nest boxes. Combination of disinfectant and lure are used to protect broods. Modern incubators should be operated for protecting bees. Placement of dichlorvos strips near the stored nest cells to reduce the number of emerging adult parasitoids.

Keywords: Fungal diseases, predators and parasitoids, pollination, nest cells

SPP-IPM-188

The importance of density dependence in juvenile mosquito development and survival: A model-based investigation

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ABSTRACT

BACKGROUND: Mosquitoes are the vectors of several pathogens and as a result they pose a serious worldwide health risk. As such, more reliable field-relevant models to study mosquito population dynamics and life history traits such as development time and survival of mosquito larva would be of great value. The early life stages of *Aedes* mosquitos are known to be density dependent. Many existing simulation models ignore or oversimplify density dependency, despite its significance. As a result, development, and survival predictions during the early stages of life are less accurate. However, in many models, density dependency is believed to have only a minor impact on larval survival rather than development

time. Even though density dependent development has been demonstrated by actual evidence. Here we create a discrete-time model of the Population dynamics of mosquito larvae, taking into consideration the effects of density on both survival and development. Using publicly available semi-field data on larval density, we established the validity of our model and pupation timing course of six-month study. We found that including density Dependence into our model throughout larval development is essential for accurate mosquito pupation prediction. This is especially true when considering mosquito larvae's density-dependent growth time as contrasted to Survival of larvae is influenced by density. In comparison to models that neglect density, simulation models with density dependence produce better prediction outcomes.

CONCLUSION: Completely dependent on Simple functional forms like this can be simply integrated into existing models and as a result, field relevant models of mosquito population dynamics, notably in *Aedes* and other mosquito species, will be improved. Mosquitoes that live in containers and are known to have density dependence during larval development.

Keywords: mosquito, population dynamics, *Aedes* mosquito

SPP-IPM-189

Integrated management of *Bactrocera zonata* (Saunders) (Diptera: Tephritidae) in different orchards

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ABSTRACT

BACKGROUND: The destructive fruit fly *Bactrocera zonata* became a threat for the fruit production and fruit export over the world. There are many reports that reveal that these two species cause serious losses to fruits and vegetables. This study was designed to reduce application of insecticides and developed eco-friendly management techniques.

METHODS: The integrated pest management (IPM) against *B. zonata* was carried out in three orchards of commonly consumed fruits including citrus, guava, and mango. Different IPM techniques like hoeing, baiting and chemicals were used singly or in combinations to control fruit flies.

RESULTS: The findings of our study revealed that the population of *B. zonata* were dominant in mango orchards rather than guava and citrus orchards. Combination of hoeing with baiting (methyl eugenol) reduced fruit fly infestation upto 70-75% and maximum (85-90%) control of fruit fly was recorded where application of all control measures including hoeing, baiting (methyl eugenol) and insecticide (Dipterex®) were incorporated.

CONCLUSION: These results suggested that *B. zonata* damage can be efficiently reduced following the integrated pest management (IPM) strategy.

Keywords: *B. zonata*, Baits, Chemicals, Fruit fly, Fruits, Hoeing, Pest Management

SPP-IPM-190

Use of nanotechnology instead of synthetic insecticides for tephritid flies control

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ABSTRACT

BACKGROUND: Tephritid flies are quarantine pests of many fruit and vegetable crops such as mango, peach, cucumber. It

oviposits eggs in the fruit and those eggs hatch into larvae due to which the quality of fruit decreases. For the management of pests, insecticidal sprays are applied but they are not very efficient because the pest hibernates into pupae. Instead of control, those insecticides leave a hazardous effect on beneficial insects and other non-target organisms. For efficient control, biological methods are used. Nanotechnology is also a biocontrol and an advanced technique. This technique is also a green revolution.

METHODS: Nanotechnology is the synthesis of nanoparticles (NPs) by chemical, physical, biological methods. The size of nanoparticles is between 1 and 100 nm. The origin of nanoparticles is from organic and inorganic compounds. Biopesticides are produced by microorganisms and plant extracts. These particles are extracted from different plants like neem extract, lemon leaves extracted by biosynthesis. Neem extracts are used for biosynthesis and silver and copper nanoparticles are produced which are applied.

RESULTS: By using the technique, astonishing results were recorded for pest control. These nanoparticles showed the ovicidal property. Approximately 80% suppression of egg development is observed. This technique is eco-friendly and very effective for pest control.

CONCLUSION: Nanotechnology is a modern technique for pest control and is much more efficient than synthetic insecticides.

Keywords: Nanotechnology; plant extracts; Tephritid flies; green revolution

SPP-IPM-191

Review on efficacy of different insecticides against Pink Bollworm

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ABSTRACT

BACKGROUND: Pink bollworm is a major devastating pest of cotton which effect the seed cotton yield, oil contents and cotton fiber. The aim of this study was the evaluation of different chemical insecticides on pink bollworm and its effect on natural enemies. The field experiment conducted in summer season to calculate the efficacy of different insecticides against pink bollworm *Pectinophora gossypiella* and its effect on natural enemies. Its larvae feed on cotton bolls destroys its fiber and yield quality. On the other hand, natural enemies protect the crops from other insects. Different insecticides Gamma cyhalothrin, Deltamethrin, Spinetoram, Cypermethrin, Bifenthrin, Triazophos, Spinosad were evaluated from field. The experiment conducted in RCBD in four replications. Pyrethroids showed effectiveness up to 7th days of the spray during both steps. In the first step the reduction of pink bollworm in cotton is medium and the second application its reduction on peak value.

DISCUSSION: Pyrethroids show more efficacy against pink bollworm, but it is harmful for natural enemies. It demolished natural enemies from the cotton crop.

Keywords: Pink bollworm; Insecticide's efficacy; Natural enemies.

SPP-IPM-192

Uncovering the range of competitive ability factors in wheat can recover integrated weed management

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ABSTRACT

BACKGROUND: In organic and moderate farming, weed stress can be severe, reducing productivity and quality traits. Integrated weed management in such systems comprises a variety of agronomic strategies, but it usually encourages the development of highly competing varieties, which would decrease dependence on conventional weed control measures and their negative impacts on soil and the ecosystem.

METHODS: The focus of this research was to characterize common wheat (*Triticum aestivum* L.) germplasm grown in the field of research for four factors linked to productive capacity against weed growth (above-ground organic matter until stem elongation, number of tillers, spike length, and leaf area morphological characteristics) and two yield traits (Kernel weight and grain yield). This method was used to find the best groups of competitive and productive features, which frequently display trade-offs, and it resulted in the discovery of eight germplasm with a lower grain output to crop length trade-off. SNP markers were used to analyze the sample, indicating a high level of genetic variation and showing a pattern of polymorphism reduction from ancestral to present germplasm, despite the existence of distinct variants in both categories.

RESULTS: These results highlight the significance of analyzing both historic and elite genetic variability when investigating characteristics which are not focused on by formal breeding, like weed competitiveness. For all attributes tested, MTAs (Marker-trait associations) with false discovery rates (FDR) of less than 5% were found, whereas FDR of less than 1% were found for spike length, bioenergy, yield components weight.

CONCLUSION: This study indicates the tremendous potential of research activities that connect modern genetic analysis with organic agriculture strategies to choose highly effective bread wheat genotypes as a technique in more efficient integrated weed control systems.

Keywords: Cultivars, Germplasm, Marker-trait association, Polymorphism, Weed management

SPP-IPM-193

Drones: Innovative technology for integrated pest management

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ABSTRACT

BACKGROUND: Remote sensing has been used in different fields of precision agriculture like crop phenology evaluation, predictions of yield and these technologies also monitored drought, nutrient deficiency, pathogens, weeds, and nematodes. Remote sensing technologies used to monitor different plant stressors caused by pests in the fields, orchards and apply different control measures according to collected data from fields.

METHODS: Two types of drones are used in pest management; sensing drones are used to detect plant reflectance and

pest hotspots while actuation drones are referred for application of precision controls or solutions. These drones were used to establish a loop of communication in IPM solutions. After detection of pest damages with sensing drones, actuation drones apply control measures according to information of sensing drones at that specific spot. Pests can be managed with various control methods like release of natural enemies and application of pesticides. Aerial remote sensing has been used for many decades for controlling pests without harming the environment, ecosystem, and human health.

RESULTS: It was studied that application of pesticides other than proper place may be substantial. That's why there is a need for precise and improved technology for pest control. Drones are used in precision agriculture for application of precise solutions like pesticides application and release of natural enemies. Sensing and actuation drones are used in precision agriculture for pest management because these drones reduce time for pest scouting and pesticide applications.

CONCLUSION: This technology in precision agriculture is ecofriendly and cost effective.

Keywords: Drones, Ecofriendly, Natural enemies, Precision agriculture, Remote sensing

SPP-IPM-194

Evaluation of conventional and microbial insecticides against Pink bollworm, *Pectinophora gossypiella* (Lepidoptera: Gelechiidae)

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ABSTRACT

BACKGROUND: Cotton is an important fiber crop in Pakistan because of its commercial cultivation and export requirements. But Pakistan has experienced devastating crop production losses (40–50%) in recent years due to insect pests. Among these insect-pests, the pink bollworm (PBW) is the most important, as it affects the crop both qualitatively and quantitatively. The PBW larvae enter the fruiting body quickly after hatching from eggs, making their management a bit challenging for the pest managers. Additionally, increasing applications of synthetic insecticides have resulted in a higher level of resistance and pest resurgence. Alternatively, the use of microbial pesticides along with insecticides can affect the activity of the pink bollworm.

METHODS: Considering the importance of management of the pink bollworm, this research was planned. In this research, the first rearing technique of pink bollworm was standardized on natural and artificial diets. Following this, laboratory evaluation of microbial and conventional insecticides was carried out under controlled conditions. For this purpose, larvae were brought to the laboratory and were reared on closed cotton bolls. The F1 generation was used to study the life cycle of the pink bollworm on different diets. Third instar larvae were provided with artificial diets.

RESULTS: A bioassay was conducted, and mortality was recorded after 72 hours. The responses of both insecticides were recorded.

CONCLUSION: Such a study improved the management strategy of the pink bollworm. After one, two, and five days, the larvae were examined to determine the mortality rates.

Keywords: Bioassay, Cotton, Mortality, Management, Pink bollworm, Rearing

SPP-IPM-195

Effect of elevated carbon dioxide (CO₂) on *Sitobion avenae* Fabricius (Aphididae; Homoptera) - *Triticum aestivum* Interaction

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ABSTRACT

BACKGROUND: Increasing level of atmospheric carbon dioxide (CO₂) reduces nitrogen concentration, also accelerates carbohydrates accumulation, and increases biomass and C₃ crop plants yield. The changes in primary and secondary metabolites affect the feeding of insect-pests and palatability of plants. Aphids are only pests that positively respond to elevated carbon dioxide and are also phloem feeder insects. Wheat aphid *Sitobion avenae* Fabricius is a key and cosmopolitan pest of spring wheat in north china.

METHODS: It was planned to test plant-insect interaction under elevated carbon dioxide by a photo climate chamber. Aphids were collected from the field and reared in the Lab.

RESULTS: We applied different concentrations of CO₂ (370, 700 and 1050ppmv) to 2× ambient and 3× ambient levels for testing response of wheat and aphid to elevated Co₂.

CONCLUSION: Our results facilitate elevated atmospheric carbon dioxide change chemical composition of wheat plants and aphid showed negative response to host.

Keywords: Biomass, CO₂, Host plant, Wheat Aphid, Yield,

SPP-IPM-196

Evaluation of Neem leaf powder against *Musca domestica*

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ABSTRACT

BACKGROUND: *Musca domestica* L is a pest of human beings as well as animals. This insect is commonly known as housefly and found throughout the world. This is a notorious pest because its carries hundreds of pathogens. Neem leaf powder possesses insecticidal properties but before going to employ this its effects on different population and demographic parameters were studied.

METHODS: Sublethal doses of Neem leaf powder was determined by conducting a preliminary bioassay and were given in sugar solution. About fifty eggs were separated and their hatching, larval stages, Pupal duration, adult exclusion, and survival rate were recorded. The difference between control and treated population were studied. Net reproductive rate, TPOP, APOP and fecundity were studied.

RESULTS: Fecundity was significantly decreased comparative to control. While TPOP and APOP values were slightly decreased in treated population comparative to control. The intrinsic rate of increase was 0.19 in case of control and was about 0.15 in the treated population. The net reproductive rate was 10.25 /day. The finite rate of increase (λ) was higher in control. The net reproductive rate was higher in control.

CONCLUSION: Observing the results, it was suggested that neem leaf powder could be used as population suppressor against *M. domestica*. No hermetic effect was observed in this case.

Keywords: Housefly, Botanicals, *Musca domestica*, Neem leaf powder, Population Parameters,

SPP-IPM-197

Evaluation of three insecticides against *Solenopsis invicta*

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ABSTRACT

BACKGROUND: *Solenopsis invicta* is a common pest of households. This insect is commonly known as RIFA (red imported fire ant). And is given the status of number one or super pest by structural industry. This pest has status among 100 quarantine pests which are more important pest for both medical and agriculture point of view.

METHODS: The insecticide solution was prepared in 25% sugar solution. This solution was subjected to serial dilution. About 40 individuals in 4 different replications were subjected to each concentration. Mortality was counted about 12, 24 and 48 hours.

RESULTS: The LC₅₀ value was lower in case of Methoxyfenozide (0.18) comparative to Imidacloprid (4.00) and Chlorantraniliprole (3.80). The higher LC₅₀ value in imidacloprid was indicating that it is less toxic to RIFA.

CONCLUSION: Insecticides are an important control measure against Red imported fire ants Methoxyfenozide is a potent insecticide to control RIFA. Among other insecticides Chlorantraniliprole could be a control option for this notorious pest.

Keywords: RIFA, *S. invicta*, Insecticides, LC₅₀, Methoxyfenozide, Imidacloprid, Chlorantraniliprole

SPP-IPM-198

RNA interference (RNAi) an efficient tool for insect pest management

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ABSTRACT

BACKGROUND: RNA interference (RNAi) is now widely used for the substantial management of insect pests. RNAi is a post-transcriptional mechanism through degradation of mRNA by small interfering RNA (siRNA). The occurrence of gene silencing has been deliberated as a prospective tool for the controlling of insect pests. The double-stranded RNA (dsRNA) introduced in an organism has the capability to silence post-transcriptional genes. Introduction of dsRNA into an organism has been verified by using altered techniques such as microinjection, soaking, or, most preferably, oral feeding of artificial diet. Most of the studies on RNAi for insect control have been concentrated on the insect midgut as it is contemplated as the most operative target for the RNAi based pest control. The transference of dsRNA into the midgut is exaggerated by feeding as dietary constituent; nevertheless, the place of midgut is hostile for the fed dsRNA, where the gut nucleases and pH plays a major role amongst other allied aspects. Numerous studies have revealed that pest resistance to chemical pesticide and Bt has amplified demanding new techniques to be realistic to diminish the influences of pest on crop production. While commonalities regarding the development of resistance to chemical and biological control agents persist to be unwavering, research advocates that both biochemical and genetic aspects can contribute to this resistance. It is therefore decisive to investigate the perspective of integrated pest control or management (IPM) to condense the threat of pests on agroecosystems.

CONCLUSION: Prevalent escalation in the solicitation of RNAi technology in insect research has expedited the identification of insect gene function. Research has revealed that while dsRNA is predominantly unadventurous, there are innumerable functions and growth dynamics among insect species. Such discrepancies are yet to be fully implicit but certainly can serve as a basis for determining their capacity to control insect genes. The main contest for moving towards

larger scale projects remnants the development of actual delivery mechanisms. Feeding is very popular in insect RNAi research and may have the most auspicious effect in pest control, exclusively with the establishment of transgenic plants producing dsRNA. Ultimately, the use of transgenic insects will also lead to more efficient pest control.

Keywords: RNAi, dsRNA, IPM, resistance, insect pest, management.

SPP-IPM-199

Essential Oil-Based biopesticides: Formulation and Bioactivity against the Red Flour Beetle *Tribolium castaneum*

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ABSTRACT

BACKGROUND: Post-harvest pest control is limited to a few synthetic inorganic pesticides. Uncontrolled and irresponsible use of synthetic pesticides has many side effects on non-target organisms and the environment. Now there is increasing interest in the scientific community to propose eco-friendly techniques. The growing resistance to phosphine has created the need for urgent development of alternatives for stored product pest management.

METHODS: Three commercial Essential Oils (Anise *Pimpinella anisum*, Garlic *Allium sativum*, mint *Mentha piperita*) were selected to test their bioactivity. Acute toxicity of developed formulation was tested against a major pest, red flour beetle. All products were tested through adult bioassay.

RESULTS: Mortality values showed that Garlic (*Allium sativum*) EO emulsion caused the highest mortality. Essential Oil based insecticides is the best method to control stored grain pests, it can be integrated with other pest management approaches.

Keywords: Insect pest management, red flour beetle, insecticide resistance management, integrated pest management.

SPP-IPM-200

Management of cotton diseases and pests by intercropping

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ABSTRACT

BACKGROUND: Cotton (*Gossypium hirsutum* L.) is a globally important crop that's often damaged by pests and diseases and causes economic loss for farmers. Current cotton pests and disease management is dependent on chemical pesticides. Chemical pesticides are usually considered more effective for long-term due to persistence in the environment for a long time. Application of those pesticides often results in increased insecticide resistance within the pests, fewer natural enemies, reduced natural control, and degrades our environment.

METHODS: Need to increase environmental awareness for sustainable cotton production, the control of cotton pests and diseases using biological means e.g., intercropping is a more effective technique. Intercropping of cotton with other crops can often boost the entire yield and output of the intercropping system and provide significant economic benefits without sacrificing cotton quality. Intercropping also increases the number of natural enemies and reduces the occurrence of cotton pests and diseases by changing the ecological structure and environmental conditions in the fields.

RESULTS: Cotton-based intercropping is an efficient strategy to scale back the competition between cotton and grain or other economic crops for arable land. It is also crucial thanks to increasing the populations of natural enemies for the eradication of pests and diseases in cotton fields. Although inappropriate intercropping also can increase labor requirements and even end in inadequate control of pests and diseases. This review focuses on the importance and the

mechanisms of intercropping for reducing cotton diseases, pests and on the effective management of intercropping systems. The risks and limitations, also because the study approaches needed and therefore the prospects of intercropping for the control of cotton diseases and pests, also are discussed.

Keywords: Cotton; disease management; pest; intercropping

SPP-IPM-201

Comparative efficacy of different plant extracts and their green synthesized Zinc Oxide Nanoparticles against Wheat Aphid (*Sitobio avenae* F.).

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ABSTRACT

BACKGROUND: Pest infestation is a serious concern nowadays in the field. Injudicious use of pesticides is a common factor which affects human health and environment. Different types of pests (Insect and Mites) cause heavy damage to crops. Species of wheat aphid (*Sitobion avenae* F) is one of the most destructive pests in wheat crops and in some vegetables like brinjal and okra. Nano technology is getting popular worldwide in pest management.

METHODS: In present study, the effects of plant extract such as extract of Moringa, Tobacco and Peel of Citrus alone and their zinc oxide green synthesized nanoparticles against (*S. avenae* F) were evaluated. The bioassay was performed by applying five concentrations (1.5, 3.1, 6.2, 12.5 and 25) of plant extract and 15, 30, 60, and 120ppm green synthesis of zinc oxide nanoparticles. Leaf dip methods were applied for bioassay. Research trials were conducted under CRD with three replications of each concentration. In petri dishes 40 adults were released on the treated leaves dead and live insects were counted under microscope. Petri dishes were kept at room temperature. Data for mortality were noted after 24, 48, 72 and 96 hours.

RESULTS: Result indicated that all nanoparticles showed mortality (65-86%) at maximum concentration (120ppm) after 96 hours exposure of time. It was noted that date concentration and exposure time were increased, mortality also increased. Plant extracts were also tested alone. Maximum mortality (75%) was recorded in Moringa as compared to tobacco (72%) and peel of citrus (68%) at maximum concentration (25%) after four days.

CONCLUSION: It was evaluated that all plant extracts alone and in combination with synthesized nanoparticles were effective to control aphids and have no effect on the environment as well as on human health.

Keywords: Nanoparticle, plant extracts, *Sitobio avenae*

SPP-IPM-202

Demographic parameters of *Tribolium castaneum* on conventional and fortified wheat flours

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ABSTRACT

BACKGROUND: Wheat *Triticum aestivum* L. (Poaceae: Poales) is an important staple food in many countries across the globe. During storage, the wheat is ravaged by several insect pests which deteriorate the quality and quantity, rendering them unfit for consumption. Laboratory study was carried out to investigate the growth performance of *Tribolium castaneum* Herbst (Coleoptera: Curculionidae) on conventional and fortified wheat varieties and lines.

METHODS: Samples of six wheat varieties and tow lines were taken from Regional Agriculture Research Institute (RARI), Bahawalpur and study was carried out in the entomological laboratory, department of Entomology, The Islamia university of Bahawalpur. Experimental conditions were maintained at 27 ± 2 °C, $65 \pm 5\%$ RH and a 12:12 (D:L) hours photoperiod.

RESULTS: Highest fecundity was recorded for wheat variety Gold followed by Manthar, AAS-2011, Mirajj-2008, Fareed-2006, 1620 and 1091, while lowest number of egg laying was recorded for Zincol. Contrarily, the hatching period was extended for Zincol and found non-significant for other varieties and lines. Similar trends were observed for larval production and larval duration, pupation and pupal duration, and adult emergence and adult longevity. Overall, Zincol retarded the production and growth of *T. castaneum*, and extend the life span compared to the conventional wheat varieties and lines.

CONCLUSION: Our study suggested that fortified wheat varieties are resistant to insect pests attack, hence can play an important role in integrated pest management (IPM) of wheat for long term storage.

Keywords: *Triticum aestivum*, *Tribolium castaneum*, Gold, Manthar, AAS-2011, Mirajj-2008, Fareed-2006, Zincol

SPP-IPM-203

Sublethal effects of acetamiprid and furathiocarb on the aphidophagous predator *Coccinella septempunctata* L. (Coleoptera: Coccinellidae)

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ABSTRACT

BACKGROUND: Chemical insecticides are effective tools for speedy control of insect pests of economically important crops. However, injudicious uses of these chemical insecticides pose a serious threat to the life of non-target and beneficial organisms. Moreover, insecticides also exhibit diverse modes of actions which further enhance the negative impact.

METHODS: Sublethal effect of acetamiprid (neonicotinoids) and Furathiocarb (carbamate) was evaluated against ladybird beetle *Coccinella septempunctata* L. (Coleoptera: Coccinellidae).

RESULTS: Toxicity bioassay revealed that both insecticides enhanced the life duration of ladybird beetles as compared to the control treatment. Furathiocarb reduced the larval and adult survival rates and lowered the fecundity rate of ladybird beetles as compared to acetamiprid and control. Compared to the control, duration of each larval instar was extended in Furathiocarb than acetamiprid. Likewise, adult emergence was less in Furathiocarb followed by acetamiprid and control.

Interestingly, acetamiprid enhanced the fecundity in female ladybird beetles compared to the Furathiocarb and control treatment.

CONCLUSION: Higher fecundity in acetamiprid treatments reveals that it should be the principal choice in integrated pest management (IPM) program for managing pests in agricultural crops compared to the Furathiocarb when considering ladybird beetle as a natural biocontrol.

Keywords: ladybird beetle, chemical insecticides, acetamiprid, Furathiocarb, IPM.

SPP-IPM-204

Role of Different Botanical insecticide on the Repellency of Red flour beetle (*Tribolium castaneum*) store grains insect pest.

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ABSTRACT:

BACKGROUND: In present investigation the effects of different botanical water extract on the repellency (%) of red flour beetles. The experiment was conducted in the Department of Entomology, LUAWMS, Uthal, Baluchistan. Red flour beetles (*Tribolium castaneum*) were collected on wheat grain cultured under laboratory conditions at $32 \pm 2^\circ\text{C}$ and $60\% \pm 10\%$ RH at room temperature. three different plant extracts (Neem seed powder, Neem leaves, Tobacco, and Eucalyptus) were used to find the significant effects of this botanical extract on the repellency of red flour beetles. Each treatment was replicated five times and the numbers of insects on the two half paper disks were recorded after 24 hours. The Repellency (%) of red flour beetles were found on different plant extract Eucalyptus (54%), Tobacco (74%) and Neem seed (86%). However, the maximum repellency (%) of red flour beetles was found on neem seed (86%), whereas a minimum repellency (%) was found on Eucalyptus (54%). But a statistically significant increase in repellency (%) was observed by neem seed and Tobacco water extract, whereas a significant decrease in repellency (%) was found on Eucalyptus.

METHODS: Tobacco Leaves: The total net weight of 500 grams of dry flue-cured tobacco leaves were crushed and soaked for 24 hours in 1 liter of water. After that, water (extract) was diluted in 37.19 ml/ 2 liters of water. Eucalyptus Leaves: 10 Kg of Eucalyptus leaves were collected separately. Later, these leaves were chopped and boiled in 5 liters water until 2 liters of boiled water was left that was drained through muslin cloth and prepared to use in 37.19 ml/ 2 liters of water. Neem Seed water Extract: 5-liter water was boiled with 20 g detergent. After boiled water 1 kg neem seed powder was included and left for 16 hours. After 16 hours extract was drained through muslin cloth and prepared to use. In preparation of botanical extracts, methods of Lawrence (2012) and Chang et al. (2013) were used. All these prepared extracts were used at the proper dose of 37.19 ml/ in 2 liters water to evaluate the repellency (%) of red flour beetles. All botanical Extracts were applied to one half of the filter paper; the other half filter paper was treated with Water extract alone. Both the treated and untreated halves of filter paper were joined with staple pins and then were placed in Petri dishes 10 cm 7 diameter. Ten adults were put in the center of each Petri dish. Petri dishes were subsequently covered.

RESULTS: Significant increase repellency (%) was observed by neem seed, whereas a significant decrease repellency (%) was found on Eucalyptus.

CONCLUSION: In present investigation the effects of different plants water extract on the repellency (%) of red flour beetles. A significant increase in repellency (%) were observed by neem seed whereas a significant decrease in

repellency (%) was found on Eucalyptus; it means the plant's water extract has ability to repel the red flour beetle of stored grain pests. Present data will be useful for the help of researchers and extension workers.

Keywords: botanicals insecticides; *Tribolium castaneum*; repellency effect

SPP-IPM-205

Lethal effects of selected novel pesticides on immature stages of *Trichogramma pretiosum* (Hymenoptera: Trichogrammatidae)

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ABSTRACT

BACKGROUND: *Trichogramma pretiosum* Riley is an important egg parasitoid and biological control agent of caterpillar pests. We studied the acute toxicity of 20 pesticides (14 insecticides/miticides, three fungicides and three herbicides) exposed to recommended field rates. Egg, larval, and pupal stages of the parasitoid in their hosts were dipped in formulated solutions of the pesticides and evaluated 10 days later for percentage of host eggs with holes, number of parasitoids emerged per egg with holes, and stage-specific mortality of immature as well as adult wasps within the host eggs.

RESULTS: Seven insecticides (buprofezin, chlorantraniliprole, spirotetramat, flonicamid, flubendiamide) and miticides (spiromesifen, cyflumetofen), one herbicide (nicosulfuron), and three fungicides (myclobutanil, pyraclostrobin, trifloxystrobin + tebuconazole) caused no significant mortality to immature stages or pre-emergent adult parasitoids relative to controls. By contrast, seven insecticides/miticides (abamectin, acetamiprid, dinotefuran, fipronil, novaluron, spinetoram, tolfenpyrad) adversely affected immature and pre-emergent adult *T. pretiosum*, with tolfenpyrad being particularly lethal. Two herbicides had moderate (glufosinate ammonium) to severe (s-metolachlor) acute lethal effects on the immature parasitoids.

CONCLUSION: This study corroborates earlier findings with adult *T. pretiosum*. Over half of the pesticides – and all the fungicides – tested in the current study would appear to be compatible with the use of *T. pretiosum* in integrated pest management programs, with respect to acute parasitoid mortality.

