



International Conference on Smart Plant Protection

(online)

🕒 January 27-28, 2021



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

*International
Conference on*
**Smart Plant
Protection**
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Everyday a plant faces plenty of challenges of biotic factors including insect pests, diseases, competition of weeds and also 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 of 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 had 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 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. Populations 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

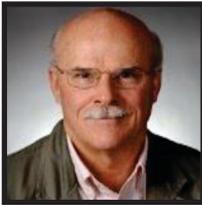
3. WEEDS MANAGEMENT

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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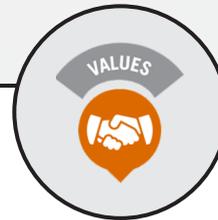
INTRODUCTION TO
Institute of
**PLANT
PROTECTION**

The foundation of teaching and research in Entomology and Plant Pathology in the 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 a large number of 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 of 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.

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



Development of human resource 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 community.
- Ensuring sustainability of natural agro-ecosystem promoting biological control of insect-pest complex and diseases.

Institute of PLANT PROTECTION



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Vice Chancellor
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THEME-1:

INSECT PEST MANAGEMENT

THEME-1:

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SPP-IPM-101

Novaluron, chitin synthesis inhibitor, damages midgut cells and interferes with behaviors of *Aedes aegypti* larvae

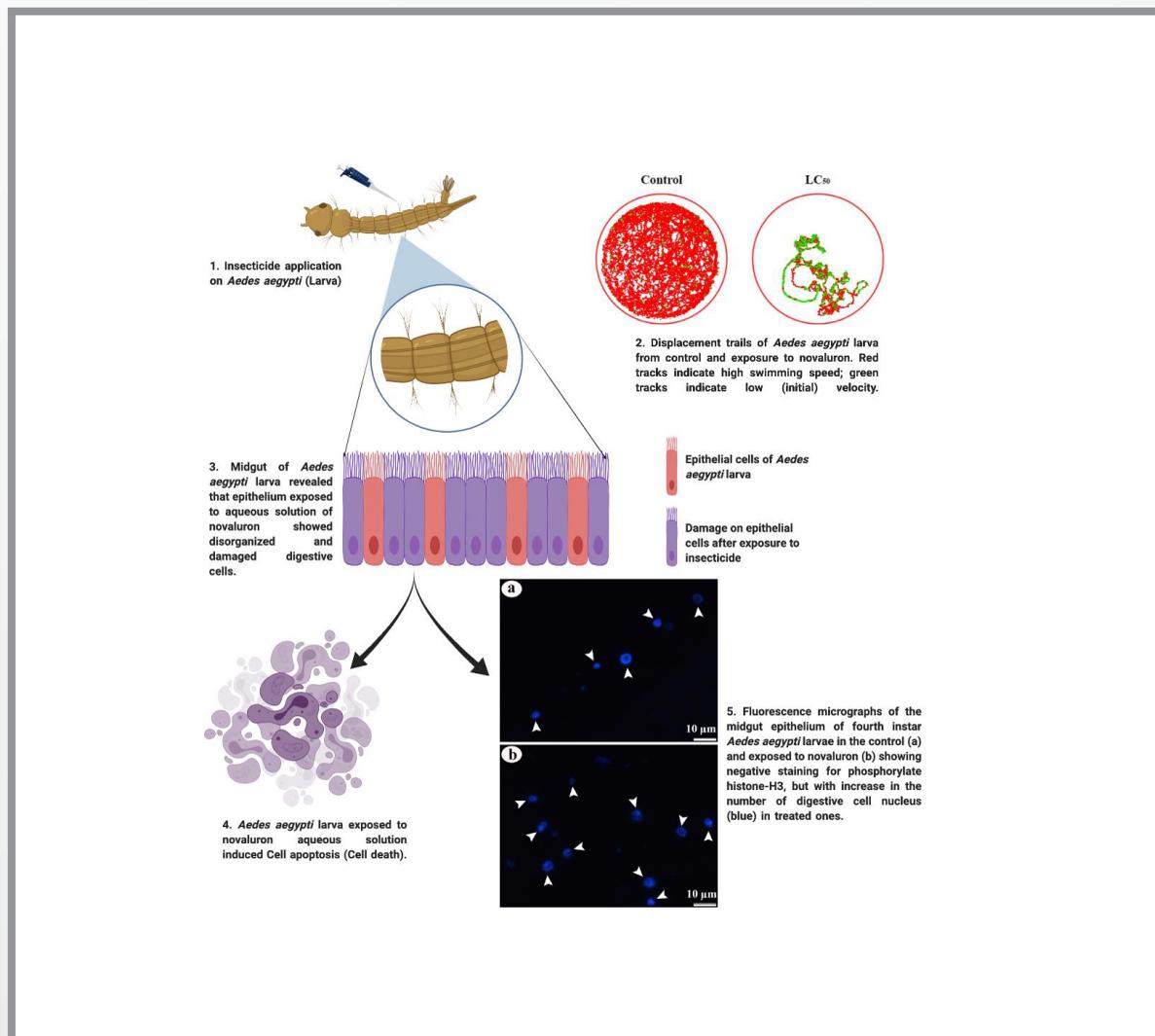
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ABSTRACT