Keywords: insecticides; *T. pretiosum*; management

SPP-IPM-206

Role of Insect Pollinators in Fruit Setting, Economic Value of Pollination, and Pollinator Fauna on Different Commercial Mango Varieties in South Punjab Pakistan

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ABSTRACT

BACKGROUND: Mango is known as the second most important fruit crop in Pakistan after citrus. Pakistani mangoes are famous globally for their unique sweet taste and are exported to the Middle East, China, Afghanistan, and different European countries. Although mangoes have been cultivated in Punjab, Pakistan since ancient times, yield of mangoes is

still very low, about 8-10 tons per hectare. Successful pollination is required to achieve a bumper crop. In this regard, an experiment was conducted at Mango Research Institute, Multan to understand the role of insects in successful pollination and fruit setting in Southern Punjab-Pakistan. The experiment consisted of three varieties (Sindhri, Retaul No.12, and SB Chaunsa) and two treatments (netted and open trees). The netted trees of each variety were covered with mosquito net before initiation of flowering, while the open trees of the same varieties were not covered with net. Overall, we found that insects are necessary for pollination and fruit setting. There was no fruit setting i.e., zero fruits per panicle in netted trees where the insects could not visit, the inflorescence during peak period. Maximum fruit setting occurred on trees where the trees were not covered with net. The most abundant insect was blue bottle flies. The other insects in the order of abundance were house flies, syrphid flies, native drones, zebra flies, stingless bees, bumble bees, wild bees, and flesh flies. *Apis florea* can be utilized as the pollinator but honeybee species *A. dorsata*, and *A. mellifera* visitation was almost negligible.

CONCLUSION: The total value of insect pollination was estimated as 1299 million dollars. Overall, this is the first study describing the role of pollinators in successful fruit setting in southern Punjab Pakistan and describing the pollinating insects of mango orchards during peak flowering season.

Keywords: Pollinators, netting, mango inflorescence, Economic value of insect pollination, South Punjab

SPP-IPM-207

Impact of biopesticides and botanical extracts for the management of borers

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ABSTRACT

According to FAO insect pests cause a 40% yield reduction in global agriculture crops annually that is a major threat to human food security. Borer are pests that belong to different families of order lepidoptera, especially Bupalidae, Cerambycidae and Curculionidae. These borers are immature larvae that makes tunnels in the stems, roots and fruits which destroys the plant internal structure and cause branch dieback, structural weakness, and eventual death of plants. Biopesticides are pesticides that rely on natural resources such as animals, plants, microbes, and a few minerals, but mainly these biopesticides are derived from secondary metabolites. Biopesticides are used instead of chemicals because they are more environment friendly and have minimum impact on beneficial fauna. Several studies have reported efficiency of these biopesticides against the borers around the globe. In India Naeem extracts were used in combination with emamectin benzoate against shoot and fruit borers of brinjal and okra which results in 45% reduction in infestation. When cow urine was applied against tomato borer in India, the results show that 70% to 80% borer reduction and 35% increase in fruit yield. Pod borer was also controlled by the application of neem oil and apple leaves extracts that has a significant impact on crop yield. Significance results were also achieved in Indonesia when biopesticides were applied against pepper stem borers.

CONCLUSION: Biopesticide and botanical extract have huge potential for insect pest management but still more study and research are required to maximize its use in the practical field.

Keywords: Pest damage, immature stage, shoot borer, bacteria.

SPP-IPM-208

Insect Pest Susceptibility, Yield, and Fiber Characteristics of New Transgenic Cotton Cultivars

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ABSTRACT

BACKGROUND: Cotton (*Gossypium hirsutum* L.), being used as a cash, an oilseed and fiber crop, regarded as the backbone of Pakistan's national economy. Cotton contributes 7.8 percent to agricultural value addition and meets 55 percent of the country's domestic cooking oil needs. A variety of insect pests and diseases attack the cotton crop, reducing seed-cotton yield and lowering fiber quality. In total, 1326 insect species have been reported on cotton, with more and less 10–15 causing financial losses. Numerous insect pests and viral diseases attack cotton crops in Pakistan and around the world. These species are a significant constraint in cotton production. Cotton pest management has been a difficult task for agricultural experts and cotton growers. In Pakistan, insect infestation in cotton is estimated to cause 20–40% annual yield and quality losses.

METHODS: To combat bollworms, genetically modified transgenic cotton, abbreviated as 'Bt-cotton,' has been introduced in many parts of the world. However, cultivars differ in terms of pest susceptibility, yield response, and fiber quality. Nonetheless, recent research suggests that lepidopteran insect pests are developing resistance to 'Bt-cotton.' Several 'Bt-cotton' cultivars have been developed in Pakistan over the last decade, but little is known about their pest susceptibility, seed-cotton yield, and fiber quality traits. The field study in Pakistan assessed pest susceptibility, yield, and fiber quality traits of three (FH-414, FH-415, and FH-492) newly developed 'Bt-cotton' cultivars.

RESULTS: The cultivars differed in their susceptibility towards sucking as well as bollworms during the year. The cultivars FH-492 was more resistance in case of lepidopterans and having ginning outturn (37.9%), fiber length (28.6mm), fiber fineness (4.90µg/inch), fiber strength (30.2g/tex) and yield 4748kg/ha. The other two varieties were FH-415 with 36.7 percent ginning out turn, fiber length (28.5mm), fiber fineness (4.25g/inch), fiber strength (27.2g/tex), and yield 3664kg/ha, and FH-414 with 36.7 percent ginning out turn, fiber length (28.6mm), fiber fineness (4.77g/inch), fiber strength (30.8g/tex), and yield 35.39kg/ha.

CONCLUSION: The cultivar 'FH- 492' exhibited low pest susceptibility and infestation as compared to the rest of cultivars. Keeping in view the low pest susceptibility and high seed-cotton yield, 'FH-492' could be recommended for higher yield and economic returns in the core region of Pakistan.

Keywords: Bt-cotton, susceptibility, insect pests

SPP-IPM-209

Conservation of Insect Predators ~ A review

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ABSTRACT

BACKGROUND: Conservation biological control is the protection of NEs against adverse effects of pesticides and incompatible cultural practices and improving their efficiency via providing food sources.

Organic crop production systems are designed to preserve the presence of natural enemies by means of conservation biological control, which involves providing environments and habitats that sustain natural enemy assemblages. During

non-crop periods, natural enemies may need of benefit from pollen and nectar. Preservation of natural enemies can be achieved by providing habitat and resources for NEs. The collection is mainly conducted before crop harvest and during winter from fruit orchards. Preservation greenhouses are dedicated for natural enemies rather than commercial production of crops. Natural enemies taken from preservation greenhouses are released in target crops during the growing season. Different techniques used in collection, preservation and release of natural enemies are reviewed. Such a conservation biological control strategy might contribute to preserve the natural biodiversity in the agricultural environment and provide natural alternatives to pesticides. Habitat management a form of conservation biological control, is an ecologically based approach aimed at favoring natural enemies and enhancing biological control in agricultural systems.

CONCLUSION: The goal of habitat management is to create a suitable ecological infrastructure within the agricultural landscape to provide resources such as food for adult natural enemies, alternative prey or hosts, and shelter from adverse conditions.

Keywords: Conservation of predators, pest management, protection of crops by enhancing of insect predators

SPP-IPM-210

Isolation and identification of different entomopathogenic strains and their evaluation for efficacy against *Bactrocera cucurbitae* (Coquillett)

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ABSTRACT

BACKGROUND: *Bactrocera cucurbitae* is a very serious and quarantine pest of agricultural commodities and poses a significant threat to trade. It causes qualitative and quantitative loss. Chemical control is the major controlling method of this pest, which results in the presence of pesticide residues in fruits and vegetables. The use of biopesticide is environmentally friendly and effective control of the pest. Present study was carried out to isolate and identify different EPF strains from soils collected from different sources. The isolated EPF strains were evaluated for their efficacy against larvae, pupae and adult stages of *B. cucurbitae*. The soil samples were collected and baited with fruit fly larvae after the death of the insect EPF was isolated and cultured on artificial media. Five concentrations 1×10^5 , 1×10^6 , 1×10^7 , 1×10^8 and 1×10^9 of each of EPF strains was tested by diet incorporation and immersion methods to find out the percentage mortality and pathogenic potential of each strain after 3, 7, 15 days. The mortality for adults of melon fruit fly was between 27 to 65% and the highest mortality was demonstrated by strain HCF-1 65%. In case of larvae, the mortality was between 25 to 66% and the highest mortality was caused by strain HR-1 66%. The treated pupae demonstrated a mortality ranging between 27 to 66% with highest mortality by AWMF-1 (66%). The LC_{50} value for ingestion application methods on adult was between 1.1×10^6 cfu/mL and 1.2×10^7 cfu/mL and for direct foliar method was between 1.6×10^7 cfu/mL and 2.4×10^7 cfu/mL. The LC_{50} for larvae at maximum exposure interval for ingestion application methods was between 1.3×10^6 cfu/mL and 8.4×10^7 cfu/mL and for direct foliar application method LC_{50} was between 1.1×10^7 cfu/mL and 8.4×10^7 cfu/mL. The LC_{50} for pupae at maximum exposure interval for immersion application method was between 1.3×10^7 cfu/mL 2×10^7 cfu/mL and for direct foliar application method the LC_{50} at maximum exposure interval was between 1.0×10^7 cfu/mL and 2.0×10^7 cfu/mL.

CONCLUSION: All the strains showed potential as a biopesticide and could be used as a biocontrol agent against *B. cucurbitae*.

Keywords: *B. cucurbitae*, EPF, biopesticides

SPP-IPM-211

Olfactometric assessment of acetic acid for its lure-potential to *Diaphorina citri* (Hemiptera: Psyllidae)

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ABSTRACT

BACKGROUND: The Asian citrus psyllid, *Diaphorina citri* (Hemiptera: Psyllidae) is causing drastic damage to citrus fruits by reducing its yield and quality. The control of *D. citri* is based on synthetic insecticides which contaminate not only the fruits with toxic residues but also population the environment and imposed health hazard effects. There is need of an alternate ecofriendly strategy like lure-based trapping of insects. The present research was conducted to assess the lure potential of acetic acid against *Diaphorina citri* (Hemiptera: Psyllidae) under laboratory conditions through olfactometer. Twelve concentrations of acetic acid (0, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100%) were prepared in distilled water and placed in the scall chamber of the olfactometer. An Estimated number of 200 *D. citri* adults were aspirated from the laboratory culture and released in the central chamber of the olfactometer. The number of *D. citri* adults attracted to each concentration was counted after 24 hours. Results revealed significant variation on attractiveness of citrus psyllid adults. The acetic acid concentration @ 80% exhibited maximum attraction of citrus psyllid adults in the olfactometer (58 ± 6.1) with an attractant index of 62.61% and was classified as a strongly attractive class of concentration (class-III = AI > 50).

CONCLUSION: It was proved that acetic acid has lure potential against *D. citri* under laboratory conditions and should be further investigated in the field.

Keywords: *Diaphorina citri*, lure potential, Acetic acid, Olfactometer studies.

SPP-IPM-212

Assessment of lure potential of acetic acid against *Diaphorina citri* (Hemiptera: Psyllidae) under field conditions

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ABSTRACT

BACKGROUND: *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae) is the major pest of mainly Rutaceae family. A complete knowledge of diversity of attractant sex pheromones is considered very essential for the sustainable insect pest management program and/or strategies.

METHODS: Plastic bottle Traps containing acetic acid were installed on plants according to the layout Randomized Complete Block Design with three replications in citrus orchard (University of Agriculture, Faisalabad). Thirty-six (twelve concentrations; three replication) plants with equal distance from each other were selected and plastic bottle traps having lures of acetic acid in small plastic bottle were installed in citrus orchard. Every single selected plant was used for single trap as single treatment. All traps were refreshed and reshuffled every week. Data was observed for ten weeks. The data was transformed into attractancy rating.

RESULTS: Results revealed significant variation in different weeks on attractiveness in citrus orchards. The concentration 90% was found highly attractive during 1st, 2nd, 3rd, 6th, 7th, 8th, 9th, 10th week of observation period exhibiting higher psyllid adults/trap (5.67 ± 0.67^a , 2.67 ± 0.34 , 1.67 ± 0.88 , 9.67 ± 1.52 , 3.3 ± 2.28 , 2.33 ± 0.67 , 1.33 ± 0.33 , 3 ± 0.92 , more attractancy index of class-II and class-III (Class-III: 61.90%, Class-II: 25%, Class-III: 93.33%, Class-III: 66.56%, Class-II: 50%, Class-III: 60%, Class-II: 50%). The concentration 80% was found more attractive during 4th and 5th week of

observation period (3.33 ± 0.33 , 5.67 ± 0.33 psyllids/trap) with attractancy index of class-II and class-III (Class-III: 53.84%, Class-II: 36.36%).

CONCLUSION: Based on the above results, it can be concluded that acetic acid can be a useful strategy for the management of *D. citri* under field conditions.

Keywords: Integrated Management, Asian Citrus Psyllid, Lure Traps, Acetic Acid; Attractancy

SPP-IPM-213

Extraction of gut bacteria and evaluation of their effect on mating, foraging, and attraction of *Bactrocera zonata* (Diptera: Tephritidae)

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ABSTRACT

BACKGROUND: Symbiotic gut bacterial effect the mating, foraging and attraction of fruit flies. Such aspects of fruit fly life can be exploited for devising fruit fly pest management tools.

METHODS: Present research was conducted to extract gut bacteria and assess their effect on mating, foraging and attraction of *Bactrocera zonata*. Morphological identification indicated that BZF-1 had Citobacter, Microbacterium, Klebsiella and Rhodococcus; BZF-2 had Citobacter, Microbacterium and Rhodococcus; and BZF-3 had Erwinia, Lactobacillus, Enterobacter and Klebsiella. Bacterial primers sequence was 16S rRNA fD1 (5'AGAGTTTGATCCTGGC TCAG-3') and rP2 (5' ACGGCTACCTTGTACGACTT-3') by polymerase chain reaction (PCR), yield with an amplicon of approximately was 1450 base pairs.

RESULTS: The *B. zonata* male and female pairs, which were treated with gentamycin and fed on bacterial manipulated adult diet (BZGMmx BZGFm), exhibited maximum pairing (80%) that was approximately 2.67 times higher than that of *B. zonata* male and female pairs, which were neither treated with gentamycin nor fed on bacterial manipulated adult diet (BZMmx BZFm) (30.21%). The mating pairing time of *B. zonata* ranged between 2.5-9.5, 2.9-10.6, 1.8-6.7 and 3.2-11.6 minutes, respectively, being significantly lower in arena-5 and arena-7 and higher in arena-2. Foraging time of BZGMm, BZMm, BZGMnm and BZMnm population of *B. zonata* ranged between 7.5-18.8, 8.4-23.8, 5.3-13.2 and 9.2-22.4 minutes, respectively, being significantly lower in arena-4 and higher in arena-5. Longevity of BZGMm, BZMm, BZGMnm and BZMnm population of *B. zonata* ranged between 20.15-33.2, 16.1-30.1, 19.1-35.7 and 17.2-22.4 days, respectively being significantly lower in arena-2 and higher in arena-5. Fecundity of BZGMm, BZMm, BZGMnm and BZMnm population of *B. zonata* ranged between 88.9-96.3, 81.7-198, 52.2-97.1 and 89.9-99.3 eggs/female respectively, being significantly lower in arena-1 and higher in arena-8. Total landing flies of BZGMm, BZMm, BZGMnm and BZMnm of *B. zonata* population ranged between 37.6-69.4%, 57.7-98.1%, 36.5-69.4% and 63.2-99.3%, respectively being significantly lower in arena-2 and higher in arena-5 and arena-7. Drop consumptions by BZGMm, BZMm, BZGMnm and BZMnm population of *B. zonata* ranged between 32.1-71.3, 48.8-93.3, 31.1-70.4 and 53.5-99.3% respectively, being significantly lower in arena-2 and higher in arena-5 and arena-7. The results of third experiment reveal that *B. zonata* population BZGMm, BZMm, BZGMnm and BZMnm exhibited attraction in the range of 13.3-53.2%, 8.3-48.3%, 18.3-58.4% and 5.8-44.6%, respectively, being significantly less toward bacterial manipulated diet (BMD) incubated for 0h (0h-BMD) and higher toward bacterial manipulated diet (BMD) incubated for 96h (96h-BMD).

CONCLUSION: From the results it can be concluded that a bacterial manipulated diet enhanced the attraction after an incubation interval of 96 hours. Hence these gut-bacterial can be utilized for the development of fruit flies' baits.

Keywords: fruit flies, baits, *B. zonata*

SPP-IPM-214

Some Preliminary Studies of Population dynamics of the fauna of Butterflies of District Faisalabad, Pakistan

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ABSTRACT

BACKGROUND: Butterflies are source of happiness to everyone due to their marvelous bright colors. 2/3rd of the world's 3000 species of agricultural crops requires pollinators and butterfly also play a critical role in crop/fruits/vegetable Pollination and they are found on flowering plants in every habitat of the world except Antarctic, Arctic and mountains that are uttered with snow. The study was conducted at the main campus of the University of Agriculture, Faisalabad to explore the butterfly species in district Faisalabad. The specimens of adult butterflies were collected by hand net swiping method from different localities of district Faisalabad and were identified with the help of available literature. Colored pan traps and Malaise traps have widely been used for monitoring pollinators. Pan traps of different colors were deployed at the farming lands located at main campus of University of Agriculture, Faisalabad for the comparison and confirmation of an insect as a floral visitor. Our data reveals that most of the butterfly population was collected during spring season while visiting flowers of the plants and significant fluctuation in population dynamics was observed.

CONCLUSION: This preliminary information would be helpful in devising sustainable strategies for the conservation of fauna of Butterflies in urban and peri urban areas.

Keywords: Butterflies, Population Dynamics, floral visitor

SPP-IPM-215

Efficacy of Potassium silicate (K_2SiO_3) against wheat aphid and their natural enemies on wheat crop

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ABSTRACT:

BACKGROUND: Aphids are considered as damaging pest of wheat that can multiply rapidly on plant, cause significant crop losses both quantitatively and qualitatively. Application of regular nitrogenous fertilizers and rise in atmospheric carbon dioxide concentrations, aphid infestation becomes more serious. As an alternate to synthetic pesticides, potassium silicate can be a potential essential nutrient to manage wheat aphid. Keeping in view the importance, in the current study potassium silicate was assessed against wheat aphid and their natural enemies under field conditions.

METHODS: The trial was conducted in research area Young Wala Department of Entomology, University of Agriculture Faisalabad. Silicon was applied using soil drenching and foliar application methods. Different concentrations (400, 800 and 1200 ppm) of silicon were used in both application methods. Silicon was applied three times (first application 20 days after crop emergence, second application 15 days after first application, third applications at appearance of aphids on crop). The experiment was conducted under RCBD layout with three replications for each treatment. The multiplication of the aphid population was recorded on a regular basis on treated and untreated plants. Finally, the collected data was analyzed through statistica 8.1 for analysis of variance and means were compared through Tukey's test.

RESULTS: The results showed that the foliar application of potassium silicate at 800 and 1200 ppm significantly reduced aphid's population as compared to other treatments. The drenching application of potassium silicate effectively reduced

the aphid's population at 1200 ppm concentrations. The lower numbers of aphids were recorded (75.75 ± 7.77) after foliar application as compared to drenching application, which were recorded as (146.5 ± 0.9). Overall foliar application of potassium silicate effectively reduced aphid's population as compared to drenching application. The foliar application of potassium silicate was not significantly affecting the natural enemies as compared to drenching application. The maximum population were recorded (9.18 ± 1.08) after drenching application at 800 ppm as compared to foliar application at 800 ppm which were recorded as (5.75 ± 0.8).

CONCLUSION: The use of silicon will be useful for the future sustainable management of aphids in integration with other IPM strategies.

Keywords: Aphids, Potassium silicate, Wheat, Natural enemies

SPP-IPM-216

Impact of *Trichogramma chilonis* against maize stem borer (*Chilo partellus*) (Lepidoptera: Pyralidae) under field conditions

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ABSTRACT

Maize (*Zea mays*) is considered an important cereal crop used as food and several other products. The crop productivity has been lagging due to several biotic and abiotic factors. Among these, maize stem borer (*Chilo partellus*) causes severe economic losses to maize crop. The use of synthetic chemicals for the management of this pest has resulted in pest resurgence, resistance to pesticides and harmful effects against natural enemies. Keeping in view as an alternate to synthetic pesticides use of *Trichogramma chilonis* can be a potential bio control agent against maize stem borer.

METHODS: Hybrid maize seed was planted in the research area Youngwala Department of Entomology, University of Agriculture, Faisalabad. The field was divided in to blocks with different treatments using RCBD layout. The *Trichogramma* cards were prepared in the Biological Control Lab. Department of Entomology, University of Agriculture, Faisalabad. Tricho-cards were stapled, and interaction was recorded on pest on regular basis divided in to treated and control blocks. Different treatment means has been separated by using LSD test at 5% probability level.

RESULTS: The results revealed that *C. partellus* larval population was 0.25 at highest *Trichogramma* egg (500) concentration, while 6.5 at lowest *Trichogramma* egg (500) concentration fields after 3rd day of 1st treatment. After 3rd day of 2nd treatment at maximum *Trichogramma* egg concentration (500), the *C. partellus* larval population was 6.7 and at lowest (100) were 18.2. After the 3rd day of 3rd treatment results revealed that at maximum egg concentration (500) the number of larvae was 7.2 and at lowest (100) was 6.25. After the study of 3rd day of 4th treatment results showed that at maximum amount of egg (500) the pest population was 7.5 and that at lowest (100) was 30.2. Study revealed that with the card installation pest population decrease gradually. The study will be useful for the future sustainable management of maize stem borer using bio control agents and can be interacted in to other IPM strategies.

Key words: Maize stem borer, Maize, Parasitoid, *Trichogramma*, IPM

SPP-IPM-217

Novel Techniques for insect pest management

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ABSTRACT

BACKGROUND: Insect pest control is an important challenge for both public health and agriculture, as these pests inflict widespread injury and economic loss. Different insecticides were used to kill all these insect pests but due to consecutive applications of repeated insecticides, many insect pests show resistance against these conventional and new chemistry insecticides. The purpose of this paper is to describe the novel techniques for the management of several urban and agricultural insect pests these techniques include sterile insect technique SIT and Gene Editing techniques like CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and RIDL (Release of insects carrying a dominant lethal). Bio pesticides are plant-based products used to control the population of several insect pests. Insect host plant resistance (HPR) is a low-cost, ecologically friendly pest control method. Farmers don't need much experience with application techniques, and they don't have to invest any money, which is the most enticing feature of HPR. Entomopathogenic organisms like fungi, bacteria, and nematodes have the potential of being a biological control agent. Entomopathogenic fungi show pathogenicity against many insect pests due to its cuticle degrading power of enzymes and Mycoproteins.

CONCLUSION: Conventional techniques like trap cropping and intercropping are also good techniques used for the management of many insect Pests.

Keywords: Novel Technique, Gene Editing, CRISPR, RIDL, HPR, SIT, EPF

SPP-IPM-218

Risk factors and control of Wax Moth in Honeybee Colonies: A Review

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ABSTRACT

BACKGROUND: Apiculture is a very common and old practice with many benefits which include honey availability. It has much environmental and economic importance. However, beekeeping faces many challenges regarding the health of bees. The main challenge of honeybees is wax moth *Galleria mellonella* which is the major pest of honeybees. It causes serious damage to bee colonies. Wax moths can be detected by looking at pupae of honeybees which are uncapped in a straight line. If larvae of wax moths are detected, they can be removed by digging for larvae with a sharp tool from beneath the capping. Tunnels are formed by the presence of wax moth larvae and the quality of honey has deteriorated. Its adults do not damage honeybees but larvae feed on honeycomb and cause honeycomb destruction which is a major problem of colony destruction. The damage caused by wax moth larvae is severe in subtropical and tropical regions which is the main factor in the decline of wild and domestic bees. It attacks weak colonies and can be controlled by using traps and increasing colony strength.

CONCLUSION: For management of wax moth, various plant extracts are being used including turmeric (*Curcuma longa*), sweet basil (*Ocimum basilicum*), medicinal coleus (*Coleus forskohlii*) and essential oils used were lemon grass (*Cymbopogon Citratus*), peppermint (*Mentha Piperita*) and eucalyptus (*Eucalyptus globulus*). It was found that sweet basil, *O. basilicum*, caused the highest mortality of 89.29% in wax moths. Peppermint oil, *M. piperita* caused minimum loss in comb weight which indicates the treatment effectiveness for controlling the damage of wax moth larvae.

Keywords: Apiculture, essential oils, damage to honeybees, highest mortality

SPP-IPM-219

Management of Wheat Aphid By using Brassica as inter Crop

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ABSTRACT

BACKGROUND: Agriculture is the backbone of our country which relies on the good production of different major and minor crops. Some major crops i.e., Wheat, Cotton, Sugarcane and Rice which are also considered as cash crops which together accounts for more than 75% of the value of total crop output and plays a significant role in the economy of Pakistan. Decrease in the yield of these crops leads to decrease in the economy of Pakistan. Different major pests in different crops cause significant losses to crop yield. Aphid is the major pest of wheat in Pakistan. Aheer reported that 7.19 aphids per tiller reduced the yield of wheat up to 16.38%. However, 15 aphids per tiller caused 30–40% losses in yield. Use of only Brassica crop as inter Crop, an alternative to pesticides is an effective environment friendly way to control Wheat Aphid. Brassica in wheat fields increases the predator's population which suppresses the aphid's population and enhances the yield. An environment friendly safe method indeed is our present and future need.

DISCUSSION: I suggest that the Govt. should emphasize on the plant protection Department to implement this at every tehsil and union level. Keywords: Brassica Crop, Inter cropping, Wheat, Major pest.

Keywords: management, wheat, aphid

SPP-IPM-220

Conservation of Beneficial Fauna in Cotton Crop

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ABSTRACT

BACKGROUND: Nowadays world's farmers are moving towards organic farming, and they use biological ways for the management of insect pests instead of conventional insecticides. Beneficial insects play a pivotal role in the better development of the crop and management of insect pests. Beneficial insects included pollinators, predators, and parasitoids. Predators and parasitoids play a role about 35% in the management of insect pests while pollinators play a role about 75% in pollination.

METHODS: Conservation is necessary to get benefits from beneficial insects. There are many ways to conserve this fauna like delaying the spray while cropping at an early stage, using botanicals and microbial pesticides, and using target-specific pesticide if insect pests are not managed by biological ways.

RESULTS: It is observed that if the application of synthetic insecticides is avoided at the early stages of the cotton crop and use of botanical sprays help to enhance the population of beneficial fauna.

CONCLUSION: It is concluded that in the conservation of beneficial fauna good agricultural management practices play a vital role. It is necessary for the best production of the crop in an eco-friendly way without harming the environment.

Keywords: Beneficial insects, insect pest, organic farming

SPP-IPM-221

Management of Whitefly *Bemisia tabaci* (Hemiptera: Aleyrodidae), using Biological Control Methods– A Review

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ABSTRACT

INTRODUCTION: White fly *Bemisia tabaci* (Hemipterans: Aleyrodidae) is genetically a variety of species known to cause serious damage to many crops around the world. Whitefly nymphs and adults can damage plants during feeding and act as carriers of viruses. It causes significant crop loss in tropical and subtropical regions. Chemically based pesticides are widely used for control of whitefly due to the immediate effects of chemical pesticides but using chemical pesticides leads to many negative effects such as food safety issues, pesticide resistance, environmental pollution and mainly effects on non-target organisms like predators and parasitoids. Biological control agents using entomopathogenic fungi (EPF) are developed as an alternative to overcome the use of conventional chemical pesticides and effectively apply integrated pest management (IPM) systems for effective control of *B. tabaci*. *B. tabaci* can be effectively controlled by integrating multiple biological control agents such as parasitoids, predators, and EPF. There are at least 115 species of whitefly parasitoids, including five families such as Aphelinidae, Azotidae, Encyrtidae, Signiphoridae (Chalcidoidea), and Platygasteridae (Platygastroidea). *Encarsia* and *Eretmocerus* in the order Hymenoptera are the most well-known whitefly parasitoids. Predators of whiteflies are ladybird beetles, predaceous bugs, lacewings, phytoseiid mites, and spiders, phytoseiid species, *Euseius scutalis* and *Typhlodromips swirskii* significantly suppress *B. tabaci* population on a single plant. *Aschersonia aleyrodis* kill nymphs and adults of *B. tabaci*. *Beauveria bassiana* is also used against eggs and second nymphal instar of whiteflies. Combination of bacterial biosurfactant with entomopathogenic fungi, *Cordyceps javanica* and *B. bassiana*, has recently been found to cause 100% mortality of the third instar nymphs of *B. tabaci* within 4 days. Combination of *B. bassiana* and some plant extracts such as neem have shown increased mortality of *B. tabaci*.

CONCLUSION: *Bemisia tabaci* is considered a destructive insect pest of numerous crops around the world. Crops are affected directly by *B. tabaci* during feeding and vector of virus, causing economic damage to cotton crops in millions of dollars worldwide. Use of chemically based pesticides causes resistance development in insects, harmful to the environment and food chain. The application of EPF and other effective biological control methods for the management of *B. tabaci* is needed at present and is an environmentally friendly approach.

Keywords: Carrier of virus, predator, Entomopathogenic fungi, neem extracts

SPP-IPM-222

Species composition of thrips on chilies

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ABSTRACT

BACKGROUND: The species composition of chili thrips was studied in the field during the Kharif 2014-15 season.

METHODS: The species composition of chili thrips was investigated by obtaining the thrips from fruits, flowers and leaves identified using taxonomic keys, according to the findings.

RESULTS: *Scirtothrips dorsalis* was obtained from the leaves and fruits, while four species of thrips colonized the flowers: *T. palmi*, *F. schultzei*, and *T. hawaiiensis*, while *Haplothrips verbasci* (Tubulifera; Phlaeothripidae). *F. schultzei* was the most common species among flower thrips.

CONCLUSION: Understanding the species composition is the need of hour in entomology

Keywords: thrips, chili, *Scirtothrips dorsalis*

SPP-IPM-223

Sustainable approaches used to control pest and disease management in ginger (*Zingiber officinal*)

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ABSTRACT

BACKGROUND: Ginger (*Zingiber officinal*) is a perennial crop that is widely grown in tropical and sub-tropical zones of Asia. It is a marvelous crop due to its nutritional composition, exhibiting more than 60 active volatile and non-volatile compounds that make it suitable for usage as a spice and medicinal crop. However, worldwide its production is declining due to biotic infestations. The rhizome rot or soft rot, yellows, phyllosticta leaf spot, thread blight, bacterial wilt, nematodes, shoot borers and rhizome scale are major diseases and pests of ginger that affect its yield and quality. However, their infestation can be minimized by integrated pest and disease management approaches as these techniques are concerned with the implementation of cultural control such as deep ploughing in summer, soil solarization, application of neem cake, mulching, hot water treatment, and crop rotation.

CONCLUSION: Further, the use of biocontrol agents such as ladybird beetle, spiders, Chrysopids, and *Trichogrammatids* are eco-friendly insects that protect ginger from harmful pests. Similarly, the intercropping of ginger with marigold and the use of organic pesticides may be helpful to protect plants from harmful pathogens and is a sustainable eco-friendly solution to enhance ginger crop production.

Keywords: Biotic; Biocontrol; Cultural control; Eco-friendly; Sustainable

SPP-IPM-224

Evaluation of Insecticides for the Management of Whitefly in Cotton

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ABSTRACT

BACKGROUND: The cotton crop plays a vital role in the textile industry of Pakistan and contributes about 0.6% to the national GDP. However, a yield reduction of about 50% has been recorded during the last decade, severely affecting the farming community, textile industry, and national exports. One of the main reasons for this decline include high infestation of cotton whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae). The pest was uncontrolled in spite of a series of pesticide applications by the farmers. Keeping in view the problem, the trials were conducted to find the effectiveness of insecticides to manage its infestation.

METHODS: A total of 10 insecticides were selected and sprayed using knapsack power sprayer and tractor mounted sprayer at recommended dose at farmer fields. Each insecticide/combination was replicated three times. The data of whitefly nymphs and adults was recorded prior to spray followed by after 1, 3 and 7 days of spray. The application was repeated after seven days of 1st spray.

RESULTS: The most effective single insecticide against whitefly was Pyriproxyfen (@200g/acre) on 3rd day of 1st and 2nd spray. However, none of the insecticides caused more than 60% mortality. The efficacy of the insecticides/combinations was comparatively better when they were applied with tractor mounted boom sprayer. In both trials, insecticides caused higher mortalities (more than 60%) of natural enemies.

CONCLUSION: The insecticides were ineffective to control whitefly for more than three days. However, the farmers should apply insecticides using boom sprayer when the crop height is more than five feet for proper coverage.

Keywords: Cotton, Insecticides, Whitefly management, Natural enemies

SPP-IPM-225

Sustainable approaches used to control pest and disease management in ginger (*Zingiber officinal*)

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ABSTRACT

BACKGROUND: Ginger (*Zingiber officinal*) is a perennial crop that is widely grown in tropical and sub-tropical zones of Asia. It is a marvelous crop due to its nutritional composition, exhibiting more than 60 active volatile and non-volatile compounds that make it suitable for usage as a spice and medicinal crop. However, worldwide its production is declining due to biotic infestations. The rhizome rot or soft rot, yellows, phyllosticta leaf spot, thread blight, bacterial wilt, nematodes, shoot borers and rhizome scale are major diseases and pests of ginger that affect its yield and quality. However, their infestation can be minimized by integrated pest and disease management approaches as these techniques are concerned with the implementation of cultural control such as deep ploughing in summer, soil solarization, application of neem cake, mulching, hot water treatment, and crop rotation.

CONCLUSION: Further, the use of bio-control agents such as ladybird beetle, spiders, Chrysopids, and *Trichogrammatids* are eco-friendly insects that protect ginger from harmful pests. Similarly, the intercropping of ginger with marigold and the use of organic pesticides may be helpful to protect plants from harmful pathogens and is a sustainable eco-friendly solution to enhance ginger crop production.

Keywords: Biotic; Biocontrol; Cultural control; Eco-friendly; Sustainable

SPP-IPM-225

Use of Biopesticides in vegetables

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ABSTRACT

BACKGROUND: Biopesticides are organic compounds that can be used to control agricultural diseases without harming the environment. Vegetables are the necessary part of human diet that are either consumed as fresh or processed. The use of synthetic pesticides is harmful for human and ecosystem as pesticides kill beneficial insects as well. The use of natural products derived from plants such as essential oils, botanical extracts, and nano biopesticides is increasing due to increased demand for organic products and it's a viable option as part of an integrated pest management strategy (IPM). To control pests and diseases, various agricultural practices such as crop rotation, cover crops, disease resistant varieties, and good seed bed preparation were adopted. However, these practices do not provide complete plant protection.

CONCLUSION: Therefore, the use of organic biopesticides is a viable option to protect plants from insects and pathogens as they have allopathic properties and is a sustainable practice to control diseases. Moreover, they are environment friendly and are harmless for human health.

Keywords: Allopathic, biopesticides, integrated pest management, organic

SPP-IPM-226

Composition And Abundance of Thrips Species In mango orchards of Multan region

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ABSTRACT

BACKGROUND: Mango is the most important fruit crop in the Indo-Pakistan area, particularly in Pakistan's South Punjab. It is well-known for its sweet flavor, as well as its nutritious content. Throughout the year, numerous insect pests attack mango plants. Thrips are developing pests of mango trees in both nurseries and orchards, according to hexapods. It feeds heavily on fresh emergent leaves because of its rasping sucking mouthparts. The development of the leaves is slowed by a high infestation, and plant growth is hampered as a result.

METHODS: The goal of the research was to find out how many thrips there were in the different mango orchards in the Multan region. Thirty mango trees of varied ages were chosen at random and divided into six groups: Center, North, East, West, and South. Thrips were collected weekly using the flower shaking/tapping technique from five randomly chosen flowering branches per tree from 1st February to the end of March 2020. Thrips were sorted and examined under a microscope.

RESULTS: *Thrips palmi* (82 %), *Scirtothrips dorsalis* (8.9 %), *Thrips hawaiiensis* (5.1 %), and *Aeleothisrips intermedius* 4.0% were among the 3,100 adult thrips collected. Analysis of variance (ANOVA) between thrips counts per group was not significantly different while counts of four thrips species showed a significant difference ($p < 0.05$). *Thrips palmi* were dominated all thrips species.

CONCLUSION: Temperature was strongly connected with the presence of thrips, but relative humidity was moderately correlated.

Keywords: Thrips, mango, management

SPP-IPM-227

Cost effective Techniques for Pest Control and Plant Protection

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ABSTRACT

BACKGROUND: Throughout the human history, food production and economic developments have been seriously affected by crop pests and diseases. For ensuring food security, plant protection and pest control are the main techniques that must be brought in contact with farming. Farmers must be trained in economic use of pesticides and herbicides. Using biological control methods such as mass rearing and periodic release of farmer friendly insects is an effective approach for controlling key pests of crops and reducing losses. Pheromone traps are used by progressive farmers as they inhibit the fertilization and reproduction processes of various insects.

CONCLUSION: The use of biopesticides not only acts as a pest control method but also reduces the cost a farmer has to bear during a cropping season. Governments and regulatory institutions play a vital role in the awareness and implementation of these economic control strategies for the betterment of farmers and agriculture as a whole.

Keywords: Biopesticide, Food Security, Plant Protection, Pest Control.

SPP-IPM-228

Effect of planting geometry on insect population and yield of cotton

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ABSTRACT

BACKGROUND: Sucking insect pests are one of important limiting factors in cotton yield in Pakistan. In dense planting attack of sucking insect increased.

METHODS: The study was conducted to evaluate the effect of different plant geometry on the population dynamics of sucking insect pests of cotton on four different cultivars of cotton i.e., FH-142, Cyto-124, MNH-1016 and Lalazar. Research trials were conducted on the Research area of MNS-University of Agriculture, Multan. Plant to plant distance was maintained for all cultivars as 6, 9, 12, 15 and 18 inches with row to row distance at 30 inches. Cotton was sown in RCBD with three replications for each cultivar.

RESULTS: Insect pest population data for whitefly, thrips and jassid were taken on weekly basis. Our result revealed that whitefly population was high in treatments where cotton was sown at 6 inches (P-P), which decreased respectively by increasing the spacing of the plants. Jassid and thrips populations also showed more impact on the low spacing and their impact also decreased in 18 inches plant space. Plantation of cotton could be recommended 15 and 18 inches plant to plant distance in order to minimize damage of sucking insect pests especially whitefly, thrips and jassid. In cotton cultivar MNH-1016 highest yield and yield components were recorded at plant spacing of 6 inches.

Keywords: planting geometry, insect population, cotton yield

SPP-IPM-229

Transportation of Chromium (VI) to *Bombyx mori* L. from mulberry Plant (*Morus alba* L.) grown at soil irrigated with Chromium (VI) containing effluents

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ABSTRACT

BACKGROUND: The research was conducted to determine Chromium (VI) toxicity in population *Bombyx mori*.

METHODS: The synthetic wastewater used to irrigate soil to evaluate the impact of pH (4 to 8) at 100 mg/L and initial Chromium (VI) concentrations (25 mg/L to 300 mg/L) at 5 pH in its bio accumulation in *B. mori* foodchain. By using atomic absorption spectrophotometer (AAS) analysis the amount of Chromium (VI) determined in soil, mulberry plants, *B. mori* larvae, silk glands and silkworm feces.

RESULTS: The results showed that local cobalt pollution can be indicated by using *B. mori* as template as its body length, body weight and mortality rate was found to be strongly related to Chromium (VI) concentration. Higher the Chromium (VI) amount in mulberry leaves causes more toxicity to *B. mori* population. At 300 mg/L Cr (VI) concentration and pH 4 there was maximum deposition of Chromium (VI) in soil, mulberry plants, *B. mori* larvae, faeces and silk glands from the synthetic effluent. The maximum deposition was 123.5 ± 0.03 mg/kg, $89.76 \pm .031$ mg/kg, 23.31 ± 0.019 mg/kg, 41.32 ± 0.069 mg/kg and 35.67 ± 0.04 mg/kg observed respectively.

CONCLUSION: effluents in waste water irrigating the mulberry can cause development issues in silkworm larvae Silkworm, *Bombyx mori*, *Morus alba*, Cr (VI), Bioaccumulation

SPP-IPM-230

A Machine Vision Approach for Classification of Sunflower Seed

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ABSTRACT

BACKGROUND: Agriculture is viewed as the backbone of any country, and it is the most significant sector in Pakistan. Sunflower is a vital crop for the modern agricultural industry. Worldwide, sunflower production is estimated to be 23 million hectares in 60 countries. The grower's concerns regarding the originality of the sunflower seed variety and quality. The purity of seed is an essential quality indicator for crop seed.

METHODS: The goal of this research was just to investigate feasibility of a ML (machine learning) technique for identifying various kinds of sunflower seed varieties. The DI (digital images) of 6 sunflower seed varieties were Aguará-4, Armoni, T-40318, Fh-675, Fh-701, US-444. This was accomplished using a digital camera in a naturalistic environment even without a specialized laboratory system. The obtained digital picture collection is transformed into a hybrid feature dataset, which combines histogram, texture, binary, and spectral features.

RESULTS: On each non-overlapping region of interest, sizes (32×32) total number of 55 hybrid features were obtained for every sunflower seed digital images. Three optimal features were obtained by using the correlation based feature selection technique (CfsSubsetEval) with the BFS (BestFirstSearch) algorithm.

CONCLUSION: To develop the classifications algorithms, J48, RandomTree, Random committee, Bayes net, and Bagging were used with an optimized multi feature cross validation technique (10-fold).

Keywords: Machine learning, classification of seed,



**2nd International
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THEME-2:

Plant Disease Diagnostics
and Management

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-201

Incidence and prevalence of bacterial wilt of chili caused by *Ralstonia solanacearum* in Pakistan

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ABSTRACT

BACKGROUND: Bacterial wilt caused by *Ralstonia solanacearum* is one of the major constraints in the production of chilies in Pakistan.

METHODS: As the information regarding distribution and prevalence of *R. solanacearum* is exiguous, the present studies were conducted during 2015-16 to determine the incidence and prevalence of *R. solanacearum* in the major chili growing areas from different agro-ecological zones of Pakistan. Variations in incidence and prevalence of *R. solanacearum* were recorded throughout the country. The overall incidence and prevalence of *R. solanacearum* in the country was found to be 10% and 76% respectively. Of the four provinces, maximum disease incidence of 16.4% was recorded in Sindh province followed by Punjab and Khyber Pakhtunkhwa showing 11.4% and 7% disease incidences respectively and the minimum incidence of 4.9% was observed in the province of Baluchistan. As regards prevalence, the same pattern was observed.

RESULTS: Out of 8 agro-ecological zones the maximum disease incidence of 19.5% was observed in Indus delta followed by Sandy deserts (14.1%) while the minimum disease incidence of 5% was found in Western dry mountains. The disease incidence in other zones ranged between 5.4 and 14.1%. Similar trend was noticed regarding prevalence being the maximum in the Indus delta (100%) followed by Southern irrigated plains (90%). Out of 114 *R. solanacearum* isolates, 92 (81%) were identified as Biovar 3 while the remaining 22 (19%) were recognized as Biovar 4. Biovar 3 was recorded from all the four provinces and was found to be predominant in all the provinces while Biovar 4 found in the Punjab and Sindh provinces only. Similarly, biovar 3 was observed from all the eight agro-ecological zones and found to be predominant. On the other hand, biovar 4 was recorded from four agro-ecological zones.

CONCLUSION: It is concluded that bacterial wilt caused by *R. solanacearum* is prevalent throughout the country in all the agro-ecological zones with varying intensities warranting stringent surveillance and control measures.

Keywords: Bacterial wilt, *Ralstonia solanacearum*

SPP-PP-202

Morpho-molecular characterization of *Pyricularia oryzae* in Punjab Pakistan

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ABSTRACT

BACKGROUND: Blast of rice is one of the most destructive diseases that is responsible for heavy yield reduction in Pakistan.

METHODS: To find out the pathogenic diversity, one twenty five *P. oryzae* isolates were collected from diseased rice plants in different geographical locations in Punjab Province, Pakistan, in 2017 and 2018. The associated pathogen was

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

isolated, purified and multiplied by using the potato dextrose agar nutrient medium.

RESULTS: Based on the morphological identification, four distinct sub-specific groups were found. Pathogenicity assays have shown that one of these groups (G-I) was highly pathogenic, with disease severity of 47% four weeks after inoculation. DNA sequence analysis of the internal transcribed spacer (ITS) region conducted with MUSCLE alignment found an identical single-base-pair substitution in thirty-five isolates. Phylogenetic analysis of the ITS region, β -tubulin, actin and calmodulin genes using maximum parsimony (MP) with tree bisection reconnection (TBR) confirmed the identification of all the isolates as *P. oryzae* when compared with the available data set of *P. oryzae* on NCBI with 100% bootstrap value. The varied isolates of *P. oryzae* collected from Punjab, Pakistan existed as a sub-clade under the main clade of *P. oryzae* with 95-100% bootstrap values.

CONCLUSION: We concluded that a new ecotype of *P. oryzae* has prevailed in different geographical areas of Punjab, Pakistan.

Keywords: *Oryza sativa*; rice blast; morphology; genetic diversity and molecular markers.

SPP-PP-203

Specific and sensitive detection of *Phytophthora nicotianae* causing citrus gummosis by loop-mediated isothermal amplification assay

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ABSTRACT

BACKGROUND: Citrus is one of the prime fruits of Pakistan. Decline of citrus orchards due to gummosis become a potential threat to successful production of fruit during the last few years and now continuously hammering farmer's as well as the economy of Pakistan. Early and accurate detection of *P. nicotianae* is essential for controlling this disease in the field.

METHODS: In this study, a novel and highly sensitive loop-mediated isothermal amplification (LAMP) assay was developed for the specific detection of *P. nicotianae* using hydroxynaphthol blue (HNB) as a fluorescent indicator. Four LAMP primers were designed based on the translation elongation factor 1-alpha (EF1 α) sequence of *P. nicotianae*.

RESULTS: A total 40 isolates of *P. nicotianae* from various districts of Punjab province Pakistan yielded positive results in the LAMP assay. No cross-reaction was observed with other oomycetes or fungal pathogens. The detection limit of *P. nicotianae* by LAMP was 10 pg genomic DNA per 25 μ L reaction.

CONCLUSION: The LAMP assay developed in this study is simple, fast, sensitive and specific, and can be used in the field to detect *P. nicotianae* in infected plant tissue.

Keywords: Citrus gummosis, Primers, LAMP, Diagnosis

SPP-PP-204

Integrated management of plant pathogenic *Streptomyces* species causing Potato Scab in Okara region

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THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

ABSTRACT

BACKGROUND: Potato scab (PS) also known as common scab (CS) caused by *Streptomyces scabies* is an important disease of potato all over the world. In one of the latest surveys, a disease incidence of 44% was determined in district Okara for PS. PS has been identified in Pakistan as one of the dangerous diseases as far as the potato export industry is concerned. So far no potato cultivar has been found resistant to this devastating pathogen. Moreover, different groups of pesticides have been tried but no adequate control measures are established and by now, there are no registered chemicals for PS management in Pakistan. Therefore, there is a dire need to find out some effective integrated management strategies for controlling this growing disease.

METHODS: A survey was conducted to collect potato scab affected disease samples from different areas of Okara region. Isolation, identification and purification of the pathogen (*Streptomyces* species) causing common scab of potato was done using different growth mediums. Isolates of *Streptomyces* isolates were grown on YME agar plates at 28°C and preserved at -80°C in eppendorf tubes. Afterwards, beneficial bacteria were isolated from the rhizosphere potato samples using serial dilution method.

RETHODS: These test bacteria were then evaluated *In-vitro* for their bio-control efficacy against isolated pathogenic *Streptomyces* species. In the same way, plant extracts and chemicals were also evaluated using *In-vitro* plate assays with different concentrations. DNA extraction, PCR and 16s rRNA sequencing was done for the identification of pathogenic and bio-control isolates. Moreover, all the selected biocontrol bacteria, plant extracts and chemicals were then evaluated *In-vivo* under greenhouse conditions using seed treatments.

CONCLUSION: Conclusively, an integrated management strategy was developed that can be used to control *Streptomyces Species* causing Potato Scab disease in potatoes.

Keywords: *Streptomyces scabies*, Integrated management, Potato scab, Rhizosphere

SPP-PP-205

Unraveling the architecture of the plant-specific “Onset of Leaf Death1” (OLD1) protein by x-ray crystallography

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ABSTRACT:

BACKGROUND: The proper regulation and execution of programmed cell death is of fundamental importance for the development and homeostasis of multicellular organisms. The primary goal of the current study is to solve the crystal structure of a protein “OLD1” which has been associated in the regulation of various types of programmed cell death in *Arabidopsis*, for instance, the onset of leaf death, the execution of hypersensitive response, and the initiation of early leaf senescence. The OLD1 protein is believed to exert a pleiotropic effect and the determination of its basic function needs further elucidation.

METHODS: In the present study, a detailed *in silico* followed by *in vitro* analyses were carried out in order to elucidate the important motifs/regions of OLD1 protein and gain a structural insight of the protein.

RESULTS: The *in silico* analysis of the OLD1 sequence using TOPCONS, SMART, TMHMM showed a difference in the total number of annotated transmembrane domains compared to those predicted and reported in previous studies. Analysis of the soluble region of the protein predicts the presence of coiled-coil motifs, suggesting a role of OLD1 in either DNA/RNA binding, and/or protein-protein interactions. Further examination of the OLD1 protein sequence displays the presence of a highly polymorphic region at the N-terminus of orthologs. Our results report for the first time that these polymorphic regions are typical and present in the majority of the understudy orthologs. Furthermore, polymorphic N-termini of the

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orthologs are predicted to contain a nuclear localization signal (NLS) whereas the orthologs failed to contain annotated NLS, lacking such polymorphic region(s). Based on *in silico* results, 24 *old1* constructs were designed including N-terminal and C-terminal truncations proposed by PSIPRED, PHYRE2, XTALPRED, I-TASSER, COILS, DisMeta, and DisPred. All constructs were successfully expressed using a T7 expression system with an inducible T7 promoter. The most successful construct(s) was found partially soluble when expressed in *E. coli* and has been purified using ion exchange chromatography. Crystallization trials will be undertaken in order to produce diffraction quality crystals.

CONCLUSION: This study essentially indicates important structural motif(s) and subsequently proposes truncation(s) to avoid recalcitrant impediments for x-ray crystal formation and structure resolution. The gained structural information will enable researchers to understand OLD1 function and its pleiotropic roles especially in disease resistance and plant growth and development

Keywords: OLD1, OLD1 structure, atomic structure, crystallography

SPP-PP-206

Cultural, morphological and molecular characterization of *Sclerotinia sclerotiorum* causing fruit rot of Papaya and its management

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ABSTRACT

BACKGROUND: tropical and subtropical regions of the world. The investigations were carried out on papaya fruit that were collected from different regions of the Punjab Province with symptoms consisting of softening, discoloration, watery rot with white fuzzy mycelium, and initial sclerotium formation. Diseased fruits were isolated and identified on the basis of cultural, morphological and molecular characteristics.

METHODS: The pathogen was isolated from sclerotia that were air dried at room temperature (25 °C), then surface sterilized for 1 to 2 min in 1% NaOCl and rinsed twice in sterile distilled water before transferring to half-strength acidified potato dextrose agar (PDA) amended with ampicillin (100 µg/ml). For molecular characterization, total DNA was extracted, and the internal transcribed spacer region was amplified using ITS1/ITS4 primers. In addition, the β-tubulin gene was amplified using primers TU1/TU2/TU3 and sequenced. The assessment of different plant extracts including *Euphorbia milii*, *Plumeria rubra*, *Cascabela thevetia*, *Moringa oleifera*, *Syzygium aromaticum*, *Quisqualis indica* was done to control *S. sclerotiorum* with the help of Agar Well Diffusion Technique under CRD design.

RESULTS: The pathogen produced sparse and creamy white mycelial colonies on PDA medium which later turned fluffy and light brown in color. Initiation of sclerotia was observed after 3 days of mycelial growth which became completely visible in 7 days in ring form or scattered on the mycelial surface in the Petri plate. Hyphae were hyaline and septate, later developing dark, black, irregular sclerotia (4 to 8 mm diameter). Apothecia produced hyaline and unicellular ascospores (2-4 x 08-12 µm). The amplified product of ITS was deposited in GenBank as accession no. OM692487 and showed 99 % homology with *S. sclerotiorum* accession nos. MW077292 and KJ744364, respectively. The resulting sequence of β-tubulin gene was also submitted to GenBank, accession no. Ak970359 and showed 99 % identity with various *S. sclerotiorum* isolates. The results of *in vitro* evaluation of plant extracts revealed that *P. rubra* and *M. oleifera* showed significant results at higher concentrations (50µg/ml) and showed maximum zone of inhibition (3.60 mm and 3.30 mm),

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respectively while *C. thevetia* was least effective against *S. sclerotiorum*.

CONCLUSION: It was concluded that *S. sclerotiorum* is responsible for causing fruit rot of Papaya based on morpho-molecular evidence. Among various medicinal plants evaluated, *Plumeria rubra* and *Moringa oleifera* showed promising results and could be used as an alternative of synthetic fungicides.

Keywords: Papaya; *Sclerotinia sclerotiorum*; Identification; Fruit rot, Agar well diffusion

SPP-PP-207

Antifungal potential of different fungicides towards Collar rot disease of chili caused by *Sclerotium rolfsii* in relation to epidemiological factors

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ABSTRACT

BACKGROUND: Chili (*Capsicum annum*) is one of the 2nd most important members of the family solanaceae. It has high nutritional as well as health benefits. Its production is continuously decreasing by different fungal, bacterial and viral pathogens. Among them the most important is *Sclerotium rolfsii*, which causes collar rot in chili peppers. This disease causes huge economic as well as yield losses. When sudden appearance of disease takes place in the field, the farmers have no option except the use of synthetic fungicides because these chemicals give quick response to manage disease in the field.

METHODS: Keeping in view, current study was conducted to evaluate five different fungicides against collar rot of chili. The experiment was conducted under RCBD by maintaining three replications and three concentrations (50, 100, 150 PPM) of each fungicide were evaluated against collar rot.

RESULTS: Results showed that Topsin M was the most effective fungicide for the management of collar rot followed by Score, Carbendazim, Amistar Top and Revus. Epidemiological factors play a significant role in disease development and spread. All the epidemiological factors showed positive correlation (increase in epidemiological factors results increase in the disease spread) with disease development.

CONCLUSION: It was concluded that Topsin M can be used in future for the management of collar rot disease of chili.

Keywords: Chili, Collar rot, Fungicides, Epidemiology

SPP-PP-208

Impact of Potassium Dihydrogen Phosphate On The Activation Of Defense Mechanism Of Chili Plant Infected With *Colletotrichum capsici*

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ABSTRACT

BACKGROUND: Chilli (*Capsicum annum* L.) ranked 2nd after potatoes in the NightShade family. Several biotic and abiotic factors are involved in limiting the yield of chili but the most destructive disease of chilli is anthracnose which is caused by

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Colletotrichum capsici. It causes huge crop losses (Up to 10-90%) in chilli growing regions of the world. When pathogen attacks, it inhibits the production of such enzymes which are involved in the working of normal physiological functions including activation of defence mechanisms.

METHODS: Current study was planned to induce resistance in chilli plants with the help of Potassium Dihydrogen Phosphate (KH_2PO_4) which is known as a defence activator. For this purpose KH_2PO_4 was used at three concentrations (0.5, 1.0, and 1.5%) against chilli anthracnose under green-house conditions. Three consecutive applications were done on infected chilli plants after a one week interval.

RESULTS: It was observed that infected chilli plants with *Colletotrichum capsici* showed less disease severity as compared to control after the application of KH_2PO_4 . Various defence related enzymes i.e. superoxide dismutase, peroxidases, catalase and total soluble phenols were found in greater amounts in treated plants as compared to control.

CONCLUSION: It was concluded that activation of defence mechanisms by the plant activator (KH_2PO_4) is the most recent, environment friendly and economical approach for the management of disease.

Keywords: Chilli, *Colletotrichum capsici*, Activators, KH_2PO_4

SPP-PP-209

Antimicrobial activity of plant extracts against *Colletotrichum capsici* causal agent of chilli anthracnose

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ABSTRACT

BACKGROUND: Chilli (*Capsicum annum* L.) is a very significant and valuable crop belonging to the family *solanaceae*. It has a great economic value around the world as it is used as spice. Chilli production is facing different diseases both in the field and storage conditions that reduce the yield and quality of the fruit. *Colletotrichum capsici* is a major pathogenic threat that causes chilli anthracnose. The best and environmentally friendly way to control plant diseases is the use of bio-extracts.

METHODS: So, the current study was conducted to evaluate efficacy of different plant extracts against targeted pathogens. The pathogen was isolated, purified and identified with the help of morphological characters and a pathogenicity test was done to fulfill Koch's postulates. Six different phyto-extracts, Kashni (*Cichorium intybus* L.), Kari pata (*Murraya koenigii* L.), Ajwain (*Trachyspermum ammi*) Gajar boti (*Parthenium hysterophorus* L.), Kalonji (*Nigella sativa* L.), and Alsi (*Linum usitatissimum* L.) were used with three concentrations as 5, 10, and 15% against *C. capsici* through poisoned food technique.

RESULTS: Results expressed that maximum fungal growth inhibition zone was recorded by Ajwain extract with least fungal growth (7.05 mm) at 15% concentration followed by Kashni (9.11 mm), Kari pata (11.81 mm), Kalonji (18.83 mm), Gajar boti (19.61 mm) and Alsi (21.32 mm).

CONCLUSION: From these findings it is recommended that use of Ajwain extract can protect the chilli fruit from anthracnose.