Background: Chitin synthesis inhibitors (CSI) are supposed to inhibit formation of chitin microfibrils in newly synthesized cuticles during the molting process. Conversely, there has been comparatively little data on morphological effects of CSI on non-target insect organs.

Methods: In this work, the effects of the CSI novaluron on behavior and midgut of *A. aegypti* were evaluated.

Results: Toxicity bioassays revealed that novaluron is toxic to *A. aegypti* larva with $LC_{50} = 18.57 \text{ mg L}^{-1}$ when exposed in aqueous solution for 24 h. Novaluron treated larvae were less active and spent more time resting compared to the control group. Histopathology showed that mid guts of novaluron-treated larvae had cytoplasmic vacuolization and damaged brush borders. Cytotoxic effects in midguts of treated larvae induced necrosis, autophagy and damage to mitochondria. Despite being a chitin synthesis inhibitor, novaluron did not induce alterations in the integument of *A. aegypti* larvae. Fluorescence microscopy revealed that the number of digestive cells were higher in novaluron-treated larvae than in control, in response to digestive cell apoptosis.

Conclusion: The present study highlights the importance of novaluron against *A. aegypti* larvae by causing injuries to non-target organs, altering behaviors, inducing cell death and inhibiting cell proliferation.

Keywords: autophagy, chitin synthesis inhibitors, mid gut, ultrastructure.

SPP-IPM-102

Pathogenicity Assessment of Entomopathogenic Fungi, *Beauveria bassiana* with Integration of *Bacillus thuringiensis* Against Jassid (*Amrasca biguttula biguttula*) Population in Okra

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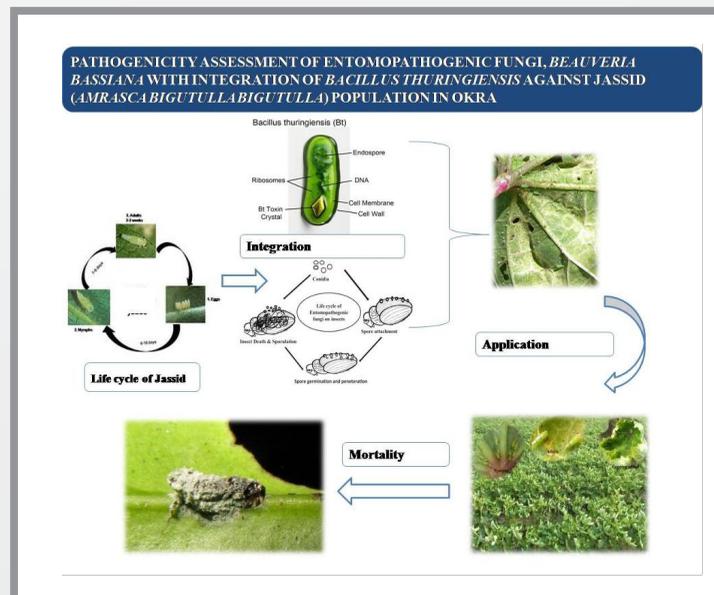
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ABSTRACT