Keywords: Ajwain, Kalvanji, Kari pata, Gajar boti, Kashni, Alsi

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Epidemiological aspects for the development of Fusarium wilt of chilli caused by *Fusarium oxysporum* f. sp. *capsici*

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ABSTRACT

BACKGROUND: Environmental factors are considered to be the most important for establishment and development of plant diseases. Fusarium wilt of chilli caused by *Fusarium oxysporum* f. sp. *capsici* is one of the most devastating chilli pepper diseases. The disease development is favoured by some typical environmental factors which were studied in this study.

METHODS: For current study the chilli crop was grown at the research area of the department of Plant Pathology, UAF. Before transplantation of chilli nursery soil were artificially infested with 7-10 old pure culture of Foc suspension of 1×10^6 spores/ml of water. Soil moisture was measured by soil moisture meter while soil temperature was measured by soil thermometer. Environmental factors including maximum and minimum air temperature, relative humidity (R.H), evaporation, rainfall, sunshine and wind speed were examined under natural field conditions.

RESULTS: Maximum and minimum air temperature, evaporation, sun shine, maximum and minimum soil temperature and soil moisture expressed positively significant correlation, relative humidity expressed negatively significant correlation, while rainfall and wind speed expressed non-significant correlation ($P \leq 0.05$) with disease incidence on all lines/varieties of chilli. Maximum disease incidence (65-78%) was recorded at maximum (21-38°C) and minimum (9-21°C) air temperature, relative humidity (21-61%), evaporation (3-7%), sun shine (6-10 h), wind speed (3.3-6.4 km/h), maximum (21-36°C) and minimum (8-14°C) soil temperature and soil moisture (21-31%).

Keywords: Chilli, Epidemiology, Fusarium wilt, *Foc*

SPP-PP-211

Response of various sugarcane varieties against rust caused by *Puccinia melanocephala*

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ABSTRACT

BACKGROUND: Sugarcane is the most important cash crop of Pakistan. Rust is caused by *Puccinia melanocephala* which significantly reduces the growth and biomass of sugarcane. It causes significant yield losses in sugarcane growing areas of the world. The best way to manage sugarcane rust is the formation of resistant varieties. Formation of a resistant genome is a long term procedure which takes almost ten years. So screening of available germplasm is a prerequisite to give sudden solutions to the farmer community.

METHODS: Keeping in view, current study was planned to screen ten varieties of sugarcane against rust under field conditions. The experiment was conducted under RCBD by maintaining three replications.

RESULTS: Results showed that one variety CP77-400 showed resistance response against rust disease while three

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varieties (CPF-246, US-658 and CPF-248) showed moderately resistance, and six varieties (SPF-234, SPF-213, US-54, HSF-240, CPF-220, NSG-59) showed susceptible response towards sugarcane rust.

CONCLUSION: It was concluded that CP77-400 can be used in future in those areas where incidence of sugarcane rust is high.

Keywords: Sugarcane, Rust, Screening, CP77-400

SPP-PP-212

Oxalic acid induced disease alleviation by enhanced antioxidative attributes of jamun fruit (*Syzygium cumini* L.) after harvest

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ABSTRACT

BACKGROUND: In plants, oxalic acid has been reported to play multifarious functions including plant defence against diseases and toxins detoxification produced by fungus.

METHODS: This study was planned for assessing the effect of combined and individual applied pre-harvest and post-harvest oxalic acid (OA) treatments on jamun fruit quality and shelf-life management. In this experiment, fruit was treated with pre + postharvest application of an already optimized dose of OA (2mM) as control (spray with water only), pre-harvest, post-harvest application individually and combined pre- and post-harvest application of OA at the fruit set stage. After treatment jamun fruit were harvested at fruit maturity and was air dried and kept at ambient condition (25±2 °C, 60-65% RH) for the evaluation of various fruit physiological (weight loss, color, disease infestation, disease severity, skin shriveling % age), biochemical (total soluble solid, titratable acidity, vitamin C, pH), anti-oxidative parameters (antioxidants, TPC, anthocyanin), activity of antioxidative enzymes (superoxide dismutase, peroxidase, catalase, polyphenol).

RESULTS: The result showed that combined application of 2mM OA as pre- and post-harvest treatment significantly decreased the jamun fruit postharvest disease incidence and severity by reducing physical losses, retained significant higher biochemical and anti-oxidative parameters as compared to other treatments. Also significantly retained the higher activity of antioxidative enzymes and reduced lipid peroxidation. Moreover, the higher antioxidative activities of jamun fruit was significantly correlated with less fruit disease severity and infestation.

CONCLUSION: Thus OA application as pre + post-harvest application enhanced fruit quality and decreased post-harvest losses by reducing disease infestation and severity at shelf.

Keywords: Toxins, Postharvest losses, Biochemicals, enzymes

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SPP-PP-213

Efficacy of various fungicides against stripe rust caused by *Puccinia striiformis* with relation to epidemiological factors

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ABSTRACT

BACKGROUND: Wheat (*Triticum aestivum*) is a staple food and is considered to be one of the most important crops in the world. It is an annual cereal crop and consumed by humans and used to feed livestock around the world. Wheat cultivation has strengthened Pakistan's economy significantly. Wheat is the second most important crop after rice in terms of productivity. Wheat Yellow rust caused by *Puccinia striiformis* f. sp. *tritici* is one of the most devastating diseases of wheat, affecting quality and yield of wheat significantly.

METHODS: Current study was conducted to check the efficacy of five fungicides (Tilt 25EC, Folicur 250EC, Bayleton 25 WP, Bavistin 50 WP, Indofil M-45 75) against stripe rust of wheat. In the current study, the relationship of stripe rust and yield with environmental factors was also studied.

Results: Results indicated that two consecutive sprays of Tilt after 15 days interval control disease up to 90.3% followed by Bayleton, Folicur, Indofil and Bavistin. Stripe rust was found to be strongly linked with maximum temperature, minimum temperature, and sunshine radiations, while other environmental factors were found to have no effect on stripe rust. The results showed that Stripe rust infection increased as the minimum temperature and relative humidity increased, but stripe rust infection decreased as the maximum temperature increased.

CONCLUSION: It was concluded that Tilt can be used in future to manage stripe rust of wheat.

Keywords: Wheat, Fungicides, *Puccinia striiformis*, Management, Epidemiology

SPP-PP-214

Management of citrus green mold through the use of essential oils

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ABSTRACT

BACKGROUND: Citrus comes first about production and area as related to other fruit in the world. It comprises vitamin C in a rich quantity. Post-harvest diseases cause huge losses in citrus fruit. *Penicillium digitatum*, is a destructive disease of citrus fruits.

METHODS: Diseased and healthy fruits (Musambi, Fruiter early, Grapefruit, Lemon and Sweet orange) were collected. Coated healthy fruits were used with three altered essential oils namely Clove, Eucalyptus and Neem at 40% and 60% concentrations after inoculation with *P. digitatum* and were kept in polythene bags. Trial was carried out in CRD-factorial

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and three replications were used in each treatment.

RESULTS: Coated clove oil at all doses found to be most effective (0.25-13.67 cm) against *P. digitatum* growth as related to control (6.70- 26.25cm) and other coating oils.

CONCLUSION: Use of essential oils can be an economic way to manage citrus green molds

Keywords: Green mold, *Penicillium digitatum*, Clove oil, Eucalyptus oil and Neem oil

SPP-PP-215

Identification and Genetic Diversity of *Garlic virus D (GarV-D)* Infecting Garlic in Pakistan

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ABSTRACT

BACKGROUND: Garlic (*Allium sativum* L) belongs to family *Alliaceae*, an aromatic bulbous cool season vegetable and spice, grown all around the world at domestic level as well as commercially. China is the leading country among top garlic producers around the globe. Pakistan garlic produces 85,642 tonnes from an area of 9.6 hectares, the average yield in Pakistan is quite low and variable owing to many RNA viruses. Viral diseases of garlic reduce the yield up to 50% during the growing season.

METHODS: Garlic leaf samples from Punjab, Pakistan showing yellowish chlorotic strips, mild mosaic and leaf distortion were tested for genus *Allexivirus* incidence using reverse transcription-polymerase chain reaction (RT-PCR) with degenerate primers AllexCP+ -74/ AllexNABP-R75. After sequencing, one sequences of 746 nt GarV-D isolate comprise of 402 nt encoding 133 aa of partial CP gene and 345 nt encoding 115 aa of complete NABP gene was submitted to GenBank with accession no. MH094030.

RESULTS: Sequence identity matrix revealed that Pakistani GarV-D isolate of this study shared 74.2-89.6% of nucleotide and 78.9-97.7% of amino acid identity among them while (98.6%) identity with previously reported GarV-D isolate being higher with the Indian isolate (KP862055) isolate and lowest 74.2% with the isolate of Iran (HQ681934). Pakistani GarV-D isolate *Allexivirus* characteristic features were observed i.e. Flexi-CP motif "FDFFNVLSDFS" at position 62-74 while "CFDCGAFLVDGHR" in viral-NABP at 66-78 and they are clustered with each other forming sister clad with isolates from India, Iran, Poland and Czech Republic affirming the results of evolutionary distances and sequence identity matrix. No recombination event was detected in isolate examination. Fu, & Li's F, Fu, & Li's D Tajima's D statistical test results revealed that CP genes of GarV-D isolate are under balancing selection with contraction of population while NABP gene is under the negative or purifying selection.

CONCLUSION: The present research is the first evidence of genetic variability of GarV-D in garlic from Punjab, Pakistan. The study findings will enable breeders to grow *Allex Virus* resistant varieties and also lead to forecast the chance of resistance breakdown in future with pathogen mediated resistant transgenic lines of vegetable crops.

Keywords: *Allium sativum*, RNA virus, *Allexivirus*, GarV-D, RT-PCR, Coat Protein

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UV irradiation effects phyllosphere colonization and Biofilm formation of *Olea europaea*

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ABSTRACT

BACKGROUND: The Aerial parts of plants termed as phyllosphere are normally colonized by a variety of bacteria, yeasts, and fungi. The aerial inhabitants are called epiphytes. Bacterial colonization as biofilms is well documented and has been reported to cause many economic and health problems. **METHODS:** Hence this study was designed to isolate microbes from the phyllosphere of *Olea europaea* (olive plant species) and assess the biofilm forming ability. Four strains L1, L2, L3 and L4 were isolated from the phyllosphere of *O. europaea* and characterized morphologically, biochemically and physiologically.

RESULTS: 50% strains were gram positive while 50% was observed to be gram negative. All strains were catalase positive with no H₂S production. All strains showed best growth at 37°C temperature and pH 7. From above characterization, strains were found to belong to genera *Erwinia* spp., *Pseudomonas* spp., *Micrococcus* spp. and *Bacillus* spp. Biofilm formation determined by two methods i.e. Congo red and cover slip proved *Bacillus* spp. as the only biofilm former Congo red method. Afterwards mutations were induced at different time intervals i.e., 3, 4, and 15 minutes. There was an incredible difference in biofilm formation between wild type and mutant strains. Highly significant biofilm formation ($p > 0.001$) was observed in all mutated strains after 15 minutes of UV exposure.

CONCLUSION: Hence our study discussed the significant decrease in biofilm formation of various pathogenic strains of *O. europaea* after UV exposure for 15 minutes which could be applied to overcome many plant diseases in future.

Keywords: UV irradiation, *Olea europaea*, Biofilm

SPP-PP-217

Biochemical markers of resistance in citrus against canker disease

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ABSTRACT

BACKGROUND: Biochemical compounds are important factors in plant-disease interactions. Plants become prone to pathogen infection due to alterations in these compounds which help the plants in restricting the pathogens. Knowledge of these alterations is helpful for researchers to develop some concrete solutions for the management of canker disease.

METHODS: For this purpose, experiments were conducted with three replications to find out the alterations in biochemical compounds of citrus leaves infected with canker disease by artificial inoculation through syringe method. So, six varieties (three susceptible and three resistant) were selected after two years screening of thirty species of citrus under natural field conditions. Leaves of susceptible (Grapefruit, Succari, Kinnow) and resistant (Kumquat, Jaffa, China lemon) varieties of inoculated and un-inoculated groups were collected and analyzed for variation in biochemical compounds by using Nested Structured Design. Variations ($p \leq 0.05$) were observed in the biochemical compounds among the

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treatment types.

RESULTS: Resistant type of plants expressed 3.35, 2.90, 1.01, 2.10, 2.50, 3.18, and 0.66 $\mu\text{g/g}$, susceptible type expressed 2.29, 2.49, 1.36, 2.41, 1.73, 4.13 and 0.86 $\mu\text{g/g}$ of total phenolic contents, total soluble sugars, super oxidase dismutase, peroxidase, total soluble proteins, catalase and hydrogen peroxide respectively, while in case of groups, inoculated plants expressed 1.59, 2.52, 1.98, 3.20, 0.93, 5.11 and 1.21 $\mu\text{g/g}$ and un-inoculated group exhibited 4.05, 2.87, 0.39, 1.30, 3.29, 2.19 and 0.30 $\mu\text{g/g}$.

CONCLUSION: These variations can be used as biochemical markers to identify sources of resistance in citrus species against canker disease.

Keywords: Canker, biochemical alterations, artificial inoculation, plant-disease interaction, nested structured design

SPP-PP-218

Root-knot nematodes (*Meloidogyne* spp.) infecting cucumber in the Pothwar region of Pakistan

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ABSTRACT

BACKGROUND and Methods: Studies to estimate root-knot nematode infestations on cucumber were conducted during mid to late season at 378 randomly selected sites in 126 villages of the four districts across the Pothwar zone of the country.

RESULTS: The overall mean infestation of root-knot nematodes in the region was found to be 16%. The studies revealed variations in the incidence and severity of root-knot nematodes in the four districts. The incidence of root-knot nematodes was the highest in Rawalpindi district (22%), followed by 14% in Attock. Of the four districts, the minimum incidence of 11% was recorded in Jhelum district. The maximum mean severity (3.8), measured in terms of the galling index, was found in Rawalpindi district, while the minimum (1.9) was observed in Jhelum district. The mean severities of root-knot nematodes in the districts of Attock and Chakwal were 2.7 and 2.2 respectively. Variations in incidence and severity were also observed among subdivisions of the districts. Of all the associated species of root-knot nematodes, *Meloidogyne incognita* constituted 79%, *Meloidogyne javanica* 19%, *Meloidogyne arenaria* 2% and *Meloidogyne hapla* 1%. *M. incognita* and *M. javanica* were recorded in all of the districts, with *M. incognita* predominating. *M. incognita* as a pure population was recorded in 30% of the villages, while the other three species were found as mixtures. The most common mixed population was *M. incognita* and *M. javanica*, observed in 70% of villages in the region. *M. arenaria* and *M. hapla* were not found together in any of the population mixtures.

CONCLUSION: The results indicate that cucumber is severely attacked by root-knot nematodes, warranting adoption of strict control measures for its management.

Keywords: Root-knot nematode, Cucumber, galling index

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Effect of Garlic extract (Polysulfide) on the development of *Meloidogyne incognita* in tomato

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ABSTRACT

BACKGROUND: Tomato (*Lycopersicon esculentum*) is the 2nd most significant vegetable. We did an investigation to assess the effectiveness of garlic extract on the reproduction of *Meloidogyne incognita* in tomato plants. We conducted two experiments during the investigation; one as root dip application and other was soil drench application method. The influence of garlic extract was also determined on the second stage juvenile (J₂) mortality.

METHODS: The active substance of garlic extract is diallyl polysulfide with cellular target mode of action. There were three replications for each treatment. The parameters including number of galls and egg masses per root system, shoot and root length, weight, number of fruit and flower were recorded.

RESULTS: Results showed significant J₂ mortality under *in vitro* conditions. Significant effect of garlic extract on root knot nematode development was observed in soil drench application method as compared to root dipping method.

CONCLUSION: Soil treatment with garlic extract reduced the nematode root gall index besides raising up the action of catalase, B-1,3 glucanase enzyme in tomato plants as compared to root dipping.

Keywords: Tomato plant, RKN, Garlic extract, polysulfide, soil drenching, root dipping.

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Effect of castor bean aqueous extract on the reproduction of *Meloidogyne incognita* in tomato

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ABSTRACT

BACKGROUND: This study has been planned to assess the effectiveness of castor bean aqueous extract on the reproduction of root knot nematode (*Meloidogyne incognita*) on tomato.

METHODS: Four experiments were conducted with the different concentrations (25%, 50%, 75% and 100%) of castor bean extract. The effect of castor bean extract was observed on the egg hatching and juvenile's mortality of *M. incognita* under *in vitro* conditions. Egg hatching calculated after 2, 4 and 6 days of interval and juvenile's mortality observed and calculated after 24, 48 and 72 hours of incubation. Maximum mortality was observed after a 72 hours interval. The efficacy of castor bean aqueous extract was checked by soil drench and root dip methods, in soil drench method 1000 juveniles of *M. incognita* were inoculated. In root-dip method, roots of tomato plants were dipped for half hour in castor bean extract with different concentrations. Roots were inoculated with 1000 juveniles of *M. incognita*. There were six treatments with five replications for each treatment. Parameters including shoot length, root length, stem girth, fresh shoot weight, root weight, no. of leaves, no. of branches, no. of flower and fruit per plant, no. of egg masses of *M.*

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incognita, no. of galls and no. of juveniles per 100 g soil of roots.

RESULTS: An increase in plant growth parameters and decrease in nematode reproduction was observed in soil drench application method.

CONCLUSION: So, castor bean extracts have the nematicidal potential and could be integrated in management strategies against root knot nematodes under field conditions.

Keywords: castor bean, root knot nematode, *Meloidogyne incognita*

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Effect of salicylic acid on the growth of eggplant infected *Meloidogyne incognita* through different means of application

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ABSTRACT

BACKGROUND: The present research was planned to assess the efficiency of salicylic acid on the reproduction of root knot nematode (*Meloidogyne incognita*) on eggplant.

METHODS: Four experiments were conducted during the research; out of which one was *in vitro* and three were *in vivo*. In *in vivo* experiments root dipping, soil drenching and foliar spray method were used. In root dipping method, seedlings of eggplant were dipped in different concentrations of salicylic acid (3 mM, 5 mM, 10 mM) for half hour and in soil drenching potted soil was drenched with different concentrations of salicylic acid (3 mM, 5 mM, 10 mM). Plants were inoculated with one thousand freshly hatched second stage juveniles of *M. incognita* while in foliar spray method plants were sprayed with different concentrations of salicylic acid (3 mM, 5 mM, 10 mM) after inoculation with *M. incognita*. After three weeks of inoculation a second application of treatments were applied for soil drenching and foliar method. There were five treatments with five replications of each experiment. In *in vitro* experiment juvenile mortality test of *M. incognita* was conducted. Different parameters were recorded i.e., root and shoot weight, root and shoot length, no. of galls per plant, no. of egg masses per plant, no. of leaves, branches and fruits per plant, no. of females, no. of juveniles per 100 g of soil and stem girth.

RESULTS: The result of all the field experiments exhibited the increased growth of eggplant with significant decrease in nematode development.

CONCLUSION: So, salicylic acid could be successfully used as an effective field management strategy.

Keywords: Salicylic acid, eggplant, root knot nematode

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Environmental characterization and biological management of wheat yellow rust

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ABSTRACT

BACKGROUND: Stripe rust of wheat is an air borne obligate parasite and distributed globally. Current research was planned for the management of stripe rust by applications of biological control agents.

METHODS: The evaluation of bacterial strain along fungicide as a positive control, was done under field conditions under randomized complete block design (RCBD) along three replications. The data regarding disease severity, environmental factors and disease management was collected. Seven wheat varieties (Sehar, Galaxy, Abdul sattar, Faisalabad, Johar, Td1 and Ujala) were cultivated in research area of MNS- University of Agriculture, Multan during November 2019-20 to determine their response toward *Puccinia striiformis* var. *Tritici*. For the fungicide 2ml of fungicide (Tilt®) was added in 1500ml of water while bacterial strain was added @ 0.25ml/ml of water to make a fine suspension. The screening was done to check the response of wheat varieties. The overall results of the management trial showed that biological (T1) reduced the disease effectively upto (8.18%) followed by chemical (T2), 10.7%, as compared to control (T0), 23.8%.

RESULTS: The correlation of environmental factors and disease severity showed highly significant correlation with minimum air temperature and relative humidity while negatively non-significant with maximum air temperature. Wind speed, solar radiation and rainfall showed non-significant correlation with disease severity whereas after application of (T1) and (T2) minimum air temperature expressed significant correlation with disease severity of Sehar, Galaxy and Abdul sattar while non-significant with Faisalabad, Johar, td1 and Ujala.

CONCLUSION: Maximum air temperature, relative humidity, wind speed and solar radiation showed non-significant correlation with disease severity while Rainfall was negatively non-significant.

Keywords: Epidemiology, *Puccinia striiformis*, Biological control

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An insight into Manage Anthracnose: Global status and the way forward for disease management

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ABSTRACT

BACKGROUND: Mango anthracnose is the most ravaging biotic stress to the successful production of mango fruit across the globe. *Colletotrichum gloeosporioides* is an etiological agent of this disease that adversely affects the quality as well as quantity of produce. The occurrence of disease at pre and postharvest conditions is a common phenomenon which is responsible for potential economic losses.

METHODS: It has been studied that hot and humid climatic conditions are conducive for the outbreak of disease. Therefore, integrated management of mango anthracnose is essential. It has been estimated that approximately 25 to

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30% losses in mango production are due to anthracnose and stem end rot. Previous investigations revealed that the disease incidence may reach up to 100% on fruits under humid conditions. Various management strategies such as chemical control, biocontrol, use of Phyto-extracts and nanotechnological approaches have been introduced to combat this disease. The synthetic fungicides are used to curb the disease incidence. Pathogens have developed resistance against various chemicals that are generally utilized to overcome this disease.

RESULTS: Among these strategies, nanotechnology is a rapidly evolving discipline that is gaining the attention of researchers because of its antifungal potential against mango anthracnose.

CONCLUSION: The objective of the present manuscript is to review pathogen profile and modern approaches that can prove an effective tool for disease management.

Keywords: Phyto-extracts, Fungal pathogen, Bio-active compounds, *C. gloeosporioides*, *Trichoderma viride*

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Citrus Brown Spot: An Emerging Threat to Citrus Industry

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ABSTRACT

BACKGROUND: Citrus is graded as 2nd most important fruit crop of Pakistan which belongs to family Rutaceae. It is gaining popularity being a good source of nutrition for human health and owing to being a good source of nutrition, it can be categorized as functional food containing components known to have health promoting, antiviral and anticancer activities. Its production is affected due to a number of biotic (Citrus canker, citrus gummosis, citrus melanose, citrus greening and citrus slow decline) and abiotic (rainfall, temperature, wind speed and humidity) factors. Citrus brown spot (caused by *Alternaria citri*) is one of fungal diseases and is becoming a serious threat towards the citrus industry. The pathogen affects various parts of citrus plants and is responsible for huge economic losses in different citrus growing areas of Pakistan.

CONCLUSION: Citrus brown spot is managed by a number of control strategies including removal of infected parts of plant, sanitation practices and by the application of various chemical as well as biological approaches.

Keywords: Anticancer, Fungal disease, Biological approaches, *Alternaria citri*.

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Analysis of fungal ITS region and mtSSU region of rDNA for the identification of pathogen associated with Alternaria leaf spot of Spinach

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ABSTRACT

BACKGROUND: Alternaria leaf spot of spinach is one of the most abundant and economically imperative diseases that is responsible for 20-80% spinach reduction globally. The current study was planned to assess the fungi associated with leaf spot of spinach at molecular level in Pakistan.

METHODS: The infected leaf samples of spinach plants were collected from the vicinity of University of Agriculture,

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Faisalabad. Fungi was isolated, purified on respective media and morphologically identified by observing fungal growth pattern, growth color, spores shape, spores color, hyphal septation and color. Pathogenicity test was performed to confirm Koch's postulates. Fungal genomic DNA was isolated by following the modified CTAB method. PCR amplification of nrDNA was performed by using ITS1/ITS4 primers for Internal Transcribed Spacer Region and NMS1/NMS2 primers for mt SSU.

RESULTS: Sequencing and phylogenetic analysis of PCR products of associated fungi was evaluated among closely related species of our tested fungi by using different bioinformatic tools.

CONCLUSION: The phylogenetic trees revealed that isolated fungus was closely associated with *Alternaria alternata* that is the causal agent of *Alternaria* leaf spot of spinach. Keywords: *Alternaria alternata*, ITS, NMS, PCR, Morphology, Characterization.

Keywords: *Alternaria* leaf spot, spinach, PCR, Internal transcribed spacer.

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Characterization and Control of *Ceratocystis manginecans* cause of Shisham Quick Decline (SQD) in Punjab, Pakistan

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ABSTRACT

BACKGROUND: Shisham is one of the most common cultivated forest trees grown all over the world. Shisham Quick Decline disease has caused devastating effects on shisham. Surveying and sampling of declined trees from different districts of Punjab (Pindi Bhattian, Multan, Sahiwal, Rahim Yar Khan) was conducted and more than 80% disease incidence was recorded. Isolation of fungal isolates was done on carrot baits and 2% malt extract agar. Morphological and molecular characterization of 29 fungal isolates was revealed that the cause of this quick decline is *Ceratocystis manginecans* with 99% similarity bootstrap.

METHODS: Pathogenicity testing confirmed the association of *C. manginecans* in artificially infected shisham plants. After disease progression, histopathological studies were revealed that the diseased seedlings have disintegrated vascular tissues, tylosis, production of phenolic compound and hyphal proliferation. While the controlled healthy seedlings remained intact.

RESULTS: The efficacy of systemic fungicides was tested against *C. manginecans in vitro* which resulted in carbendazim exhibiting more significant results in the inhibition of *C. manginecans* at 700 PPM than Topsin-M and propiconazole.

CONCLUSION: Therefore, use of carbendazim against *C. manginecans* is a quick measure to combat against the disease.

Keywords: *Ceratocystis manginecans*, disease incidence, shisham, deciduous, decline.

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Characterization and Control of *Ceratocystis fimbriata* cause of Eucalyptus Wilt Disease (EWD) in Punjab, Pakistan

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ABSTRACT

BACKGROUND: Eucalyptus, a fast growing forest tree, having great commercial, economical, medicinal and antimicrobial properties is cultivated throughout the world. Forest trees' growth, maturity and productivity is highly affected by a number of diseases and fungal pathogens, particularly "*Ceratocystis fimbriata*". This fungus being a soil borne pathogen affects a large number of eucalyptus plantations as more as 40%. It is known to cause eucalyptus wilting with characterized symptoms of wilt including- discoloration, bark splitting, rapid wilting of leaves, dark streaks on stem upon bark removal followed by ultimate death of tree. *C. fimbriata* also kills young seedlings of eucalyptus, which may affect its natural regeneration and biodiversity. A survey was conducted in Hafizabad and Seikupurah districts of Punjab, Pakistan. Disease incidence was 42% in Sheikhupura and 55% in Hafizabad respectively.

METHODS: Disease samples were collected; isolated, purified and histopathological parameters of these isolates were evaluated. Histopathological study also revealed that wilting is caused by the same fungus, which was applied during inoculation. Formation of plasmodemata and tylosis were also observed. Pathogenicity test of isolates was conducted under controlled conditions.

RESULTS: Results concluded that fungus was proven to be the cause of eucalyptus wilt as it is proven in pathogenicity trials. DNA extraction and ITS regions both forward and reverse were studied of these isolates followed by sequencing. It also confirmed that wilting is caused by *ceratocystis* genus due to close resemblance with *Ceratocystis manginecans* 100% and 64% with *C. accalivora*. Furthermore, for the management strategies of disease, endobiophytes) and systemic fungicides (Topsin-M, Carbendazim and Propiconazole) was applied to evaluate their antagonistic effects under in-vitro study on fungal isolates. In fungicides, carbendazim restricts 100% growth. Topsin-M and propiconazole showed less results as compared to carbendazim.

CONCLUSION: In biological agents, *Nigrospora oryzae* were given best results inhibiting growth 88% and *Trichoderma viridae* restricted growth 60%. The experiment was conducted according to complete randomized design (CRD) under greenhouse conditions and data was analyzed using SPSS software.

Keywords: *Ceratocystis fimbriata*, *Nigrospora oryzae*, *Trichoderma viridae*, Eucalyptus, deciduous, decline.

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Spatial variation analysis of *Ceratocystis manginecans* cause of Indian rose wood quick decline in Punjab, Pakistan

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ABSTRACT

BACKGROUND: Indian Rose wood (*Dalbergia sissoo*) is a deciduous tree of family Papilionaceae. Indian rose wood is economically important for Asian subcontinent due to its timber quality. Unfortunately, Indian rose wood is facing a quick

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decline problem from the last 20 years. Quick decline has ravaged the whole Indian rose wood plantation in Asian subcontinent. In Pakistan, 85% disease losses have been recorded. Quick decline is characterized by the presence of symptoms such as streaking in vascular tissue, reduced growth, shortened internodes, root necrosis, yellowing, loss of foliage, dieback of twigs and branches and ultimately the tree death. *Ceratocystis manginecans*, soil borne and decline causing fungus is responsible for the huge loss of Indian rose wood trees.

METHODS: Therefore, this study was conducted to map the disease incidence of this quick decline in different districts of Punjab Pakistan; Faisalabad (FSD), Islamabad (ISL), Sheikhpura (SKH), Sahiwal (SHL) and Rahim Yar Khan (RYK). Spatial variation analysis was conducted by GPS (Garmin) tagging, surveying and sampling of Indian rose wood trees and assessed by ARCGIS 10.2.1 and ARC View 10.2.1 Software to make the semi-variograms.

RESULTS: On the basis of spatio-variational analysis, the districts of Punjab are highly affected. District wise disease incidence was recorded; FSD 80%, ISL 90%, SKH 85%, SHL 70% and RYK 82%.

CONCLUSION: Consistent with our hypothesis, SQD is caused by *Ceratocystis manginecans* and is highly prevalent in all of Punjab, Pakistan.

Keywords: Indian rose wood, *Ceratocystis manginecans*, spatio-variational, semivariograms.

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Some Laboratory Studies for the assessment of Parasitic Response of Ectoparasitoid, *Tamarixia radiata* towards its host, Asian Citrus Psyllid, *Diaphorina citri*

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ABSTRACT:

BACKGROUND: Citrus is the most commonly grown fruit tree in the world. Citrus is mostly used as a fresh fruit crop and as well as juice. In the past scenario citrus trees are facing a savory problem of citrus greening caused by an insect named as Asian citrus psyllid *Diaphorina citri*. Uses of insecticides increased the air and land pollution and as well as directly affected the beneficial insects that are living into the soil.

METHODS: Pakistan is already facing a problem of smog, air pollution so we need to more work for control of *D. citri* through biological control and rearing of *Tamarixia radiata* (Waterston) (Hymenoptera: Eulophidae) is the need of time that is used for biological control and for this purpose study was conducted at research sites during April 2019 to February 2020 in Insect Molecular Biology Laboratory, Dept. of Entomology, UAF. The experimental unit consisted of a single three days old female in a centrifuge tube containing a young (Kinnow) Citrus reticulata shoot infested with a range of 1–50 fourth-instar *D. citri* nymphs. Shoots were changed on daily bases for 5 days and the nymphs containing one or more parasitoid eggs were noted.

RESULTS: Results showed that the maximum number of hosts parasitized were produced at the highest density that was 50 that was statistically similar with 40 and 30 host density respectively. The lowest percentage parasitism % was observed under the highest that was statistical at par with 40, 30, and 20 host density respectively. Number of pupal parasitoids was calculated maximum under fifty host density that was six and minimum was 2.67 the number of pupal parasitoids that was similar with ten host density. Maximum adult parasitoids were recorded 5 under 50 hosts density of *D. citri*.

CONCLUSION: The obtained information was helpful to understanding the parasitic response of *D. citri* and its control through *T. radiata*.

Keyword: *D. citri*, Host density, *T. radiata*, parasitic response

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Incidence of Common Scab of Potato Caused by (*Streptomyces Scabies*), In District Sahiwal and Application of Chemicals for its Management

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ABSTRACT

BACKGROUND: Potatoes are a highly nutritious and industrial crop which is cultivated worldwide on large scales. Pakistan ranks as 18th largest potato grown country in the world with annual production of 4.59 million tons. Worldwide and in Pakistan diseases caused by bacteria are among the most extensively recognized and are the real production declining biotic culprits. Common scab of potato is one of the earliest known diseases which results in significant losses in the potato production yields. Common scab of potato is identified as circular and angular lesions which are often raised and are in-filtered to several couple of millimetres resulting in poor quality of the potato harvest without causing any impact on decreasing the total production yield.

METHODS: Plant pathogenic *Streptomyces* species undertake production of toxins which belong to a family of phytotoxins named as Thaxtomins that imitate scab symptoms on host plants. As the incidence of scab lesions is on the surface of the tubers it reduces the marketability of the potato crop by decreasing the economic worth of the produce. District Sahiwal were surveyed and the data regarding Common Scab disease was recorded. The survey was designed to determine the incidence and severity of common scab disease across District Sahiwal. Celeste (Fludioxonil), Moncut (Flutolanil), Ernesto (Penflufen), Triton (Validamycin) and Protector (Difenoconazole + Validamycin 12 wp) were tested against *S. scabies*. Three concentrations of chemicals 250 ppm, 500 ppm and 750 ppm were tested. Three replicates were used for individual treatment. By measuring the diameter of the inhibitory zone (mm) the outcome of each treatment was determined. Data was recorded after 24 hours, 36 hours and 48 hours respectively.

RESULTS: The maximum inhibitory zone was expressed by (Difenoconazole + Validamycin 12 wp) 54.11 % as compared to other Chemicals and in field conditions the combination of (Difenoconazole + Validamycin 12 wp) expressed 19.55% minimum disease incidence rate.

CONCLUSION: Statistical analysis determined the response of different concentrations of chemicals under in-vitro and in-vivo conditions. Potato growers should be used for treatment against common scab disease of potato.

Keywords: Potatoes , Common Scab of Potato , management

SPP-PP-231

Biochemical Characterization of *Xanthomonas axonopodis* pv. *citri*; A Major Impediment to Citrus Orchard

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ABSTRACT

BACKGROUND: Citrus is a significant crop playing an important role in Pakistan's economy. However, its production is under constant threat by numerous pathogens resulting in considerable economic losses. Bacterial canker caused by

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Xanthomonas axonopodis pv. *citri* is a major limiting factor in the successful production of citrus.

METHODS: Isolates of the pathogen were collected from infected citrus orchards of Toba Tek Singh, Gojra and Bahawalpur regions. Citrus canker disease based samples were evaluated in Citrus Pathology Laboratory, Department of Plant Pathology, University of Agriculture Faisalabad, Pakistan.

Results: Bacterial pathogen was characterized by morphological evaluation, pathogenicity and biochemical tests including gram staining, catalase test, KOH test, simmons citrate test, starch hydrolysis test, methyl red and voges proskauer test, gelatin liquefaction test, casein hydrolysis test, kovac's oxidase test, nitrate reduction test and tween 80 hydrolysis test were performed which confirmed that citrus canker is caused by bacterial pathogen (*Xanthomonas axonopodis* pv. *citri*)

Keywords: citrus, *X. axonopodis*, bacterial canker

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Impediments Regarding Citrus Canker Disease and Its Control Measures in District Faisalabad

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ABSTRACT

BACKGROUND: Citrus is one of the significant fruit crops worldwide and also grown in Pakistan provinces. Punjab produces above 95% of this fruit crop due to conducive growing environment. The citrus production gap is linked with numerous factors; the main factor is insects and diseases of citrus fruits. In this respect, the main problem is fewer responsiveness of farmers about citrus canker disease. At the time of need, farmers are not capable of achieving the citrus fruits demands, so make a vast gap in citrus manufacture. Citrus canker is an excessive disorder, the pathogen, normally characterized through visible rough scratches on fruit, stems and leaves, twig dieback, falling off undeveloped fruits and trees and defoliation. The aim of the current study was to identify the farmer's awareness about the citrus canker disease and pest control measures.

METHODS: Therefore, the current study was conducted in Tehsil Jaranwala, District Faisalabad. From the selected tehsil one union council was selected through purposive sampling technique and from eight villages of the union council (UC-15) citrus growers were selected which made a collective sample size of 120 respondents.

RESULTS: The results of the study presented that the majority of the respondents were growing Kinnow. Farmers suffered from many constraints as the majority of citrus growers faced citrus canker disease. It also observed that the immense majority of the respondents did not know about any control measures regarding the citrus canker disease. Majority of the farmers were also not aware of new modern methods and techniques as well. Respondents faced a lot of constraints regarding plant protection measures; these were non-availability of tube wells, expensive pesticides, spraying material due to high prices, lack of knowledge and fewer co-operations of extension workers. On the basis of findings, it determined that the level of awareness of farmers was at an average level and adoption of new technologies was below the average. Farmers know the disease but unaware about the management practices.

CONCLUSION: Instead of awareness achievement growers need training to increase their technical knowledge, finance for investment and pure chemicals for better protection. Growers were more dependent on expensive chemicals than bio-control. A thorough campaign regarding adoption of bio-control should be started for clean and effective control of the disease on citrus fruit.

Keywords: Citrus fruits, citrus canker disease, symptoms, control measures, bio-control

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Significance of Latest Discoveries in Management of Stripe Rust

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ABSTRACT

BACKGROUND: Integrated pest management (IPM) chains the use of biological, chemical and cultural practices to control insect pests in agricultural productions. It tries to find the use of natural predators/ parasites to control pests, using selective pesticides for back-up only when pests are able to be controlled by natural sources. The IPM clarifies to Identify different techniques/ methods of pest management and their benefits and limitations. Analyze pest issues, determine if management is necessary, and make appropriate recommendations using integrated pest management techniques and describe the worth of beneficial insects. When advanced pesticides were 1st developed, they were used extensively. Pests susceptible to a pesticide were quickly killed, leaving resistant ones to breed and multiply. It becomes clear that pesticide alone would not solve all pest problems. Instead, overuse of pesticides caused the development of resistant pests. Scientists began to develop a new approach to pests' control. This new approach was termed as integrated pest management (IPM), integrated denoting the fact that all control measures (cultural, mechanical, chemical and biological) are considered and its suitable use. IPM plan allows some level of pests in the environment. Pests are much likely to survive a program, which uses several different methods of reducing their populations. IPM was first suggested by agricultural entomologists because insects were the 1st group of pests to prove difficult to manage with chemicals alone. Early proponents of IPM suggested using basic strategies to improve the insect management through following steps: Monitor and scout insects to recognize insect types and population levels. Identification of pest and host accurately. Assess and consider economic/ aesthetic injury thresholds.

CONCLUSION: A threshold is the point at which action should be taken. Implement a treatment strategy using cultural, mechanical, biological and chemical controls and combination of these strategies. Evaluate success of treatments.

Keywords: IPM, biological control, cultural control

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Innovative Approaches for Management of Plant Diseases In Relation to Changing Climate

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ABSTRACT

BACKGROUND: Plant diseases will almost likely be affected by climate change in term of occurrence, prevalence, and severity. This will also have an impact on disease management in terms of the timing, preference, and efficacy of chemical, physical, and biological control approaches, as well as their use in integrated pest management (IPM), initiatives. Agro-industries, extension agencies, and practical farmers are all engaged in forecasting the future disease management requirements. Overall, the issue of adapting disease control strategies to climate change will likely be similar to the modifications to technology advancements or changes in the economic framework that are already required in current crop protection.

CONCLUSION: Use of crop rotation is also one of the feasible ways of protection against disease issues. Climate change's potential positive effects, such as longer growing seasons, fewer frosts, and changing precipitation patterns, must not be overlooked, as these could mitigate the disease's projected increase.

Keywords: climate, plant disease, innovative approach

SPP-PP-236

Innovative Approaches for Management of Yellow Rust of Wheat (*Triticum aestivum* L.) And High Yield Potential

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ABSTRACT

BACKGROUND: Wheat (*Triticum aestivum* L.) is the most significant food crop in the world, with an annual production of more than 750 million tons on an area of about 220 million hectares. Furthermore, yield losses are caused by a variety of biological and abiotic factors that affect various locations, resulting in significant yield losses. Yellow (stripe) rust (YR), is caused by the fungus *Puccinia striiformis* f. sp. and is extremely severe biotic stress on a global scale, resulting in yield losses of around 5.5 million tons (or 979 million dollars) per year in the agricultural industry. Yellow rust is a devastating fungal disease of wheat that affects crops all over the world but is notably prevalent in Central and Western Asia, as well as North Africa and the Middle East. To reduce the threat of yellow rust, it is necessary to establish wheat cultivars employing a diverse germplasm collection that contains rust resistance genes that are effective at different growth stages. To maximize sowing opportunities, self-sown wheat (particularly the most susceptible varieties) should be destroyed well in advance of seeding (4-6 weeks is recommended). This is because the presence of rain during the growing season increases the likelihood of susceptible regrowth and allows for very early sowing. Long-acting seed dressings and in-furrow fungicides are highly effective choices that can give protection until around the time of flag leaf emergence,

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depending on the rate of treatment and disease pressure. Growing large areas of susceptible varieties can aggravate the spread of a yellow rust outbreak. This risk can be reduced by planting resistant cultivars among more vulnerable varieties, which will help to keep the disease from spreading further. Fungicides can be quite efficient in the management of yellow rust. In addition, the pathogen is not particularly vulnerable to developing resistance to fungicides

CONCLUSION: Systemic seed treatments may be able to prevent epidemics from forming in areas where the risk is high. Produce a high-yielding variety with a high disease resistance rating but keep an eye on disease levels throughout the season. When yellow rust appears on wheat, an azole or a strobilurin should be applied for better yield.

Keywords: wheat, yellow rust of wheat, management

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Advanced Agricultural Biotechnology: A Technique Forward for Protecting Cash Crops against Plant Disease

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ABSTRACT

BACKGROUND: Many factors, such as increased population expansion, deterioration of natural resources, climate change, and developing pests, have a significant impact on worldwide agricultural productivity. Humanity needs a reliable and sustainable food source. Agricultural biotechnology is just one of several factors that influence the health and farmers' welfare and other developing-world inhabitants. As biotechnology evolves, the honest and realistic current controversy is essential to defining the role it should play in society. Constant strain from biotic stressors not only reduces output but also decimates the yield. Advance agricultural biotechnology; work on development of resistance varieties regarding biotic and abiotic stresses. Plant transformation and genetic engineering have proved crucial in crop productivity by introducing advantageous foreign genes or limiting the transcription of endogenous genes in crops. Herbicide resistance, resistance to pests, resistance to abiotic stress tolerance disease resistance, and nutritious improvement are just a few of the beneficial characteristics reported in genetically modified crops. One of the potential strategies for providing an abundance of beneficial plant features, notably an expanded ability to endure or resist attack by plant diseases, is genetic engineering. This is most beneficial for cash and food crops worldwide. The involvement of technology in agricultural zones is a basic need in relation to climate change. Identification of new crop protection targets for intervention in pathogens, pests, and weeds which may provide the basis for screening chemical and biological agents.

CONCLUSION: Beneficial endophytes and resistance elicitors enhance crop protection and improve its efficacy. Genes responsible for plant resistance and resistance reaction genes are being identified and engineered into crop plants to protect them from plant diseases.

Keywords: biotechnology, plant disease, cash crop

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Role of CRISPR-CAS9 Based Genome Editing Methodology In Relation to Disease Resistance in Plants

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ABSTRACT

BACKGROUND: In the past, it has been customary to achieve the growth of new plants with superior or more desired features through rigorous and time-consuming breeding techniques. With the advent of genome-editing techniques, a new era of genome engineering has begun, making it possible to construct plant genomes in a way that is effective, precise, and time-efficient. As a result of the CRISPR/Cas9 method, plants have become resistant to disease. Sequence-specific nucleases like CRISPR/Cas 9 that cut specific parts of DNA and then repair them to make mutants in a wide range of plants have reached a new level of research. Genome-editing method CRISPR/Cas9 has been created and widely employed in a wide range of plants. CRISPR/Cas9 technology has made it possible to rapidly produce genome-edited plants free of transgenes (also known as "null segregants"). Gene knockouts, knockdowns, changes, and suppression and activation of target genes have all been documented in recent years in agricultural plants as examples of targeted mutagenesis.

CONCLUSION: By cleaving the DNA of phyto-pathogens (bacteria, viruses, or fungi) to impede their development, plants have been modified to have broad-spectrum disease resistance. CRISPR/Cas9 and related plant engineering technologies are predicted to speed up not just agricultural plant molecular breeding but also basic research.

Keywords: CRISPR, DNA, gene editing technology

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Molecular identification of pathogen causing sweet pepper wilt and its chemical management

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ABSTRACT:

BACKGROUND: Sweet pepper (*Capsicum annuum* L.) is one of the most popular and high value vegetable crops grown for its immature fruits throughout the world. It provides vitamin A, C, E, B6, thiamine, folic acid and beta carotene. In Pakistan it is cultivated as a warm season crop in open fields during summer and in plastic tunnels during winter. In Pakistan, diseases caused by soil-borne pathogens are a serious problem to sweet pepper production and are attacked by a number of pathogens. Wilt of sweet pepper caused by *Fusarium solani*, the most serious diseases that attack sweet pepper.

METHODS: Fungus was isolated from diseased sweet pepper plants. The pathogen was identified as *Fusarium solani* on the basis of morphological identification. Molecular identification was done by amplifying the internal transcribed spacer (ITS) region using universal primer pairs of ITS1 and ITS4. Based on molecular identification it was confirmed that the disease was caused by *F. solani* with a similarity index of 99%–100%.

RESULTS AND CONCLUSION: *In-vitro*, efficacy of fungicides against *F. solani*, such as Difenconazole and Sulfur along with control, various concentrations and days were exploited in a laboratory through food poison technique. Difenconazole expressed maximum inhibition 67.50% and sulfur expressed 53.50% inhibition of pathogen and reduction in mycelial growth respectively, as compared to control.

Keywords: wilt of bell pepper, *Fusarium solani*, chemicals management

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Morpho-molecular characterization and *In-vitro* management of maize stalk rot pathogen

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ABSTRACT

BACKGROUND: Maize (*Zea mays L.*) is an important cereal crop of Pakistan after wheat and rice. The grains of maize consisted of starch, protein, fibers, oil, sugar and ash. *Fusarium proliferatum* was associated with maize plants infected with stalk rot disease. Pathogen were isolated from diseased maize samples infecting from stalk rot.

Methods: Isolates were identified as *Fusarium proliferatum* on morphological and microscopic features. These were further verified by PCR analysis with the ITS region. The phylogenetic analysis demonstrated that all the isolates of *Fusarium proliferatum* were more than 88% similar based on the maximum likelihood tree analysis and were grouped into a single major cluster. Pathogenicity test was conducted when maize achieved its physiological maturity stage. Pathogenicity assay demonstrated the ability of these isolates to cause infection. *In Vitro* managements was done by food poisoning and dual culture methods. Biological agents such as *Trichoderma harzianum* were evaluated by dual culture method against *Fusarium proliferatum*.

Results: *Trichoderma harzianum* showed antagonistic activity against *Fusarium proliferatum* with mycelial inhibition rates of 80.99%.

CONCLUSION: Fungicides such as sulfur and difenoconazole were evaluated through food poisoning method against *Fusarium proliferatum* in vitro to develop effective management strategies for stalk rot of maize. Sulphur inhibited mycelial growth 52.76% whereas difenoconazole inhibited mycelial growth 84.41%.

Keyword: Maize stalk rot, *Trichoderma harzianum*, Chemical management

SPP-PP-241

Molecular characterization of begomovirus infecting Chili crop and ornamental Croton

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ABSTRACT

BACKGROUND: Chili (*Capsicum annum*) and Croton (*Codiaeum variegatum*) cultivated as spice crop and ornamental respectively. Chilli was found to be infected with *Cotton leaf curl Multan virus* previously, but croton was not found to be infected with *Cotton leaf curl Multan virus* previously.

METHODS: Investigation of the chili field and croton in 2018, samples were collected that are showing symptoms of leaf curling, stunting and yellowing. After DNA extraction of chili and croton samples, PCR technique was optimized. Sequencing was performed for the confirmation of begomovirus.

RESULTS: The amplicon of 579bp, 1400bp, 478bp and 2800bp was obtained by using Av/Ac core primer, beta 01/02, CLCUMuBF11/R33 and Begomo 01/02 primer respectively. Sequencing was performed of chill and croton amplified product of beta 01/02 primer and results revealed the association of 100% and 99% identity with Cotton leaf curl Multan Betasatellite and Av/Ac core result revealed association of 99.2% and 98% identity with *Cotton leaf curl Multan virus* respectively.

CONCLUSION: Chilli is found to be infected with Cotton leaf curl virus and act as a limiting factor. So, there is a need to control its vector. Croton acts as a reservoir for the virus in the absence of the field crop. So, it is important to remove the alternate host from the field and use the resistant varieties.

Keywords: Chili, Begomovirus, Croton, Cotton leaf curl Multan Virus.

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Management of *Meloidogyne incognita* through application *Tagetes erecta* extract

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ABSTRACT

BACKGROUND: *Meloidogyne incognita* is one of the most detrimental pests of crops. It causes severe effects on the *solanaceae* and *cucurbitaceae* family. It retards the growth, quality and yield of the host plant. Several management strategies are being used to control *Meloidogyne incognita*. *Tagetes erecta* extract is being used as a biocontrol agent and produces a substance that helps in the reduction of root-knot nematodes and other organisms. *Tagetes erecta* has nematostatic properties. It produces oxygen radicals by heterocyclic sulfur containing thiophenes such as α -terthienyl. Nematicides have been used to control the *M. incognita* but their use is prohibited due to toxicity and environmental hazards to humans. To reduce the reliance on chemical control, there is a need to optimize the plant extract. *Tagetes erecta* whole plant extracts are more efficacious than stem extracts although both are more effective than root extracts. In comparison with nematicide (carbofuran) at different doses, it controlled 98% of the nematode population. In Pakistan, only few nematicides are registered and being marketed.

CONCLUSION: However, in the future, studies conducted on *Tagetes erecta* and its combination with beneficial fungi i.e. *Trichoderma harzianum* and *Paecilomyces lilacinus* can be useful and helpful to figure out new ways to control *Meloidogyne incognita*.

Keywords: *Meloidogyne incognita*, *Tagetes erecta*, Biological control

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Molecular characterization and genetic diversity of *Cucurbit aphid borne yellows virus* (CABYV) infecting melon in Pothwar region of Pakistan

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ABSTRACT

BACKGROUND: Melon (*Cucumis melo* L.) is the fourth largest fruit produced in Pakistan with an annual production of 0.54 M tonnes over an area of 0.037 M hectares. Successful production of melons is hampered by a large number of biotic factors, especially viruses including *Cucumber mosaic virus* and *Cucurbit aphid borne yellows virus*.

METHODS: During a survey of cucurbit RNA viruses in 2016-17, a severe yellowing disorder (yellowing and thickening of leaves) was noticed on melons grown in the Pothwar region (Punjab) with an abundant aphid population. Total RNA was extracted from fifty symptomatic along with five healthy leaf samples. RT-PCR and subsequent characterization were performed using degenerate primers PoconF-139 (5'-TGYTCYGGTTTTGACTGG-3') and PococpR-140 (5'-CGTCTACCTATTTSGGRTTN-3').

RESULTS: RT-PCR analysis revealed an overall 31% disease incidence of poleroviruses in Pothwar during 2016-17, being highest in Attock (63%) followed by Rawalpindi (50%) and Islamabad (25%). The obtained sequences were identified as 600 nucleotides of the full coat protein gene of the CABYV genome using the BLASTn tool of NCBI. The sequences of both

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isolates were identical, so the sequence of one CABYV-melon (AAHAM) isolate was submitted to GenBank (accession no. MH141556). *In silico* and Phylogenetic analysis revealed that isolate AAHAM clustered with isolates from Thailand (KF791040 and KF815682) sharing 96 and 97% nucleotide identity, respectively. No recombination event was detected during RDP4 analysis. A total of 80 polymorphic (segregating) sites (S) with nucleotide diversity (π) of 0.04256 was evident while five INDEL events were observed in Pakistani isolates. The evolutionary distance of the Pakistani AAHM isolate was recorded as 0.0675-0.2874 with other CABYV isolates reported elsewhere in the world.

CONCLUSION: The present study highlights the presence of this potentially destructive virus on melons which could pose a serious threat to this important crop, and therefore further studies are needed to monitor CABYV disease impact on cucurbits throughout the country.

Keywords: RNA virus, CABY, Coat protein, Melon

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Management of Root-knot nematodes (*Meloidogyne incognita*) in vegetables using proteins

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ABSTRACT

BACKGROUND: Root-knot nematodes (*Meloidogyne incognita*) are one of the most harmful endoparasites that are distributed globally and cause significant threats to vegetable production. These threats are worse when vegetables i.e. cucumbers, tomatoes, and potatoes are grown under greenhouse conditions. Indirect and direct damages adversely affected production and caused a reduction in growth, yield, and quality of produce and resistance against biotic and abiotic stress. Most destructive stage is the ineffective juvenile stage when it invades the roots.

METHODS: Nematicides have been used to control the *M. incognita* but their use is prohibited due to toxicity and environmental hazards to humans.

RESULTS: To reduce the reliance on chemical control, there is a need to optimize the biological control agents. Fatty acid and retinol-binding proteins are unique in nematodes that are involved in reproduction, development, nutrient acquisition, and infection to the host. So, in vegetables identification and characterization of fatty acid and retinol-binding proteins function is a beneficial approach for the control of *M. incognita*.

CONCLUSION: However, in the future, studies conducted on vegetables are useful and helpful to figure out new ways to control root-knot nematodes.

Keywords: *M. incognita*. vegetables, root-knot nematodes, characterization

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Characterization and management of pathogen causing mango sudden death disease

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ABSTRACT

Background: Mango is South East Asia's most significant fruit because of its excellent flavour, taste and fragrance. Mangoes are utilized in a range of culinary preparations both at home and in the food industry. Mango pulp, mango peel, mango jam, and other mango products are available. There are about 1000 different mango varieties around the world, but 160 of them have been abandoned. Mango sudden death (MSD) disease is a big threat to mango growers in Pakistan as well as in the whole world. This study was carried out to emphasize the disease etiology as well as provide the insights about the antagonistic microorganisms residing in mango orchard soil that will ultimately helpful in the management of this disease.

Methods: We performed survey of different areas of Multan i.e., Band Bosan, Sher Shah, Makhdoom Rasheed and Shujaabad for MSD. Infected trees with bark cracking, vascular tissue discoloration, wilting, gummosis were used for incidence, severity and sampling purposes. Mycelial growth of *Ceratocystis* isolates was observed at different temperatures i.e., 24°C, 26°C and 28°C. Moreover, we also collected soil samples from mango orchards to isolate biocontrol agents residing in the soil.

Results: Disease Incidence of different mango orchards was highest in Shujabad (60%) followed by Band Bosan (50%), Sher Shah (45%), and Makhdoom Rasheed (40%). Moreover, the data of disease severity was statistically significant at different locations. Of these, Shujaabad ranked highest with 51-60% followed by Makhdoom Rasheed, Sher Shah and Band Bosan. Isolation of different samples from various locations revealed 48.75% recovery of *Ceratocystis* isolates. Results showed that 26°C is the optimum temperature for mycelial growth. Morpho-molecular studies confirmed that the isolates are of *Ceratocystis fimbriata*. We obtained one fungus and 6 bacterial isolates that showed inhibition of *Ceratocystis* mycelia. The inhibition of *C. fimbriata* by bacterial isolates was statistically significant where the B3 with 28.89% was significant followed by B1, B2, and B4 whereas, B6 depicted the least inhibition.

Conclusion: Information generated from this study will be useful to understand the incidence and severity of MSD in Multan district as well as help the farmers to use eco-friendly approach for the management of MSD pathogen using biocontrol agents.

Keywords: Mango sudden death, *Ceratocystis fimbriata*, Antagonists, Growth Inhibition

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Metagenomic analysis of rice sheath blight sclerotia amended soils for bacterial enrichment having potential role in Nitrogen cycle and plant growth promotion

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ABSTRACT

BACKGROUND: Rice sheath blight pathogen, *Rhizoctonia solani*, produces numerous sclerotia to overwinter. As a rich source of nutrients in the soil, sclerotia may lead to the change of soil microbiota. For this purpose, we amended the sclerotia of *R. solani* in soil and analyzed the changes in bacterial microbiota within the soil at different time points.

METHODS: Different doses of *R. solani* sclerotia i.e., 0.50, 1.00, 1.50, 2.00, or 2.50 g were amended in rice-rapeseed rotation field soil separately and the soil without sclerotia served as the non-amended control. All the non-amended and amended samples were incubated at 28 ± 2°C with 12 h/12 h day/night photoperiod in a growth chamber for three months. The sequence data was analyzed.

RESULTS: At the phyla level, Proteobacteria, Acidobacteria, Bacteroidetes, Actinobacteria, Chloroflexi and Firmicutes showed varied abundance in the amended soil samples compared to those in the control. An increased abundance of ammonia-oxidizing bacterium (AOB) *Nitrosospira* and Nitrite oxidizing bacteria (NOB) i.e., *Nitrosospira* was observed, where the latter is reportedly involved in the nitrifier denitrification. Moreover, *Thiobacillus*, *Gemmatimonas*, *Anaeromyxobacter* and *Geobacter*, the vital players in denitrification, N₂O reduction and reductive nitrogen transformation respectively, depicted enhanced abundance in *R. solani* sclerotia-amended samples. As per our knowledge, this study is of its kind where pathogenic fungal sclerotia activated microbes with a potential role in N transformation.