Background: Okra is an important vegetable crop grown in Pakistan. Quality of fruit and its production was reduced by attack of several insect pests. Pesticides have been used to control these insect pests around the globe. Pesticides have resulted in adverse effects on human health as well as toxic to the environment. So, the present experiment was designed to evaluate the potential impact of *Beauveria bassiana* and *Bacillus thuringiensis* against the population of jassid in okra in field conditions.

Methods: Treatments was designed in randomized complete block design (RCBD) with three replications of each. Population reduction data was collected before and after



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application of treatments.

Results: Result showed that jassid population reduction was maximum (about 78%) in case of *B. bassiana* treated blocks while minimum population was observed in *B. thuringiensis* treated blocks. Combined application of *B. thuringiensis* and *B. bassiana* showed maximum reduction in population (about 85%) whereas minimum reduction was found in case of *B. thuringiensis* alone application.

Conclusion: It can be concluded that combined application of *B. bassiana* and *B. thuringiensis* could be an eco-friendly and effective approach to control jassid population in okra.

Keywords: entomopathogenic fungi and bacteria, population reduction, pesticide issues.

SPP-IPM-103

An Alternate Way to Control *Bactrocera dorsalis* by Ant Pheromones in Mango Orchard

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ABSTRACT

Background: The mango fruit fly *Bactrocera dorsalis* (Hendel) (Tephritidae; Diptera) is a devastating pest of mango fruit. The present study was performed to check the potential of ants as a biological control agent against *B. dorsalis*.

Methods: The two predatory ant species of *Camponotus compressus* (Fabricius) and *Messor himalayanus* (Forel) (Formicidae; Hymenoptera) were used as biological control agents in field and laboratory experiments against *B. dorsalis*. *Mangifera indica* (Linnaeus) (Anacardiaceae; Sapindales) mangoes were exposed to different numbers of ants. Females of *B. dorsalis* were monitored for the landing, oviposition, and time spent on treated and untreated mango fruits. Larvae of *B. dorsalis* were provided as prey in a Petri dish. In a Y-tube olfactometer, the behavior of *B. dorsalis* against exposed and unexposed mangoes was observed.

Results: The results showed that female adults oviposit five times more on unexposed mangoes compared to exposed mangoes. Ant pheromones affected the behavior of *B. dorsalis* and reduced the oviposition, number of landings, and time spent on the fruits. Significant predation of ant species was observed during the larval stage of *B. dorsalis*. Additionally, the results demonstrated the type II functional response against the third larval stage of *B. dorsalis*. Ant pheromones also affected the olfactory response of *B. dorsalis* at the adult stage.

Conclusion: It can be concluded that a population of *B. dorsalis* might be controlled through the predation and pheromones of ants. Moreover, in the future, ants can be used as an integrated pest management (IPM) strategy in the management of *B. dorsalis*.

Keywords: pest, oviposition, pheromones.

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SPP-IPM-104

Expression Changes of Cytochrome P450 Genes at Low Lethal and Sublethal Concentrations of Acetamiprid in Melon Aphid, *Aphis gossypii*

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ABSTRACT

Background: Cytochrome P450 monooxygenases (P450s) are the largest and major class of insect detoxification enzymes that play crucial roles in insecticide resistance development. However, little is known about the responses of P450 genes to insecticide exposure in melon aphid, *Aphis gossypii*, a major pest in Cucurbitaceae plants worldwide. In this study, the expression levels of P450 genes were investigated in two successive generations of *A. gossypii* when treated the parental aphids with low lethal (LC15) and sublethal (LC5) concentrations of acetamiprid.