CONCLUSION: This study provided clues about the ecological functions of *R. solani* sclerotia on the stimulation of bacterial genera involved in different processes of N-cycle within the soil in the absence of host plants.

Keywords: Rice sheath blight; *Rhizoctonia solani*; Sclerotia; Reductive nitrogen transformation; Nitrogen fixation; Soil microbiome

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Isolation and characterization of *Bacillus thuringiensis* from cotton field soils

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ABSTRACT

BACKGROUND: Cotton is widely used as a raw material for textiles and is primarily produced because of its fiber. *Bacillus thuringiensis* (Bt) is a bacterium found in different habitats but mostly in soil. Transgenic cotton containing Bt is famous in

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the world due to its ability to minimize the losses caused by lepidopteran insects. Bt produces a wide range of insecticidal chemicals, including crystal (Cry) proteins (delta-endotoxins). The current study was carried out with the hypothesis that the cotton field soil is a rich source of Bt.

METHODS: We collected different soil samples from Multan (Gup wala, Mosey Wala, Taloki Wala, Hafiz Wala, Choudary Wala, Basti Mangla Mari, Sharkha Wala, Lawain Wala, Ghulamo Wala) and Bahawalpur district (Basti Deewan Wali, Check No 8, Basti Tariqabad, Basti Khaji Wala, Basti Khandin, Basti Rammo Wali, Sultanpur, Khurampur, Jahanpur) and these samples were subjected to isolation using nutrient agar (NA) media. Toxicity test was performed against cotton leaf worms to check the toxicity of *Bacillus thuringiensis*. On the basis of morphology different biochemical tests were performed for the identification of Bt and PCR were performed for characterization of *B. thuringiensis*.

RESULTS: We obtained 178 colonies of different bacteria on NA- plates from eighteen soil samples. Morphological screening yielded 18 colonies of Bt. Subsequently, we performed an endotoxin production experiment and obtained parasporal crystals that confirmed the *B. thuringiensis* colonies. Colony forming units of these samples were found statistically significant in Multan and Bahawalpur districts. Moreover, a toxicity test for resistance to cotton leafworm second instar larvae was also carried out that depicted two strains (Bts 02, Bts 07) of *B. thuringiensis* were toxic and resulted in 39.25% Mortality against cotton leafworm. On the basis of molecular characterization, we found eight colonies of Bt that showed positive results.

CONCLUSION: This study will help the scientists to utilize the local Bt isolates that can be used in the future biotechnology programs to produce transgenic cotton resistant against indigenous insect pests.

Keywords: *Bacillus thuringiensis*, crystal proteins, endotoxin, cotton leaf worm, transgenic cotton

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Morphological and Pathogenic Variability among *Macrophomina phaseolina* Isolates Associated with Mungbean (*Vigna radiata* L.) Wilczek from Pakistan

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Abstract

BACKGROUND: *Macrophomina phaseolina* is a serious pathogen of many crops and incurs huge yield losses.

METHODS: In the present studies, 65 isolates of *Macrophomina phaseolina*, a serious pathogen of many crops, belonging to different agro-ecological regions of Punjab and Khyber Pakhtunkhwa provinces of Pakistan were analyzed for morphological and pathogenic variability.

RESULTS: Significant differences were detected among 65 isolates in their radial growth, sclerotial size and weight as well as in pathogenicity regardless of their geographic origins. Sixteen isolates were rated as fast growing, 11 as slow growing and the rest of the isolates as medium growing. Nine isolates were classified as large sized, 26 as small sized and the remaining 30 isolates as medium sized. Thirty five isolates were ranked heavyweight, 12 as low weight and the rest of isolates were grouped as medium weight. Ten fungal isolates appeared to be least virulent, whereas eight isolates of diverse origin proved to be highly virulent against mung bean cultivars. The remaining isolates were regarded as moderately virulent. No relationship was found among the morphological characters and pathogenicity of the isolates.

CONCLUSION: These morphological and pathogenic variations in various isolates of *M. phaseolina* may be considered important in disease management systems and will be useful in breeding programmes of mungbean cultivars resistant to charcoal rot.

Keywords: *Macrophomina phaseolina*, Mungbean, Morphological characters, Pathogenic Variability

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Effect of seasonal variations on epidemiologic cycle of gall mite attacking *Alstonia scholaris* R. Br.

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Abstract:

BACKGROUND: Foliar galls of *Alstonia scholaris* L. Br. are caused by an eriophyid mite *Pauropsylla tuberculata* that feeds on leaf by sucking the cell sap. To maintain the epidemiologic cycle mites during feeding secretes fluids which act as chemical stimuli for the induction of gall singly or agglomerated on the abaxial surface of leaf which also retain their eggs. This situation is termed as hypertrophy which upon increase in infection turned into hyperplasia. *Alstonia scholaris* L. Br. is an evergreen shade tree commonly grown along the roadside as the part of green belt to mitigate air pollution due to vehicle emission in Pakistan. Gall infestation thus decreases the air pollution tolerance potential of the plant by inducing impairments into the internal structure of the leaf.

METHODS: Present study is planned to investigate the effect of seasonal variation on the growth rate and development of gall mite. Leaf area (cm²), no. of single galls per leaf, no of agglomerated galls per leaf, total area of gall (cm²) and no. of mites per galls were calculated which lead towards the inference total mites per leaf and percentage damage to leaf. Study carried out from January 2020 to September 2021 and data was collected on a monthly basis.

RESULTS: Phenological characterization of leaf galls revealed that temperature and humidity had a positive correlation with population density of mites and growth rate of galls. Maximum growth and mite density observed in mild temperature and humidity conditions.

CONCLUSION: The current finding is useful in selecting the defoliation or pruning time in order to reduce the mite infection in future.

Keywords: *Alstonia scholaris*, *Pauropsylla tuberculata*, Eriophyid mite, Epidemiologic cycle, Leaf gall phenology

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Impact of Abiotic Factors on *in vitro* development of *Aspergillus flavus* Isolated from Sesame Seeds collected from Punjab, Pakistan

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ABSTRACT

BACKGROUND: Sesame (*Sesamum indicum* L.) is a good source of protein and oil. Pakistan ranks fourteen in the world for its production. Sesame seeds are traditionally consumed in the form of oil, roasted seeds and as animal feeds. Various fungal diseases, the majority of which originate from seed, have a negative effect on the quality of this crop, which not only reduces its production but also affects export to various countries. The current study focuses on determination of the abiotic factors that affect the growth of *Aspergillus flavus*. Sesame seeds are commonly contaminated with a fungus, some of which are mycotoxigenic and cause economic and health issues including *A. flavus*. The purpose of this study was to investigate the impact of different abiotic conditions (temperature, light, carbon sources, nitrogen sources and pH levels) on the growth of *A. flavus in vitro* circumstances.

METHODS: For this, the experiment on the growth of *A. flavus* observations were collected at 3, 7 and 10 days after incubation. The most important physical environmental component for regulating growth of *A. flavus* was temperature.

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RESULTS: The fungus grew and sporulated best at 25°C, with colony diameters of 1 cm, 2.5 cm, and 3.5 cm on PDA medium 3 days, 7 days, and 10 days after incubation. The optimal pH for *A. flavus* growth was in the range of 5.0 to 8.0 pH. The fungus grew best at sucrose and sodium nitrate medium.

CONCLUSION: In the light of the findings of this study, farmers may be advised to avoid certain environmental circumstances that promote the growth of fungus in field and in store houses to avoid fungal contamination.

Key words: *Aspergillus flavus*, Sesame, Punjab, Abiotic Factors

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Coat protein Cistron Based Molecular Characterization of ZYMV and CMV Infecting Cucurbits in Pothwar Region of Pakistan

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ABSTRACT

BACKGROUND: *Cucurbitaceae* also known as the gourd family consist of approximately 1000 species in 15 tribes and ~95 genera that are mainly distributed in the tropics and subtropics. Cucurbits are known to be tainted by more than thirty-nine different viruses and various are considered important factors for financial losses for cucurbit crops in terms of quality and quantity. Out of these thirty-nine viruses *Cucumber mosaic virus* (CMV) and *Zucchini yellow mosaic virus* (ZYMV) have more catastrophic effect on cucurbits crops in Pothwar region of Pakistan.

METHODS: Surveys were carried out in Pothwar region of Pakistan included (Rawalpindi, Jhelum, Attock, chakwal and a capital territory Islamabad) in cucurbits field. The sample from infected plants of cucurbits showing different symptoms like mosaic, necrosis, interveinal chlorosis, yellowing, Blisters, Distortion, fan-leaf appearance, shoe string, lethal wilting of foliage, stunting, and curling were collected randomly.

RESULTS: Among five locations the highest disease incidence of ZYMV was recorded in district chakwal i.e 76% followed by 65% in Islamabad, 57% in Rawalpindi, 55% in Jhelum and 50% in Attock. The incidence of CMV was recorded as 68%, 59%, 55%, 53% and 44% in Rawalpindi, Islamabad, Jhelum, Attock and chakwal respectively. The viruses infected samples were confirmed through Enzyme-linked Immunosorbent assay (DAS-ELISA) and through RT-PCR amplification. High genetic variability was observed in the coat protein amino acid and nucleotides sequence identities of CMV and ZYMV Pakistani isolate, when compared with other reported isolates. Highest nucleotides and amino acid sequence similarity of CMV was observed as 95.5% and 97.5% respectively with Netherlands isolates. In case of ZYMV highest nucleotides and amino acid sequence similarity was observed as 91.4% and 84.3% respectively with isolates from china.

CONCLUSION: The outcome of this research raised the notion that these notorious viruses are a major threat to vegetable production. More study should be carried out to manage these devastating viruses.

Keywords: CMV, ZYMV, Incidence, Pakistan. Nucleotides, Amino acid

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Estimating inhibitory effects of Plant extracts to contain *Pectobacterium atrosepticum* growth causing black leg disease in potato

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ABSTRACT

BACKGROUND: Potato (*Solanum tuberosum* L.) is a tuberous plant crop eaten by billions of people across the globe. It is important both as a food and a cash crop so any yield losses in it causes some massive hungers and huge economic losses. *Pectobacterium atrosepticum* causing black leg disease is a devastating pathogen of this crop with severe infestation resulting in to massive economic losses.

METHODS: For our study, potato plants showing typical blackleg symptoms were collected from district Chiniot, Okara and Faisalabad. Isolation and followed by confirmation of pathogen was carried out through, pathogenicity, Bio-chemical and tuber assay. Followed by pathogen confirmation experiment was conducted to estimate the anti-microbial efficacy of plant extracts on *Pectobacterium atrosepticum*. The experiment was performed to evaluate alternatives to the traditional copper base pesticides possessing certain toxins that are a threat to human health. For the experimentation trial six plant extracts were evaluated at 3 different concentrations of 300ppm, 500ppm and 700ppm, data was collected on 12 hour regular interval for 36 hours.

RESULTS: The data analysis exhibited that *Azadirachta indica* (Neem), *Mentha spicata* (Mint), and *Zingiber officinale* (Ginger) are most effective in inhibiting bacterial growth.

CONCLUSION: This depicts that plant extracts can be used as alternative for managing the black leg disease and are further better option than copper pesticide as they have least toxic effects and residual effects.

Keywords: *Pectobacterium atrosepticum*, Blackleg, Plant extract, Tuber assay

SPP-PP-253

Priming of Okra seeds with BCAs isolates suppressed the *Fusarium oxysporum* f.sp. *vasinfectum*

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ABSTRACT

BACKGROUND: During its growth Okra (*Abelmoschus eschulentus*) plant is attacked by many fungi, bacteria, nematodes, and viruses. Various diseases of Okra including Fusarium wilt (*Fusarium oxysporum* f.sp. *vasinfectum*) cause huge losses annually. It has been determined that seed priming with biological control agents is an effective method against plant diseases. Primed seed performs well as compared to the untreated seed by enhancing germination in different crops. The present research work was conducted to evaluate the effect of different biological control agents on the productivity and rhizosphere of okra.

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METHODS: Laboratory trials for suppression of Fusarium wilt of Okra were conducted in the Plant Pathology Lab of UAF Sub Campus Burewala. Two sets of experiments were conducted; the first *invitro* trials were carried out to screen out the biological control agents. thereafter, the second round of trials was conducted in pots using the candidates to show antifungal activity against the pathogens.

RESULTS AND CONCLUSION: The present study shows that the disease incidence in the case of BCA-6 remained, 41.29% as compared to BCA-L, BCA-S, and the Control that were recorded, 83.31%, 91.65, and 99% respectively.

Keywords: Okra, Biological control agent, Fusarium wilt

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Physico-Chemical Management Of Green Mold In Oyster Mushroom Under Control Conditions

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ABSTRACT

BACKGROUND: Mushroom farming is an excellent enterprise providing employment to men and women. Mushrooms were good source of nutrition specially protein leading to reduced diseases. There may be edible, poisonous or medicinal mushrooms. Oyster mushroom was lignicolous edible mushroom. Different diseases, flies and mosquitoes lessen the yield and quality of oyster mushrooms.

METHODS: This research aims to study the biotic factors mainly green mold in oyster mushroom and its management using different physical and chemical methods. Green mold, caused by *Trichoderma pleurotum* and *T. pleuroticola*, was the major problem in oyster mushroom cultivation reducing the yield up to 30-50%. Green mold was managed physically and chemically to favour maximum growth of mushroom and get high yield. Green mold and other biotic factors was studied in controlled conditions. Compost was prepared from wheat straw and filled in polypropylene bags. Bags were provided with steam sterilization at 75°C for 2 hours. After a short cooling period, spawning was done in aseptic conditions. Identification and management of green mold in oyster mushrooms resulted in high yield generating maximum revenue. In this study two different kind of fungicides were applied to control the effect of green mold. Result of the studied showed that yield was increased upto 42% after the application of the fungicide as compared to the control bags. As well as the number of large premordia were increased by up to 50% after the application of fungicides to as compared to they control. Results of the research also indicated that the days to mycelium initiation were also increased in the control but they were reduced in the bags where fungicides were applied.

RESULTS: Results also indicated that the application of the fungicide reduced the disease index up to 50% as compared to the disease index of the bags which were left untreated or control.

CONCLUSION: Overall, it was observed in this research that application of fungicides boosted the mushroom growth and limits the disease index of the oyster mushroom by managing the growth of green mold.

Keywords: Mushroom, Fungicides, green mold

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Characterization of Novel Wheat germplasm for Karnal Bunt Resistance using Phenological or Molecular Diagnostics

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ABSTRACT

BACKGROUND: Karnal bunt (KB), also known as partial bunt, caused by *Tilletia indica* is a devastating globally recognized quarantine disease of wheat. The bunted seeds severely deteriorate the quality of seeds making them undesirable for consumption. The identification of karnal bunt resistance sources is very important to breed KB resistant varieties. Durum and synthetic hexaploids wheat are excellent sources for resistance against KB disease. The study was conducted to identify and genetically characterize the KB resistant wheat germplasm.

METHODS: The culture of *Tilletia indica* isolates were maintained and 52 synthetic hexaploids were screened under field conditions. The genotypes were inoculated at booting stage and upon harvest, seeds were rated from 0-4. The resistant genotypes were genetically characterized using PCR based analysis employing 20 and 10 RAPDs and SSRs markers respectively. The bands were scored in binary numbers and subjected to phylogenetic analysis in Popgene software package. The Xgwm538 was used to identify the KB resistant gene in the resistant germplasm.

RESULTS:

The results showed 20 synthetic hexaploids and 08 Durum wheat lines were found immune to Karnal bunt. All the 28 genotypes were morphological characterized and subjected to genetic analysis which showed substantial diversity generating 132 and 37 monomorphic and polymorphic bands respectively by RAPDs whereas 10 SSR markers generated 21 and 56 polymorphic and monomorphic bands respectively. The phylogenetic analysis revealed synthetic hexaploid wheat (D67.2/P66.270//AE.SQUARROSA), to be the most diverse genotype which could be incorporated into breeding programs. The Xgwm538 SSR marker identified KB1 resistant gene in 26 genotypes and proved to be effective for marker-assisted breeding.

CONCLUSION: The synthetic hexaploids and Durum wheat have enormous potential against wheat diseases and should be exploited to extensively to increase resistance genetic base for breeding programs.

Keywords: *Tilletia indica*; Karnal bunt; Durum wheat; synthetic hexaploids

SPP-PP-256

Phytoextracts Mediated Control of Citrus Canker Disease

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ABSTRACT

BACKGROUND: Citrus is important fruit crop and has significance economic importance in Pakistan. In Pakistan 2.17 million tonnes citrus was produced on area of 1.94 million acre. Citrus is mostly cultivated in Punjab and affected by different types of plant pathogens. Citrus canker is the most harmful disease among the major diseases of citrus which is

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caused by *Xanthomonas axonopodis* pv. *citri*. The copper based fungicides are mostly employed to manage the citrus canker in the field but excessive use of chemicals have negatively impacted the environment and warrant the need to find out organic solutions therefore the current study was aimed at identifying suitable plants extracts for the control of citrus canker bacterium.

METHODS: Isolation of the bacterium *X. axonopodis* was done through streaking on agar plate technique. Morphological and bio-chemical tests such as gram staining, KoH test, catalase test and starch hydrolysis test were performed to examine the bacteria *X. axonopodis* pv. *citri*. Plant extracts were evaluated, *in vitro*, against the *X. axonopodis* pv. *citri* through paper disc method which showed the inhibition zone against the disease. The 100 percent extract of garlic, ginger, aloe vera, moringa were used along with the streptomycin as a positive control. The efficacy of garlic and moringa extracts were also checked against the *X. axonopodis* pv. *citri* under controlled conditions. The inoculum was sprayed on Kinnow plants, with three replicates, for each extract and data were recorded 15, 20, 25, 30 and 35 days post inoculation (dpi).

RESULTS: The recorded citrus canker disease incidence in Multan region was 30.76 percent. Out of four plant extract, two proved effective under lab conditions and inhibition zone was 11.67mm and 10.83mm was obtained due to Garlic and Moringa extracts respectively while it was 16.67mm in case of positive control. The Garlic and Moringa extracts applied on one year Kinnow plants and recorded disease severity percentage, after 35dpi, on garlic and moringa treated plants were 9.67% and 14.27% respectively while the 27% disease severity was recorded on control (plants sprayed with autoclaved distilled water). The garlic extract proved to be most effective followed by moringa extract which could be used as a potential organic solution to control citrus canker.

CONCLUSION: The use of plants extracts to control citrus canker has a promising future because of pesticide-driven environmental pollution.

Keywords: *Xanthomonas axonopodis* pv. *citri*; citrus canker; plant extracts

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Characterization of New Betasatellite Species infecting Cotton

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ABSTRACT

BACKGROUND: In Pakistan, Cotton is a valuable cash crop which contributes about 0.6 percent to GDP in agriculture but it is subjected to various forms of biotic and abiotic stresses. Among all stresses, Cotton Leaf Curl Disease (CLCuD) belongs to genus *Begomovirus*, family *Geminiviridae*, is a lethal threat to Cotton which caused the loss of more than 5 billion US dollars to the country from 1989-1998. DNA betasatellites (DNA β), are associated with CLCuD and are main symptom determinant in CLCuD. This study was conducted to identify betasatellite molecules infecting Cotton in different areas and establish phylogenetic association of identified betasatellites with already reported from across the world.

METHODS: A survey was undertaken in the cotton growing areas of the Southern Punjab to assess the CLCuD severity aided by betasatellite molecules. Sampling was done based on particular symptoms, such as leaf enation induced by betasatellites infection. The collected samples were subjected to PCR analysis for detection and whole genome amplification of betasatellite molecules followed by cloning and sequencing. The obtained sequences were analyzed by BLAST, Sequence Demarcation Tool and MEGA-X software packages.

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RESULTS: The survey showed that Betasatellite induced characteristic symptom of Enation was observed on nine cotton cultivars in all districts of Southern Punjab. The genetic analysis yielded a new betasatellite species infecting cotton in Vehari district showing <91% homology with existing betasatellite molecules and tentatively named as “Cotton Leaf Curl Vehari Betasatellite”. The genomic organization of newly characterized species is of typical betasatellite molecules with a single gene β C1 on sense orientation along with A-rich and satellite conserved region (SCR). The other characterized betasatellite molecules from different districts proved to be isolates of *Cotton Leaf Curl Multan Betasatellite*.

CONCLUSION: The present research revealed substantial genetic diversity of betasatellite molecules infecting cotton in the field and there is dire need to breed new cotton varieties against emerging CLCuD components to avoid any new epidemic in future.

Keywords: *Begomoviruses*; Cotton Leaf Curl Disease; Betasatellites

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Molecular Epidemiology of Begomoviruses Infecting Ornamental Plants in Multan Region

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ABSTRACT

BACKGROUND: Ornamental plants are grown all over the world due to their high esthetic values. In all provinces of Pakistan, different types of ornamental plants are grown for the purpose of beautification. Different ornamental plants remain in the landscapes throughout the year. However, these ornamental plants may act as host of viral pathogens providing them safe haven for recombination and play a significant role in virus spread. *Begomovirus* is the biggest and important genus in virus taxonomy. It has 445 widespread species causing diseases in different plants of various families. Besides cash crops, begomoviruses also infect ornamental plants which lead to lower market value resulting in significant economic losses. The accurate and precise identification of the plant viruses is mandatory for the management of plant viruses. The research was designed to overcome the challenges faced by ornamental plants in Multan region by identification and characterization of begomoviruses infecting ornamental plants and their phylogenetic relationship with already reported begomoviruses.

METHODS: The samples of ornamental plants showing characteristic symptoms of begomovirus infection like leaf curling, enation, vein thickening, stunting and mosaic pattern were collected from Multan region, which include district Multan, Lodhran, Khanewal and Vehri. Total genomic DNA from ornamental plants were extracted with CTAB method and subjected to PCR for the amplification of partial coat proteins gene using universal primers. Full genome amplification of *Hibiscus rosa-sinensis* infecting begomovirus was done through rolling circle amplification method followed by cloning and sequencing of full amplified viral genome. The sequence was assembled and analyzed through Geneious R7, sequence demarcation tool and MEGA-X software platforms.

RESULTS: Total incidence data of begomoviruses infecting ornamental plants in Multan region was calculated as 54% while district wise disease incidence percentage was recorded as 58.06% in district Multan, 55.88% in Vehari, 55.26% in Lodhran and 50% in Khanewal. High disease incidence was recorded in *Euphorbia tithymalioides* as 77.7%, followed by *Hibiscus rosa-sinensis* 71.4%, *Euphorbia milli* 70.5%, *Tabernaemontana divaricate* 66.6%, *Tecoma stans* 54.5%, *Jasminum sambac* 37.5% and *Radermachera sinica* 20% while, *Quisqualis indica*, *Irresine herbstii*, *Cordia dichotoma*, *Ficus benjamina*, *Bougainvillea* and *Hamelia patens* were found uninfected. The BLAST analysis and pairwise sequence comparison proved sequenced clone to be an isolate of *Tomato leaf curl New Delhi Virus*. The study is very useful in

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understanding the begomovirus population and their genetic diversity in ornamental plants and the role of ornamental plants in dissemination of begomoviruses to other crops.

CONCLUSION: The ornamental plants should be comprehensively investigated for the presence of begomoviruses and their removal could prove to be an effective tool for the management of begomoviruses infecting crops.

Keywords: Begomoviruses; ornamental plants; *Tomato Leaf Curl New Dehli Virus*

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Genetic variability and CP based In silico RFLP simulation of Zucchini yellow mosaic virus infecting cucurbits in Pothwar, Pakistan

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ABSTRACT

BACKGROUND: Zucchini yellow mosaic virus (ZYMV) is a serious threat to cucurbit crops worldwide including Pakistan.

METHODS: This study aimed to assess the status, distribution and molecular variation of ZYMV isolates infecting cucurbits in Pothwar region of Pakistan.

RESULTS: Serological detection of the tested potyviruses in collected cucurbit samples revealed that ZYMV was the most prevalent virus with disease incidence (D.I) at 35.2%, followed by PRSV with an incidence at 2.2% and WMV having an incidence as little as 0.5% in 2016. While in year 2017, a relatively higher 39.7%, 2.4% and 0.3% disease incidence of ZYMV, WMV and PRSV respectively, was recorded. Among all the samples detected positive for potyviruses, five representative samples were tested by molecular techniques and subjected to sequence analysis corresponding to the partial nuclear inclusion b protein (Nlb), complete coat protein cistron gene (CP) and 3' UTR of varying length of ZYMV. Newly detected Pakistani ZYMV isolates shared 95.8-97.0% nucleotides identities among themselves and 94.6-97.9% with isolates retrieved from GenBank, NCBI. Phylogenetic relationship obtained after In silico restriction analysis revealed that four Pakistani isolates clustered with other ZYMV isolate in group A with Chinese, Italian and Polish isolates while another Pakistani isolate clustered with Egyptian isolates in group B. Recombination detection analysis showed that newly detected ZYMV isolate (MK848239) is likely to be a recombinant of Pakistani (MK848237) and Italian (MK956829) isolates having the recombinant breakpoint between nucleotide position number 266 and 814.

CONCLUSION: Comparison and recombination detection of the local isolates might help in devising a breeding program to identify resistant sources against recombinant isolate.

Keywords: RNA; ZYMV; Coat protein; In silico restriction; Subgroup A & B; Cucurbits

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Detection of *Candidatus liberibacter asiaticus* from Pakistan by Different Molecular Methods

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ABSTRACT

BACKGROUND: *Candidatus Liberibacter asiaticus* (CLAs) is a devastating pathogen of citrus causing Huanglongbing (HLB), previously known as citrus greening disease. This disease is important in Asia and has destroyed 100 million citrus trees worldwide during the last century.

METHODS: In recent years, the presence of HLB was suspected in different citrus-growing regions of Pakistan. In surveys conducted in citrus groves of Punjab, Pakistan, citrus samples exhibiting symptoms of HLB were collected. This study aimed to investigate the presence and the genetic diversity of CLAs in Pakistan.

RESULTS: A PCR method using specific primers allowed the detection of CLAs in citrus leaves by amplification of an 1160-bp fragment from the 16S rDNA. These samples were also tested by qPCR. Both assays showed similar results, and the amplicons sequence confirmed that these samples were related to other sequences from the rest of the world with varying degrees of similarity.

CONCLUSION: This work reports the characterization of HLB from the South Punjab region of Pakistan using different molecular methods.

Keywords: HLB, citrus, disease, survey, Punjab, CLAs, characterization

SPP-PP-261

Efficacy of AgNPs and Phytoextracts Against Brown Spot of Citrus

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ABSTRACT

BACKGROUND: Citrus Brown spot disease caused by *Alternaria citri* is one of the most ravaging diseases of citrus crop. Several strategies are used for management of this disease to enhance productivity and quality of citrus fruit.

METHODS: Phytoextracts and AgNPs have been evaluated under vitro conditions to contest the pathogen. Three different phytoextracts such as neem, mint and garlic extracts were used at concentration of 15%, 30% and 45%. The effect of these plant extracts on mycelial growth was examined with reference to control petri plate.

RESULTS: It was detected that almost all concentrations of Phyto-extracts significantly reduced mycelia growth as compared to control. In all treatments of phytoextracts, it was studied that 45% concentration of neem extracts is effective with mycelia growth of 3.95 cm over control petri plate which is 7.75cm, garlic extract@ 45% gave least fungal mycelia growth 5.4 cm followed by mint leaves @45% gave 3.15 cm growth as compared to control. NPs were used to control this pathogenic fungus under vitro conditions. Five different concentrations of AgNPs were used as 15, 30, 45, 60, 75ppm. The result of this investigation revealed that by enhancing the concentration of NPs inhibit mycelial growth of

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pathogen more significantly and 75 ppm concentration of AgNPs reduce fungal mycelia growth upto 2.55cm as compared to control petri plate fungal growth 7.15cm.

CONCLUSION: AgNPs have the potential to manage different plant diseases particularly brown spot of citrus

Keywords: *Alternaria citri*, AgNPs, Phytoextracts, Pathogenic fungus

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Effect of Selected Plant Extracts and Fungicides on the Control of Early Blight of Tomato Caused by *Alternaria solani*

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ABSTRACT

BACKGROUND: Tomato (*Solanum lycopersicum* Mill.) is the second most important vegetable crop world widely and serves as an important source of various important nutrients. *Alternaria solani* is the causal agent of Early Blight of tomato which reduces tomato crop yield up to 79 % if left uncontrolled.

METHODS: The current study was conducted to estimate the antifungal potential of some selected fungicides and plant extracts against *Alternaria solani* in *in vitro* and pot experiments.

RESULTS: Two isolates of pathogenic fungi were identified as *A. solani* based on morphological characterization. The results of the pathogenicity assay revealed a high virulence response of *A. solani* strain AS-1. The results of the *in vitro* assay demonstrated that ginger at a 25 % concentration level significantly inhibited the mycelial growth of *A. solani*. The results of pot experiments showed that ginger extract and Miravis duo at all the concentration levels significantly suppressed early blight disease incidence and improved plant growth parameters. Correspondingly, the results of secondary metabolites indicated the presence of tannins, terpenoids, flavonoids, alkaloids, reducing sugars, anthraquinones in plant extracts. In the case of ginger extract, DDPH scavenging assay was observed 64.9 ± 1.85 . The results of GC-MS analysis of ginger and black seed indicated the presence of 13 and 16 bioactive compounds respectively which include Ethanol, Acetone, 2-Butanone, Trichloromethane, Propane, 2,2-dimethoxy-2, 2-Dimethoxybutane, hexanal, 2-Pentanone, 4-hydroxy-4-methyl-, 2-Butanone, 4-(4-hydroxy-3-methoxyphenyl)-, Gingerol, 1, 2-Benzenedicarboxylic acid, diisocotyl ester, Hexadecanoic acid, methyl ester, n-Hexadecanoic acid, Methyl 9-cis,11-trans-octadeca dienoate, 9-octadecadienoic acid(Z)-methyl ester, 9,12-octadecadienoic acid (Z,Z)-Cis-Vaccenic acid, 9,12-octadecadienoic acid (z,z)-, 1-Monolinoleoylglycerol trimethylsilyl ether, and 9,12,15-Octadecatrienoic acid. Similarly, FTIR analysis of ginger and black seeds demonstrated 12 and 13 peak values indicating the presence of important functional groups. NMR analysis showed 4 and 7 peak values of ginger and chicory extracts indicating the structures of functional groups.

CONCLUSION: The present study highlighted the presence of various important compounds in ginger extract with antifungal potential thus can be used to suppress *A. solani*. There is a need to test the disease suppressive activity of ginger extracts under field conditions.

Keywords: *Solanum lycopersicum*, Early Blight of tomato, *Alternaria solani*, GC-MS, FTIR, NMR, Disease suppression, plant growth

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-263

Study of leaf spot disease in Cauliflower and management by using different approaches

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ABSTRACT

BACKGROUND: Cauliflower is very nutritious vegetable belongs to the mustard family. The nutritional value of cauliflower is very high due to presence of antioxidant substances with health promoting properties. The propagation of this crop is through seed. In Pakistan, there are a number of constrains responsible for low production of this important vegetable. Both biotic and abiotic factors equally play an important role to reduce the total produce.

METHODS: Among biotic constrains, *Alternaria* leaf spot, bacterial soft rot, blackleg, black rot, club rot, damping off and downy mildew are all prevalent in different areas of Punjab in the fields of cauliflower. The significant disease is the *Alternaria* leaf spot which has major impact on the yield. In the current study a survey was conducted in several places in the surroundings of District Faisalabad. After collection of diseases samples, 70% ethanol was used to remove surface contaminations, and later the samples were placed on PDA media provided with Kanamycin (50µg/ml). After the establishment of fungal growth around the samples the hyphal tip technique was implied for purification.

RESULTS AND CONCLUSION: In pot trials, three genotypes of cauliflower were sown for confirming pathogenicity of the newly isolated fungal pathogen. In future DNA will be extracted from the fungus and the ITS region will be amplified for sequencing and identification purpose. Various approaches will be employed to manage this important disease of cauliflower.

Keywords: *Alternaria brassicicola*, Cauliflower, Leaf spot of cauliflower

SPP-PP-264

Effect of biochemical changes on the development of powdery mildew of pea

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ABSTRACT

BACKGROUND: Powdery mildew of pea is an air-borne disease of global dispersal. *Erysiphe pisi*, which is responsible for powdery mildew of pea is the major threat for pea production in Pakistan and in the world. Although other fungal pathogens such as *Erysiphe baeumleri* and *Erysiphe trifolii* have also been reported by initiating this disease on pea and involved in 25–50% yield drop.

METHODS: In the current study 6 varieties of pea from which 3 resistant (Peas 2009, No. 267, F-16) and 3 susceptible (PF-450, Climax and Mateor) were cultivated in research area of the Department of Plant Pathology, University of Agriculture Faisalabad to analyze the biochemical deviations in pea leaves after the induction of powdery mildew disease.

RESULTS and CONCLUSION: The results indicated that among six chemical elements (P, K, Ca, Mg, Zn and Fe) potassium, calcium and zinc contents were higher (1.34 ppm, 2.14 ppm, 1.25 ppm respectively) in diseased leaves while phosphorus, iron and magnesium contents were decreased (0.72 ppm, 7.40 ppm and 0.35 ppm respectively) in diseased leaves as compared to the healthy leaves in both the reaction groups (resistant, susceptible).

Keywords: Pea, Nutrients, Susceptible and Biochemical changes



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THEME-3:
Weeds Management

THEME-3:

WEED MANAGEMENT

SPP-WM-301

Impact of Weed Competition on Proso Millet

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ABSTRACT

BACKGROUND: Proso millet (*Panicum miliaceum* L.) is short season summer cereals with low water requirements and high-water use efficiency for both grain and nutritious fodder for livestock. It is gluten free and has more minerals than wheat. Revival of old climate resilient cereal can be a viable option to mitigate increasing abiotic stresses due to climate change. In this scenario, optimizing crop production practices for proso millet is necessary. There are many factors responsible for low yield of proso millet, among those, weeds are important yield limiting factor because weeds compete with crops for nutrient, space, light, moisture and can reduce productivity of this crop by 20-40%.

METHODS: Experiment was conducted at MNS-University of Agriculture research Farm, Multan in February 2019 to study the weed-crop interference in Proso millet. Treatments were; T1 = Weed free, T2 = competition for 2 weeks after emergence (WAE), T3 = competition for 3 WAE, T4 = competition for 4 WAE, T5 = competition for 5 WAE, T6 = competition for the whole crop season. This experiment was laid out in a randomized complete block design with three replications. All means were analyzed by using standard statistical procedures.

RESULTS: The maximum number of weeds (108 plant m⁻²) were recorded when weeds were allowed to compete with proso millet for whole season and it was statistically at par where weeds competed for 2 WAE. The maximum plant height (87.6 cm), and grain yield (1880 kg ha⁻¹) were recorded when proso millet was kept weed free throughout the growing season and it was statistically at par with treatment wherein weeds were allowed to compete with proso millet for 2 WAE. Minimum plant height (45.3 cm) and grain yield (1370 kg ha⁻¹) were recorded where weeds were allowed to compete for full crop growth season, and it was statistically at par where weeds were allowed to compete with proso millet for 5 WAE. Hence, it is suggested that better proso millet grain production can be obtained if weeds are managed during the first three WAE.

CONCLUSION: It is concluded based on findings that the critical period for weed-crop competition in proso millet crops lies between the first 5 WAE.

Keywords: crop emergence, climate change, climate resilient, fodder, weed competition

SPP-WM-302

Mulching for Weed Control Improves the Health, Yield and Reduces the Termite Attack on Drip Irrigated Kinnow Plants

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ABSTRACT

BACKGROUND: Proper weed control is very important to improve the fertility, organic matter, and health of plants by minimizing soil borne pathogens. Drip irrigation has been adopted by advanced countries, but it is in its initial stage in Pakistan.

METHODS: Research was conducted on Kinnow plantation grown under drip irrigation. Different weed control methods such as mulching (wood chip and black polyethylene), mechanical (cultivator and rotavator) and chemical (glyphosate) were adopted. Mechanical weed control was considered as control treatment. Maximum increase in shoot length (23.00

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and 25.00 cm), chlorophyll contents (85.00 and 83.00 SPAD value) and yield (13.61 and 14.02 tons) were found under mulching as compared to other methods. Mulching also improved soil physical properties by reducing bulk density (1.50 and 1.49 Mg m⁻³), soil penetration resistance (757.00 and 740.18 kPa) and by enhancing soil organic matter (1.16 and 1.18%), hydraulic conductivity (34.00 and 35.00 mm hr⁻¹) and soil microbial biomass carbon (155.22 and 165.21 g Kg⁻¹) over control treatment followed by chemical control; while, lowest values of soil physical properties were recorded for mechanical weed control. Mulching also reduced termite, nematode and insect attacks by reducing the weed dry weight (38.59 and 39.00 g) and efficiently controlled weeds (94.00 and 96.00%) as compared to other weed control methods. In this case, wood chip mulch performed better in terms of all studied parameters than plastic mulch, mechanical and chemical weed control.

CONCLUSION: Mulches especially wood chip mulch should be in citrus orchards for improving soil physical properties and yield per plant.

Keywords: drip irrigation, organic matter, soil borne pathogens, soil fertility, termite

SPP-WM-303

Application of Glyphosate to Minimize the Weeds, Reduce the Uptake of NPK and Reduce the Resistance Against the Diseases in Sweet Orange cv. "Pearl"

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ABSTRACT

BACKGROUND: Macronutrients (NPK) play a very important role regarding plant growth, health, yield and quality of fruit. Soil herbicide can directly influence the emergence and physiological process of cultivated plants and weeds. However, currently the extensive use of weedicides/herbicides adversely affects the uptake of nutrients and leads to unhealthy vegetative growth, thereby reducing the productivity.

METHODS: The current study was conducted at Square No. 32, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. The experiment comprised of three different glyphosate rates such as 2 ml L⁻¹, 4 ml L⁻¹ and 6 ml L⁻¹ (designated as T₁, T₂ and T₃) respectively with control (weeds removed with spade and lawn mower). Treatments were allocated to experimental units as per Randomized Complete Block Design (RCBD) with three replications. Six sprays of glyphosate at different rates were done in a year and mineral nutrient status and fruit quality of these plants were compared with control plants.

RESULTS: It was observed that application of glyphosate under the tree canopy had a significant effect on biochemical and mineral nutrient status of "Pearl" citrus cultivar as compared to control treatment. Higher value of chlorophyll contents ((87.00 and 85.00 SPAD value) in leaves and maximum growth was recorded for control plants as compared to those where glyphosate was applied. In fruits, higher value of vitamin C (0.77 mg per 100 g), total sugars (70.32%), reducing sugar (41.29%), non-reducing sugars (29.75%), TSS/acidity ratio (7.85) and lower acidity (1.16%) was recorded in the unsprayed fruits as compared to those sprayed with glyphosate. Similarly, mineral nutrient status of leaves after application of glyphosate also showed significant differences.

CONCLUSION: Higher N (2.52%), P (0.226%) and K (2.56%) values were observed in control trees compared to the application of glyphosate spray under the tree canopy. In conclusion, application of glyphosate directly affects the plants growth, biochemical and mineral nutrient status of citrus by reducing the uptake of nutrients.

Keywords: citrus, glyphosate application, NPK, weed management

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Biological Weed Control in Aquaculture System

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ABSTRACT

BACKGROUND: There is an interaction between the weed growth, fish production and yield. More weeds in ponds means that there are greater chances of fish mortality and oxygen depletion in water. Weedicides cannot be applied in water as these will cause mortality of fish and other aquatic organisms.

METHODS: The objectives were to i) assess the limnology of the lake, especially aspects of the impact of the drains water input, sea water input and sewage input on the water quality, fish and aquatic plants, ii) assess the impact of annual herbicide spraying of water hyacinth on fish and water quality, and .iii) consider the current socio-economic value of the fishery. In some old water bodies, there is a considerable backlog of maintenance and replacement work, many of the buildings, including the pump houses, equipment such as fish screens etc.

RESULTS: The ponds 1.0–1.5 m deep each provided independent inflow and drainage sluices. A fish sump around the edge of the ponds is important. Most bunds are accessible by vehicle. The current condition of the ponds reflects both the nature of the site and pond construction as well as subsequent pond management. The eastern portion was constructed on what was apparently salt marsh and demonstrates a low level of reed growth. The western area was constructed on a reed swamp and these ponds now support massive stands of reeds.

CONCLUSION: The presence of weeds - emergent, floating and submerged - on the lake produces three important impacts: the loss of lake surface, and therefore productive capacity for fishery purposes. It makes access to such areas by the fishermen difficult or impossible, and therefore reduces the fish catch. The overgrown areas represent fish refuge, important from the conservation viewpoint.

Keywords: aquaculture and fisheries, grass carp, swamp, Weeds, weedicides

SPP-WM-305

Lessening Weeds Spectrum through Crop Intensification of Maize-Green Gram Intercropping Systems

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ABSTRACT

BACKGROUND: Food security of a rapidly increasing population requires increase in crop production, while weed management through crop intensification approaches can serve as a promising strategy to achieve this goal on a sustainable basis.

METHODS: A field trial was executed that encompassed maize-green gram intercropping in row proportions of 6:12, 3:3, 1:3 and 3:1 along with sole crops of maize and green gram maintained as control for comparison purpose. The experimental design was RCBD with three replications. Weeds density and biomass were taken as response variables.

RESULTS: The results revealed that maize-green gram row intercropping in 6:12 row proportion recorded the least weeds density (<16 plants m⁻²) along with minimum fresh and dry weights (21.0 and 5.5 g m⁻²) of weeds. This intercropping system was followed by 3:3 row proportions, while both sole crops recorded the maximum weed density and their biomass.

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CONCLUSION: It may be inferred that maize-green gram intercropping in 6:12 row proportions might serve as a promising strategy to lessen weed density in an eco-friendly manner.

Keywords: crop protection, food security, row intercropping, row configuration, weeds density

SPP-WM-306

Using *Calotropis* Leaf Extract (Akk) and Chemical Preservatives for Enhancing Vase Life of Gladiolus Cut Stems through Improving Pigments, Gaseous Exchange and Limiting Bacterial Growth

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ABSTRACT

BACKGROUND: Preservatives are highly important to increase the relatively short vase life of commercial cut flowers. Hence, seeking natural, inexpensive and effective strategies to extend longevity is essential. Application of *Calotropis* leaf extract (CLE) as a preservative is still elusive.

METHODS: Here we reported the impact of CLE, sodium nitroprusside and silver nitrate on vase life, physiological processes and antioxidant activity of cut gladiolus spikes. The experiment was conducted under completely randomized design (CRD) under seven treatments. Data of different vase life, physiological and biochemical attributes was recorded.

RESULTS: All levels of chemical preservatives and CLE extract showed encouraging results. Among all the treatments, CLE showed most prominent results and increased the florets life along with number of opened florets, relative fresh weight, net photosynthetic rate, sub stomatal conductance, transpiration rate, stomatal conductance, water use efficiency. Application of CLE decreased the bacterial proliferation and ethylene production. In case of photosynthetic pigments, CLE considerably attained the photosynthetic pigments and antioxidant activities while reduced the production of malondialdehyde and hydrogen peroxide.

CONCLUSION: The CPE extended maximum vase life of cut gladiolus through maintaining water relations, controlling bacterial growth and increasing enzyme activity therefore proved a novel preservative for cut flower induction.

Keywords: *Calotropis* leaf extract, CLE, weed management

SPP-WM-307

On-Farm Composting of Agricultural and Animal Waste Materials: A Path to a Sustainable Agriculture

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ABSTRACT

BACKGROUND: Pakistan's economy is based on agriculture. The majority of the country's population (67 percent) resides in rural areas and is mostly dependent on agriculture. The decomposition of the organic materials into a nutrient-rich soil supplement is known as composting. Farm compost is a humus-rich, earthy mixture that improves plant growth by retaining nutrients and moisture in the soil. Since compost contains numerous nutrients, it can be used as a fertilizer. It

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can help plants use some of the nitrogen, phosphorus, sulfur, and micronutrients they need.

METHODS: The current study was aimed to highlight the most important aspects of the farm composting process as it progresses through its stages, develop a variety of wastes, and assist farmers, researchers, and scientists in choosing an appropriate treatment plan for transforming organic waste into a value-added product.

RESULTS: Temperature and pH levels were measured throughout the composting process in a specific range of 42-45 °C and 6.1-8.3, respectively, in the current study. In farm compost, total nitrogen content ranged from 81.5 to 2175 ppm. In agricultural compost, total phosphorus concentrations range from 1.33 to 13.98 ppm, while potassium concentrations range from 91.53 ppm to 640 ppm. In this composting study, pile P3 proved to be the most successful composting method. At the end of a week, the overall nitrogen content increased progressively between each pile. The different concentrations demonstrated that microbial activity caused by the addition of various types of agricultural waste resulted in a change in the quantity of NPK. Given that the nutrient performance, or NPK, of the compost utilized in this study continues to improve week after week, it's possible that it could be used for agricultural purposes. Vermicides, fungicides, anti-nematodes, and antibacterials derived from plant or organic sources may be used to improve compost consistency. Extending the composting period would also be useful.

Keywords: farm composting, organic matter, sustainable agriculture

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Comparison of Different Herbicides for Weed Control in Maize

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ABSTRACT

BACKGROUND: Weed infestation severely reduces the production of maize. An experiment was conducted to evaluate the efficacy of different herbicides for weed control in maize crop.

METHODS: There were 10 treatments viz; T₁ = Weedy check, T₂ = Weed-free till harvest, T₃ = Weed-free till 6 weeks, T₄ = Pendimethalin 825 g a.i. ha⁻¹, T₅ = S-Metolachlor 1920 g a.i. ha⁻¹, T₆ = Mesotrione 10 g a.i. ha⁻¹ + Acetochlor 85 g a.i. ha⁻¹ + Atrazine 50 g a.i. ha⁻¹, T₇ = Mesotrione 75 g a.i. ha⁻¹ + Atrazine 750 g a.i. ha⁻¹, T₈ = Thiencarbazone-methyl 30 g a.i. ha⁻¹ + Isoxaflutole 74 g a.i. ha⁻¹ + Cyprosulfamide 50 g a.i. ha⁻¹ (Safener), T₉ = Paraquat Dichloride 500 g a.i. ha⁻¹, T₁₀ = N-phosphonomethyl glycine 1200 g a.i. ha⁻¹. The experiment was conducted in Randomized Complete Block Design with three replications at the farm area of MNS-University of Agriculture, Multan in August 2021.

RESULTS: Data on weeds (dry matter and density) and crop (chlorophyll contents, crop growth rate, and grain yield etc.) were observed and analyzed. The results showed that a minimum weed dry matter and maximum grain yield were obtained in T₂. Moreover, a significant improvement in chlorophyll content, crop growth rate and grain yield was recorded in T₈ and T₆ compared to all other treatments. Weed-free treatment recorded maximum productivity. Among the herbicides, Mesotrione 10 g a.i. ha⁻¹ + Acetochlor 85 g a.i. ha⁻¹ + Atrazine 50 g a.i. ha⁻¹ (T₆) and Thiencarbazone-methyl 30 g a.i. ha⁻¹ + Isoxaflutole 74 g a.i. ha⁻¹ + Cyprosulfamide 50 g a.i. ha⁻¹ (Safener), (T₈) performed better in controlling the maize weeds.

CONCLUSION: Timely application of herbicides can be effective in managing weeds in maize.

Keywords: herbicides, maize productivity, weed control

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Weed management in *Oryza sativa* using Different Strategies-A review

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ABSTRACT

BACKGROUND: Rice is the staple food for humans in many countries. The increasing population demands higher productivity of rice. There is a load of biotic stresses that adversely affects the crop yield. Weeds in direct-seeded rice cause serious yield losses. Weeds induced losses are 50 to 60% in puddled transplanted rice and while these losses are up to 70 to 80% in direct seeded rice.

METHODS: Use of weedicides is the most common method to control weeds. However, the application of weedicides poses the risk of environmental pollution. There is need of introducing competitive varieties of crops at different seed rates including different planting pattern to reduce the risk of weeds. This can result in crop having higher productivity with less weed infestation.

RESULTS: Although, these practices can not manage weeds completely but are useful in reducing the dose of weedicide up to 50%.

CONCLUSION: This review explains the main aspects for the selection of proper cultivar of rice, seedling vigour, proper planting pattern and allelopathy.

Keywords: cultivar, planting pattern, seedling vigour, weeds and weedicides

SPP-WM-310

Achene Yield and Oil Quality of Diverse Sunflower is Affected by Different Irrigation Sources

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ABSTRACT

BACKGROUND: Sunflower (*Helianthus annuus* L.) is a major oilseed crop grown for its edible oil across the globe including Pakistan. In Pakistan, the production of edible oil is less than the requirements. The scarcity of water resources is one of the major challenges all over the world. The water availability in arid and semi-arid is becoming a limiting factor to meet the food demands of increasing population.

METHODS: A field experiment was conducted to evaluate the impact of different irrigation sources on achene yield, oil contents and fatty acid composition of diverse sunflower hybrids. The experiment consisted of seven sunflower hybrids, viz., E.S.F.H 3391, E.S.I.H 35, S.H.F 80, A.Q.S.H.F 3, FMC1, PARSON and SINJI, which were irrigated with three different irrigation sources viz., tube well water, canal water and sewage sludge water. The result showed that the hybrid 'Parson' produced the highest plant height, stem diameter, head diameter, 1000 seed weight and achene yield in comparison with other hybrids with canal irrigation water.

CONCLUSION: Among the irrigation sources, canal irrigation was superior to other water sources to improve the yield traits, oil contents and oleic acid. In conclusion, hybrid 'Parson' should be grown with canal irrigation water under arid climate of Punjab, Pakistan to harvest better achene yield and good quality oil.

Keywords: Achene yield, Fatty acids, Oil contents, Sunflower hybrids, Irrigation sources

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SPP-WM-311

An Insight of Quinclorac Resistance Mechanism in Early Watergrass (*Echinochloa oryzoides*)

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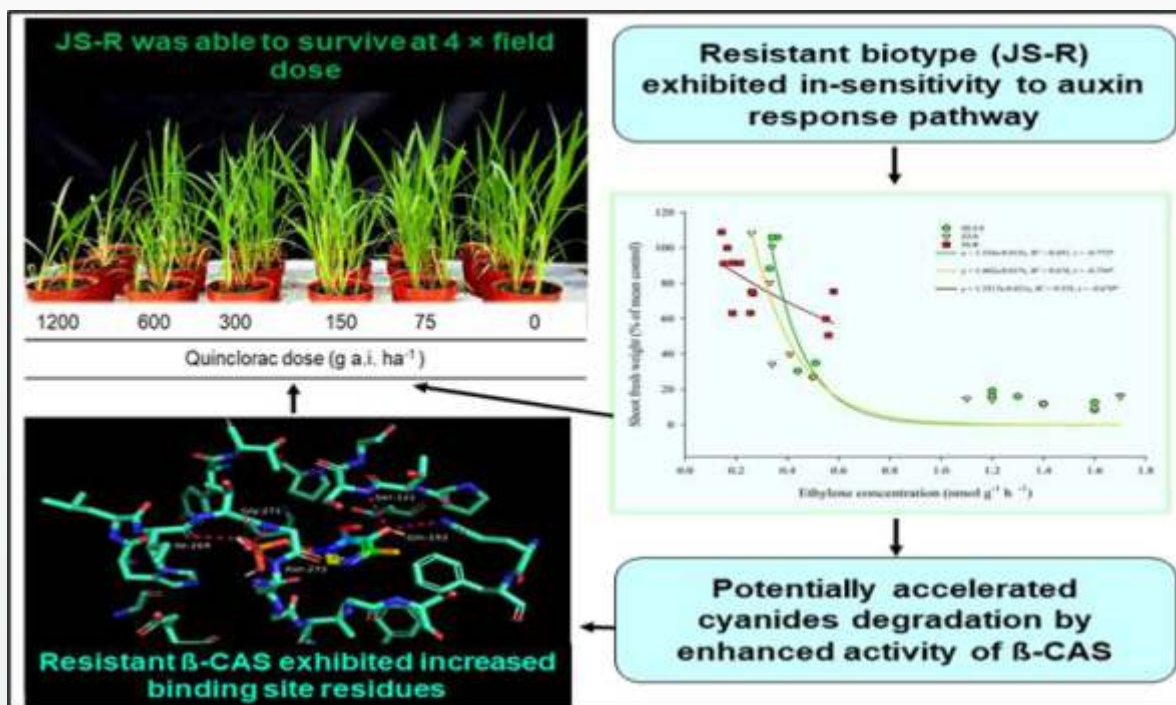
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ABSTRACT

BACKGROUND: Quinclorac- main herbicides targeting barnyard grass have been used for decades in rice fields. *Echinochloa* species have been reported evolving into quinclorac resistance. Quinclorac resistance and its mechanism remain elusive in *Echinochloa oryzoides* (Ard.) Fritsch that needs to be uncovered.

METHODS: Dose-response assays were performed followed by ethylene synthesis and related enzyme activities along with gene transcription were studied. β-CAS activity and its molecular docking were investigated.

RESULTS: *E. oryzoides* evolved into 21 times resistance to quinclorac from Jiangsu province of China. The increment in ethylene levels in this biotype was correlated negatively with the level of resistance and positively with quinclorac induced growth inhibition. Ethylene response pathway determination showed that resistant biotype decreased 1-aminocyclopropane-1-carboxylic acid (ACC) contents, related enzyme activities and transcription of *ACS* and *ACO* genes. These results indicated that ethylene biosynthesis inhibition and quinclorac resistance possessed a positive correlation. Resistant biotype exhibited ~ 2-fold more β-CAS activity than susceptible ones. Resistant *EcCAS* gene

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depicted nucleotide changes as compared to susceptible ones, which resulted in two amino acid substitutions (Met-287-Lys and Thr-352-Ala). Consequently, resistant β -CAS enzymes exhibited binding residue increment in active site (simulation modeling); that can be the probable reason for higher enzyme activity in the resistant biotype.

CONCLUSION: The study concludes that variation in response pathway of auxin or alteration in related enzyme activities due to a decreased transcription of *ACS* and *ACO* genes, improved activity of β -CAS, and amplified transcription of *EcCAS* gene were plausible mechanisms endowing quinclorac resistance in *E. oryzoides*.

Keywords: auxin response pathway, *ACS* and *ACO* genes, β -cyanoalanine synthase, ethylene biosynthesis

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An Insight of Quinclorac Resistance Mechanism in Early Watergrass (*Echinochloa oryzoides*)

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ABSTRACT

BACKGROUND: Quinclorac- main herbicides targeting barnyard grass have been used for decades in rice fields. *Echinochloa* species have been reported evolving into quinclorac resistance. Quinclorac resistance and its mechanism remain undisclosed in *Echinochloa oryzoides* (Ard.) Fritsch that needs to be uncovered.

METHODS: Dose-response assays were performed followed by ethylene synthesis and related enzyme activities along with gene transcription were studied. β -CAS activity and its molecular docking were investigated.

RESULTS: *E. oryzoides* evolved into 21 times resistance to quinclorac from Jiangsu province of China. The increment in ethylene levels in this biotype was correlated negatively with the level of resistance and positively with quinclorac induced growth inhibition. Ethylene response pathway determination showed that resistant biotype decreased 1-aminocyclopropane-1-carboxylic acid (ACC) contents, related enzyme activities and transcription of *ACS* and *ACO* genes. These results indicated that ethylene biosynthesis inhibition and quinclorac resistance possessed a positive correlation. Resistant biotype exhibited ~ 2-fold more β -CAS activity than susceptible ones. Resistant *EcCAS* gene depicted nucleotide changes as compared to susceptible ones, which resulted in two amino acid substitutions (Met-287-Lys and Thr-352-Ala). Consequently, resistant β -CAS enzymes exhibited binding residue increment in active site (simulation modeling); that can be the probable reason for higher enzyme activity in the resistant biotype.

CONCLUSION: The study concludes that variation in response pathway of auxin or alteration in related enzyme activities due to a decreased transcription of *ACS* and *ACO* genes, improved activity of β -CAS, and amplified transcription of *EcCAS* gene were plausible mechanisms endowing quinclorac resistance in *E. oryzoides*.

Keywords: auxin response pathway; *ACS* and *ACO* genes; β -cyanoalanine synthase, Ethylene biosynthesis

SPP-WM-313

Assessing impact of axial (Pinoxaden) herbicide on growth of canary grass

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ABSTRACT

BACKGROUND: Canary grass (*Phalaris canariensis*) is a high resistant winter weed, and it is continuously developing resistance against herbicides. The canary grass is a serious threat especially in wheat fields of Punjab, Pakistan. Owing to its rapid resistant development, the present herbicides are going to fail for controlling the canary grass.

THEME-3:

WEED MANAGEMENT

METHODS: Pinoxaden (Axial) is a newly introduced insecticide in Pakistan, and it is effective against the canary grass. The Lab experiment was conducted to study the resistance of canary grass against axial. The four rates (i = 2.5 ppm, ii = 5 ppm, iii = 7.5 ppm, and iv = 10 ppm) of axial herbicide were used with a control treatment. The results revealed the maximum fresh and dry weights (0.303 and 0.0128 mg plant⁻¹, respectively) of canary grass were observed in control treatment.

RESULTS: The lowest fresh and dry weight (0.123 and 0.0117 mg plant⁻¹, respectively) was observed by application of 10 ppm axial. The fresh and dry root weight was higher (0.168 and 0.0087 mg plant⁻¹, respectively) when controlled the lowest root weight (0.055 mg plant⁻¹) was observed by application of 10 ppm axial. The plant height was higher (6.86 cm) in control and the lowest plant height (5.21 cm) was observed by application of 10 ppm axial. Root length was higher (7.49 cm) in control and the lowest root length (1.35 cm) was observed by application of 10 ppm.

CONCLUSION: Therefore, application of 10 ppm axial may be considered a good agricultural practice for the control of canary grass in wheat fields of Punjab Pakistan.

Keywords: Canary grass, Pinoxaden,

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Suppressive Effects of Increasing Mungbean Density on Growth and Reproduction of Junglerice and Feather Fingergrass

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ABSTRACT

BACKGROUND: Weeds are troublesome, aggressive and competitive botanical pests of the croplands that pose multidimensional problems in every cropping system, most significant of which is reduction in crop yields due to weed interference. Cultural practices like increased planting density can impart crop a competitive advantage over weeds.

METHODS: Target neighbourhood study was conducted using a completely randomized design with five replications, and there were two experimental runs in 2016-2017. This study appraised growth and seed production of two noxious grassy weeds, i.e. feather fingergrass (*Chloris virgata* SW.) and jungle rice [*Echinochloa colona* (L.) Link] in response to different mungbean densities (0, 82, 164, 242 and 328 plants m⁻²).

RESULTS: Leaf, stem, and total aboveground biomass of *C. virgata* was 86, 59, and 76% greater than *E. colona*. For seed production, *E. colona* outnumbered *C. virgata* by producing 74% more seeds. Mungbean density-mediated suppression of height was more pronounced for *E. colona* compared with *C. virgata* during the first 42 d. The presence of 164 to 328 mungbean plants m⁻² reduced the number of leaves of *E. colona* and *C. virgata* by 53-72% and 52-57%, respectively. The reduction in the inflorescence number caused by the highest mungbean density was higher for *C. virgata* than *E. colona*. *C. virgata* and *E. colona* growing with mungbean produced 81 and 79% fewer seeds per plant. An increase in mungbean density from 82 to 328 plants m⁻² reduced the total aboveground biomass of *C. virgata* and *E. colona* by 45-63% and 44-67%, respectively.

THEME-3:

WEED MANAGEMENT

CONCLUSIONS: Increased mungbean plant density can suppress weed growth and seed production. Although increased crop density contributes to better weed management, supplemental weed control will be needed.

Keywords: crop interference; density-mediated reduction; grassy weeds; seed production; weed biomass

SPP-WM-315

Appraising Chemical Weed Control in Lentil

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ABSTRACT

BACKGROUND: Weeds cause 40-80% reduction in seed yield in lentil. Chemical weed control can be effective in lentil but herbicide options need to be optimized. Moreover, a single herbicide application may not furnish satisfactory weed control. The purpose of this study was to ascertain the effect of weeds on the growth and seed yield of lentil and effectiveness of single and sequential herbicide application for their chemical control.

METHODS: The experiment was performed in randomized complete block design (RCBD) with three replications. Pre-emergence herbicides viz. pendimethalin, S-metolachlor, pendimethalin + metolachlor, and aclonifen at 1137.5, 2400, 2400 and 750 g a.i. ha⁻¹, respectively were tested for their efficacy in lentil (cv. NIAB-2009). Each of these herbicides were followed by sequential application of haloxyfop as post-emergence (94 g a.i. ha⁻¹ at 40 DAS). Weed free and weedy check plots were maintained for comparison purpose.

RESULTS: The results showed that at all the days of observation, Sequential application of (Aclonifen at 2400 g ha⁻¹) as pre-emergence and (Haloxyfop at 94 g ha⁻¹) as post-emergence recorded significantly lower (64.22 plants m⁻²) total weed density as compared to weedy check. Weed control efficiency was maximum i.e. 86 and 64% at 40 and 60 DAS under pre-emergence application of pendimethaline at 1137.5 g ha⁻¹. At harvesting stage, pendimethaline at 1137.5 g ha⁻¹ as pre-emergence followed by haloxyfop at 94 g ha⁻¹ as post-emergence recorded weed control efficiency of 62%. The seed yield of lentil was increased from 31-67% under pre-emergence treatments compared to control. However, the seed yield of lentil was increased by 17-48% when pre-emergence herbicides were followed by haloxyfop as post emergence. Seed yield of lentil was 0.80 t ha⁻¹ under pre-emergence application of pendimethaline. While the seed yield of lentil was 0.64 t ha⁻¹ under pendimethaline followed by haloxyfop. The economic analysis suggested that the highest net returns were associated with weed free plot (Rs. 84682/- ha⁻¹). After the weed free plots, highest net returns were associated with pre-emergence application of pendimethaline (Rs.69022/- ha⁻¹) and the benefit cost ratio was also high (1.89) in same treatment after weed free treatment. While the lowest net returns were obtained from control plots (Rs.13627/- ha⁻¹) and benefit cost ratio was also lowest (0.17).

CONCLUSION: Weeds averted lentil growth and productivity and herbicidal treatments were effective in improving growth, yield and profitability of lentil. Sequential herbicide application recorded better weed control efficiency and reduced weed biomass to a greater extent than sole application of either pre- or post-emergence herbicides.

Keywords: aclonifen, lentil, pendimethalin, s-metolachlor, weed control efficiency.



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Endophytic genus consortium enhances plant growth and induces resistance in basal stem rot (BSR) diseased oil palm seedlings

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ABSTRACT

BACKGROUND: Excessive application of synthetic chemicals to control basal stem rot (BSR) disease caused by *Ganoderma* spp. may render negative impacts on the biodiversity and subsequently to the human population. Therefore, biological control would be an ideal alternative as a preventive or curative method of BSR. Thus, an insight of biological control effects via in vivo study would be crucial in selecting potential biological control agents (BCAs) to counter BSR disease in a sustainable manner.

METHODS: An array of treatments was designed to evaluate the potential of endophytic biological control agents (BCA) namely *Trichoderma asperellum* and *Bacillus cereus* as single and mixture application in an *in vivo* greenhouse trial for six months. The effects of the designed treatments on oil palm vegetative growth parameters and basal stem rot disease reduction were evaluated. In addition, induction of plant defense biochemical compounds was assessed via peroxidase assay, lignin assay and total phenolic content in BSR diseased seedlings in response to the designed treatments were also determined.

RESULTS: In the greenhouse trial, *T. asperellum* contributed significantly on the growth of aerial parts while *B. cereus* on the growth of oil palms roots. Nonetheless, the seedlings treated with *T. asperellum* demonstrated the highest disease reduction (DR) (57.2%). However, one similarity could be observed in peroxidase assay, lignin assay and phenolic content where *Ganoderma*-infected seedlings treated with *B. cereus* (treatment BG) recorded the highest values in all assays conducted.

CONCLUSION: As a conclusion, both endophytic microbes from different genus demonstrated huge potential as BCAs in oil palm BSR disease reduction.

Keywords: oil palm, basal stem rot disease, *Trichoderma asperellum*, *Bacillus cereus*

SPP-Biotech-402

Synergistic Ameliorative Effect of Zinc Oxide Nanoparticles with *Moringa oleifera* leaf extract against Cd Toxicity in LinSeed: Antioxidants and Physicochemical Studies

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ABSTRACT

BACKGROUND: The present study was conducted to evaluate the effect of cadmium (Cd) toxicity and mitigating role of green NPs on Linseed. Cd interacts with various plant mechanisms at the physiological and antioxidant levels, resulting in decreased plant output. The main purpose of this study was to look at impacts of MZnO-NPs on Cd exposed Linseed plants.

METHODS: Several plant development components and enzymes were investigated at different Cd and MZnO-NPs levels. Cadmium concentrations in root and shoot of Linseed plants decreased after administration of MZnO-NPs,

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according to our findings. Growth parameters of plants, antioxidant system, and physicochemical parameters all decreased as the external Cd level increased.

RESULTS: The administration of MZnO–NPs to the Cd-stressed Linseed plant, on the other hand, caused a significant increase in these factors. Furthermore, the antioxidative enzymes SOD, POD, CAT, APX exhibited a considerable increase in activity when MZnO–NPs were applied to Cd-stressed seedlings. The introduction of MZnO-NPs raised the levels of MDA and H₂O₂ in the Linseed plant.

CONCLUSION: The NPs decreased electrolyte leakage in Cd-stressed Linseed leaves and roots. As a result, our findings support the importance of MZnO–NPs in reducing Cd toxic effects in Linseed plants.

Keywords: ZnO-NPs, Cadmium, LinSeed, Antioxidant

SPP-Biotech-403

Potential Use of Endophytes to Overcome Food Safety

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ABSTRACT

BACKGROUND: Endophytes are a kind of microorganisms living inside the plants without having a negative impact on their habitat. Endophytes have a unique relationship with its host plant, and it protects the plant by directly inhibiting the phytopathogens or indirectly increasing the plant immunity against these pests. They are also potentially known for their role as biofertilizers to improve the plant nutritional health. The response of those endophytes towards a plant, insects and pests is an important aspect to be known for the better efficacy of such bio fertilizers. Food safety is one of the major issues to be focused in Pakistan. Some fungal pathogens produce mycotoxins which can be detrimental to humans as well as animals. Endophytes can be used to ensure the food safety as they do not cause any toxicity as compared to other traditional synthetic pesticides which might have a residual effect on the harvest. Among the endophytes from fungal and bacterial source, fungal endophytes are more powerful and effective against pests. Several compounds of anti-pathogenic nature were isolated and identified through gas chromatography and they have shown a great resistance against fungal pathogens, bacterial pathogens, nematodes and mites. Some strains were also found to be effective against plant viruses but more evidence of their effectiveness are observed against human viral diseases.

CONCLUSION: Biocontrol endophytes, such as *Ampelomyces*, are very efficient against pathogens and are also environment friendly as they do not produce harmful compounds. Endophytic properties can be transferred from parental plants to off-springs through seeds or spores present in the environment. Several environmental factors like solar radiation, moisture, wind and precipitation are important for the better performance of endophytes.

Keywords: Endophytes, Food Safety, Pathogens, Mycotoxins.

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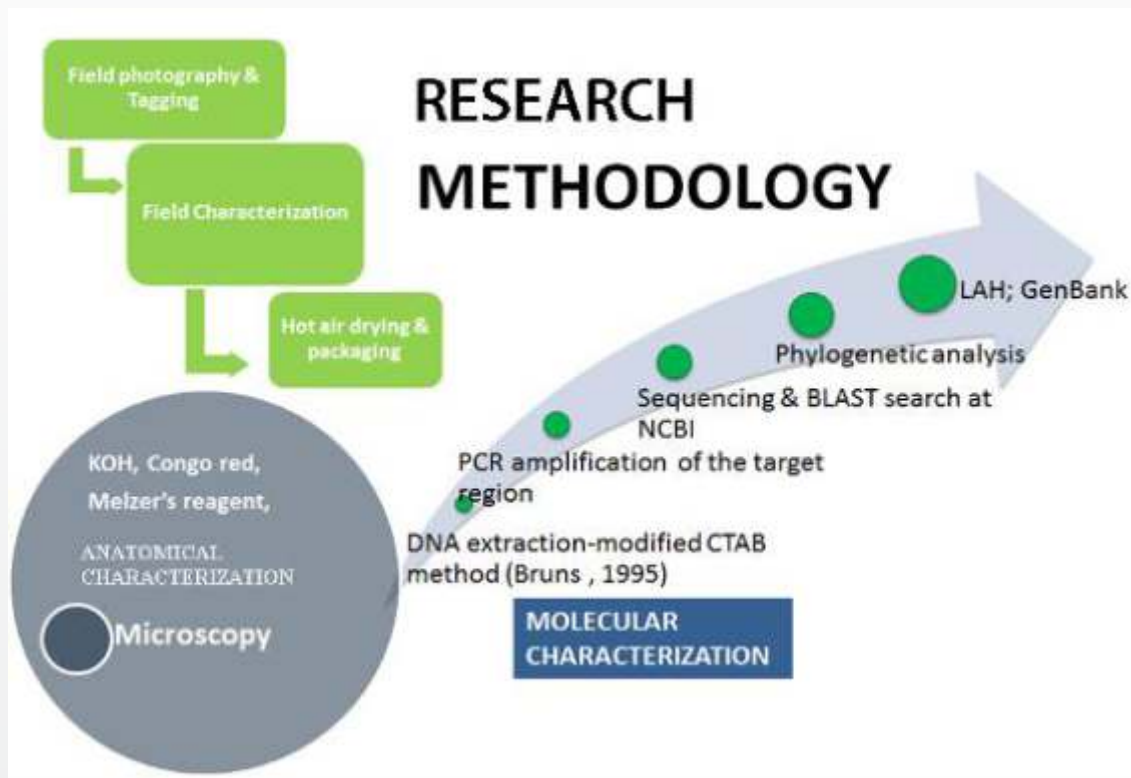
Ectomycorrhizal fungi: a potential biotechnological tool for plant protection

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ABSTRACT

BACKGROUND: Fungi inhabit a wide range of habitats where they survive in a complex environment by competing against a wide array of organisms. Therefore, fungi have unique attributes that render them with various survival mechanisms. Among these, ectomycorrhizal association describes a functional structure that results from a mutualistic symbiosis between the roots of higher plants and root-inhabiting fungi. Within this symbiotic relationship, the role of the fungi is to help the host plants take up water and nutrients, receiving plant-derived carbohydrates from photosynthesis in return. Ectomycorrhizal fungi are known to impart tolerance in host plants against biotic and abiotic stresses. They play a key role as a biotechnological tool in forest nursery production besides providing several other benefits. Forests in Pakistan harbor rich diversity of these fungi and represent a sustainable example of ECM associations that have the potential to be exploited as a biotechnological tool for plant protection.

METHODS: Primary step is the taxonomic and molecular characterization of mycorrhizal symbionts. During mycological expeditions, *Suillus sibiricus* was collected and characterized on morpho-anatomical and molecular basis (ITS region)

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from Kumrat valley, Upper Dir, Pakistan. The target internal transcribed spacer (ITS)-rDNA of species was amplified using polymerase chain reaction (PCR) with universal fungal primers (ITS1F and ITS4).

RESULTS: *Suillus sibiricus* is an integral element of our natural forest ecosystem and can be considered as a promising candidate for plant protection.

CONCLUSION: However, research is still underway to better understand the functional and molecular mechanisms involved in fungus-plant and fungus-soil interactions.

Keywords: *Suillus*, forestry, internal transcribed spacer region, fungus plant interaction, Kumrat valley

SPP-Biotech-405

Exploring the Role of Silicon on growth, boll retention and lint yield of Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

BACKGROUND: Cotton is commonly known as white gold and fiber king in the world. The shedding of bolls and flowers of various cotton cultivars is a serious threat to cotton growing farmers. An experiment was conducted to evaluate the impact of different doses of silicon foliar application on cotton crops growth promoter check, S1 (50mg/L), S2 (100 mg/L), S3 (150 mg/L) S4 (200 mg/L) on growth and yield of cotton.

METHODS: The experiment was carried out to reveal the study of Exploring the Role of Silicon on growth, boll retention and lint yield of Cotton (*Gossypium hirsutum* L.)” at Bahauddin Zakariya University, sub campus Layyah, Punjab, Pakistan between 2018 to 2019 in (RCBD) Randomized complete block design with factorial arrangement. Foliar application of silicon and two cultivars was taken under factors under examined with 3 replication and net plot size row to row distance was maintained (75 cm) and plot to plot distance (150 cm). cotton growth and yield traits Height of plant (cm) Indirectly fruiting branches (monopodia), directly fruiting branches (Symposia), Number of bolls plant⁻¹.

RESULTS: Boll's weight (g), Seed cotton yield plant⁻¹ (g), Ginning out turn (GOT) (%), Fiber Fineness (micronaire), Length of fibers staple (mm), Unif index, Fibre strength (g/tex). The highest cotton lint was recorded in the variety 'NIAB-1048'. Among the silicon levels, the highest cotton lint was recorded when silicon was applied at 200 ppm. The interaction showed that the highest cotton lint was recorded when the silicon was applied at a rate of 200 ppm in NIAB-1048. The highest fiber strength of cotton was recorded in the variety 'NIAB-1048'. Among

CONCLUSION: the silicon levels, the highest fiber strength of Cotton was recorded when silicon was applied at 200 ppm. The interaction showed that the highest fiber strength of Cotton was recorded when the silicon was applied at a rate of 200 ppm in NIAB-1048.

Keywords: Cotton growth + Silicon role + Lint Yield.

SPP-Biotech-406

Physiological survival strategies in maize (*Zea mays*) under drought stress

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ABSTRACT

BACKGROUND: The research was conducted to check the photosynthetic activity of two maize (*Zea mays* L.) cultivars under drought/water stressed conditions. Drought is defined as any lack of water that prevents crops to reach their yield potential or that affects quality of harvested products. Drought affected 10 districts of Sindh badly, mostly Karachi and

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Hyderabad (Adnan, Ullah and Gao). The main regions affected by drought in interior Punjab are Bahawalpur, Faisalabad, Mianwali, Multan, Sargodha, and Rahim Yar Khan.

METHODS: Two maize cultivars D-6619, D-3366 were used in the study. Maize plants were grown in Wirenet House of Bahauddin Zakariya University, Multan. Drought treatment was initiated when plants were two weeks old. Drought treatment was imposed by withholding water from the plants for a period of one week Control plants were watered three times a week. Chlorophyll fluorescence measurements were taken with a MultispeQ. The 2nd and 3rd fully open trifoliate leaves were selected for measurements and were taken at the same time each day.

RESULTS: The MultispeQ is a sensitive tool for measurement of photosynthetic parameters of maize. Maize varieties differed in their responses to photosynthesis under drought conditions. Phi2, PhiNPQ and PhiNO were both affected by stress, with drought stress exhibiting increased PhiNPQ. The low Phi2 for drought stressed plants was mostly caused by photosystem II photoinhibition. In contrast, in drought-stressed plants both dissipation as heat through the qE response and photoinhibition contributed to this decreased Phi2. The PhiNO signal corresponded well with observed drought as well as yield. Apparently, drought susceptible cultivar exhibited the greatest decline in PhiNO

Keywords: Maize, Drought, Photosynthesis, chlorophyll fluorescence

SPP-Biotech-407

Transcriptomics of *Ceratocystis manginecans*; cause of Shisham Quick Decline (SQD) in Punjab

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ABSTRACT

BACKGROUND: Shisham (*Dalbergia sissoo*) is a deciduous, economically important tree of Asian subcontinent. Unfortunately, shisham plantations are starting to become endangered due to a serious threatful quick decline disease caused by a soil borne fungus, *Ceratocystis manginecans*. Over the last two decades Quick Decline has ravaged 70-80% shisham plantations in Pakistan. Therefore, a proper management strategy is direly needed to save shisham trees in Pakistan. A management strategy can be more effective if its host and pathogen interaction are well elucidated.

METHODS: Therefore, this study is designed to study the whole transcriptome of the disease-causing fungi *C. manginecans*. The isolates of the *C. manginecans* (CSR-10) were collected from the Tree Pathology Laboratory of CAS-AFS, University of Agriculture Faisalabad. Fungal isolate was subjected to RNA isolation. cDNA synthesis of isolated RNA of isolate (CSR-10) was performed. Whole transcriptome was analyzed through de novo assembly.

RESULTS: The raw reads of 20 Gb were obtained, and further run in the trinity program to clean data. After this analysis 24,338,10 unigenes were identified. Among these 21,273,1 were clustered on gene ontology basis, while 50,410 were clustered on orthologous groups basis. Out of these 14,607 were mapped to 276 Kyoto encyclopedia gene and genomes (KEGG) pathways. The KEGG analysis represents that 1306 unigenes were upregulated belongs to lipid metabolism, 1651 unigenes were responsible for energy metabolism, 1879 unigenes were responsive for amino acid activity and 2694 unigenes were upregulated for carbohydrates metabolism whereas 2619 unigenes were also upregulated the genetic information transcription due to increase in secondary metabolites, signal transduction and amino acid activity. The transcriptomics analysis of *C. manginecans* revealed that the pathogen upregulates its important functional activities viz, Lipid metabolism, energy metabolism, amino acids activity, carbohydrates metabolism, secondary metabolites, signal transduction and transcription in relation to the host.

CONCLUSION: These regulations promote the aggressiveness of the pathogen on the host in a specific time and environment. In conclusion, this study leads us to understand the interaction of Plant-Pathogen more competently that

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which biological and chemical activities trigger the pathogens activity to become more aggressive toward the host and surely this will help us to formulate a better management strategy to control this disease.

Keywords: Transcriptomics, *Ceratocystis manginecans*, unigenes, shisham, deciduous, decline.

SPP-Biotech-408

Nanotechnology as an innovative technique in plant disease management

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ABSTRACT

BACKGROUND: Plants insect and pests are the most problematic factors relating to loss of yield in horticultural crops which causes the 20-40% of losses to horticultural crops yearly worldwide. Traditionally management of plant is done by the application of insecticides, pesticides and fungicides which not only cause harm to the environment but also cause harmful effect on the human health. It's the need of time to improve such traditional methods which cause unsustainability with its benefits. The use of nanotechnology in this field emerged as alternate to this traditional style of application of such insecticides, pesticides and fungicides which results in an appropriate use of these toxic chemicals and does not let them mix with soil or water which results in future toxicity.

CONCLUSION: Nanoparticles not only protects plants from such insects' pests but are also beneficial in enhancing the quality of the crops, nanoparticles protect plants directly by inducing the direct actions on plants or indirectly by activating hormones and enzymes which results in protection of plants from harm causing agents. Nano-particles benefits plants by, increasing the post-harvest life of plants, increase the absorbance of pesticides, and reduce the toxicity level. However the use of nanoparticles by farmers at commercial scale is limited.

Keywords: Fungicides, Hormones, Insecticides, Nanoparticles, Pesticides.

SPP-Biotech-409

Development and characterization of transgenic potato (*Solanum tuberosum*) for the enhancement of vitamin a contents

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ABSTRACT

BACKGROUND: Potato (*Solanum tuberosum*) is a popular vegetable with a high nutritional profile for billions of people around the world. Vitamin A deficiency is a major dietary problem that causes different diseases like xerophthalmia, weak immune system, night blindness and high infant mortality rate. Mammals get dietary Vitamin A from plants because they cannot synthesize beta carotene and other provitamins themselves. Due to low levels of vitamin A in potatoes, there is a need to enhance its concentration in potato to overcome this problem as potato is an edible crop around the globe. Beta carotene is a precursor of vitamin A. Different approaches have been used to increase the beta carotene level successfully in important cash and food crops like rice, cassava, maize and canola. In this study, to explore the possibility of regulating beta carotene synthesis in potatoes, *the IBO* gene was

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transformed through the *Agrobacterium* mediated transformation method which is the most reliable and efficient way to transform different crops. We achieved high efficiency with maximum level of beta carotene upto 14 folds and total carotenoids upto 2.5 folds. The transformants with higher levels of vitamin A pave the new way to transform economically important crops for this gene.

Keywords: Potato, *Agrobacterium*, Carotenoids.

SPP-Biotech-410

***In vitro* Production of Double Haploid in Maize (*Zea mays* L.) Through Pollen Culture**

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ABSTRACT

BACKGROUND: Maize (*Zea mays* L.) has a unique genetic system to generate routinely and randomly a huge number of haploid plants from pollen grains in aseptic anther culture or isolated pollen grains. Double haploid production technique contains immense potential for pure lines production to improve the crops proactivity and introducing the desired variability through modification in biochemical and applied genetics.

METHODS: The experiment was conducted using different doses of 2, 4-D, IAA, BAP, Zeatin, Kinetin and NAA ranging from 0.5 mg/L to 5 mg/L for the callus induction and regeneration. Optimum callus induction was achieved at 2mg/l and 3 mg/l concentrations of 2, 4-D, IAA respectively. Based on the time required for the 2, 4-D, callus formation 2mg/l exhibited (90 days) and at the same conc. IAA exhibited the minimum days of callus formation (60 days).

RESULTS: After establishment of friable and embryogenic callus, varying concentrations ranging from 100 to 500 mg/L colchicine was applied for double haploid production. Maximum regeneration was achieved at IAA and BAP with 3mg/l and 2mg/l respectively.

CONCLUSION: We report in this study an optimized protocol for double haploid production in maize, that will be helpful for the achievement of homozygosity in relatively less time and varietal improvement for desired traits in different economically important crops.

Keywords: Maize, Double Haploid, 2, 4-D, IAA, Colchicine.

SPP-Biotech-411

Micropropagation of date palm using inflorescences of explant

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ABSTRACT

BACKGROUND: The date palm (*Phoenix dactylifera* L.) is a resilient fruit tree native to the Middle East and North Africa's desert regions. The date fruit includes a variety of chemical components with significant nutritional and medical value. Traditional propagation by offshoots is inefficient to meet current demand for date palm trees. Micro-propagation, on the other hand, is a cost-effective way to propagate date palm cultivars on a wide scale. In date palm *in vitro* regeneration, both somatic embryogenesis and organogenesis have been observed, either directly or indirectly through the callus phase. Shoot-tip explants obtained from immature offshoots are routinely used to initiate culture. Adult tree immature

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inflorescences have recently been used as a nondestructive explant source. The cultivar, composition of the culture medium, and physical status all play a role in successful plant regeneration. Long in vitro cycles, latent contamination, browning, soma clonal variation, and ex vitro acclimation and transplanting are among the challenges that date palm micropropagation faces. Several commercially important cultivars have benefited from a significant amount of research into these parameters, which has resulted in better micro-propagation procedures. Several multinational commercial tissue culture laboratories have sprung up because of this. Molecular characterization ensures the genetic conformity of regenerated plantlets, which is an important aspect in commercial production.

Keywords: Micropropagation; somatic embryogenesis; soma clonal variation; organogenesis; molecular marker.

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Gene Stacking in Plants for Virus Resistance using Site Specific Recombinases

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ABSTRACT

BACKGROUND: Losses due to viral diseases are posing a serious threat to crop production. Quick breakdown of resistance to viruses like Cotton Leaf Curl Virus (CLCuV) demands application of a proficient technology to engineer durable resistance. Gene stacking has recently emerged as a potential approach for integrating multiple genes in crop plants.

METHODS: In present study, a recombinase technology was used for site specific gene stacking. A founder vector (pG-Rec) with pGreen-0029 backbone was designed to engineer a predetermined site in plant genome whereby genes can be stacked repeatedly. Using *Agrobacterium* mediated transformation, the pG-Rec was transformed into Coker-312 along with *Nicotiana tabacum* L. cv. Xanthi and *Nicotiana benthamiana*. The transgene analysis of target lines was conducted through junction PCR. The transgene positive target lines were used for further transformations to site-specifically stack two genes of interest using *Bxb1* and *PhiC31* recombinases. In the first instance, Cas9 driven by multiplex gRNAs (for Rep gene of CLCuV) was site specifically integrated in the target lines and determined by junction and real time PCR.

RESULTS: The resulting plants were subsequently used to stack the second gene of interest (AVP3 gene from *Arabidopsis* for enhancing plant growth). Addition of the genes simultaneously achieved with the removal of marker gene for recycling with the next round of gene stacking. Consequently, transgenic marker free plants were produced with two genes stacked at the specific site. These transgenic plants can be a potential germplasm to introduce resistance against various strains of cotton leaf curl virus (CLCuV) and abiotic stresses.

CONCLUSION: The results of thesis demonstrate gene stacking in crop plants, a technology which can be used to introduce multiple genes sequentially at predefined genomic sites. Current climate change scenario highlights the use of such technologies so that gigantic environmental issues can be tackled by several traits. After evaluating virus resistance in the resulting plants, the lines can be a primer to initiate stacking of further genes in Coker for other traits as well as backcrossing with elite cotton lines.

Keywords: Cotton. CRISPR/Cas9. Gene Stacking. Recombinases. Genome editing

Recommendation of the conference

- Under changing climate, artificial intelligence-based systems are necessary for identification and management of pests (insects, pathogens, weeds)
- Development of pest prediction models for real time monitoring
- Intensive need to explore pesticide resistance mechanisms
- Need for development and formulation of biopesticides
- Conduct on-site research and solutions through interactive sessions with stakeholders
- To develop transgenic-based resistance against pests
- Conservation of natural enemies and enhanced use for pollinators
- Refugia management for conservations of insect biodiversity and resistance dilution
- Production technology should be revised to synchronize with the effects of climate change
- IPP to provide platform for learning and dissemination of ideas