Methods: Quantitative Real Time PCR (RT-qPCR) was performed to analyze the expression profiles of cytochrome P450 genes, including CYP6CY9, CYP6CZ1, CYP6CY14, CYP6DC1, CYP6DD1, and CYP6CY5 in both generations (F0 and F1) of *A. gossypii*.

Results: It was found that the expression levels of cytochrome P450 genes, supposed to be involved in acetamiprid resistance, were significantly increased in both generations (F0 and F1) of *A. gossypii*. The highest expression level was observed in CYP6CY9, followed by CYP6CY14, CYP6CZ1, CYP6DD1, CYP6DC1 and CYP6CY5 in parental aphids (F0) when exposed to both acetamiprid concentrations. In the F1 generation, a similar trend was observed, but all P450 genes' expressions were higher compared to F0 aphids.

Conclusion: Overall, this study showed that *A. gossypii* exposed to low lethal and sublethal concentrations of acetamiprid can induce the expression levels of P450 genes in both generations and that it can prime the insect pest to cope with subsequent stress.

Keywords: cytochrome P450, gene expression, resistance, sublethal effects.

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SPP-IPM-105

Silicon Influence on the Yield Attributes of Wheat (*Triticum aestivum* L.) and Biology of Aphid *Schizaphis graminum*

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ABSTRACT

Background: The *Schizaphis graminum* is considered as economically important sucking insect-pest of wheat. It causes direct losses to the leaves at vegetative stage and also indirect losses by acting as a carrier of viruses and fungus. The current experiment was designed to determine the yield attributes of wheat and the biology of wheat-aphid induced by sodium silicate as a source of silicon.

Methods: The experiments were conducted in the field of Department of Entomology, B.Z.U. Bahadur Sub Campus Layyah during 2018-2019 cropping seasons under Randomized Complete Block Design (RCBD). The length of a row was kept 6 feet with row-to-row distance 15 cm. The crop was inoculated with seven treatments (0 ml, 30 ml, 50 ml, 60 ml, 70 ml, 80 ml, 100 ml) of silicon present in the form of sodium silicate solution with 0.4% SiO₂. The first silicon foliar application was performed 30 days after germination of wheat plants.

Results: The high plant height (80.76 cm) and spike length (16.5 cm) was recorded over control with the application of 100 ml sodium silicate as source of silicon (Si). The maximum spike weight (0.87g) was measured with the application of 100 ml Si over control (0 ppm). The 100 ml silicon application significantly affects the mortality rate of 1st nymphal instar. The maximum mortality rate (47%) was observed as compared to control treatment. The silicon application had a good impact on the adult longevity period and reduced it up to (18%) over control (25%). Silicon application with 100 ml concentration on wheat plants also reduced the honey drops of aphid, nymph survival and reproductive period (17days).

Conclusion: It was concluded that the high concentration (100 ml) of the foliar application of silicon had a significant impact on the yield attributes of wheat and biology of aphid *Schizaphis graminum*.

Keywords: aphid, silicon, wheat, yield attributes.

SPP-IPM-106

Genetic analysis of insecticide resistant populations of *Bemisia tabaci* (Gennadius) from different localities of South Punjab, Pakistan

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ABSTRACT

Background: *Bemisia tabaci* species complex is well documented as one of the most important emerging plant viral vectors through severe feeding damage to a wide range of host plants and severe plant virus infections to important agricultural crops.

Methods: Specimens were collected from cotton fields from seven districts of South Punjab, Pakistan. The polymerase chain reaction (PCR) was performed using the mitochondrial cytochrome oxidase I (mtCOI) whitefly Gene premium for biotyping.

Results: From all selected locations, 23 out of 90 samples gave negative results during PCR amplification analysis. The Single-Strand Conformation Polymorphism (SSCP) studied revealed that the two samples of Mian Channu and

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Bahawalpur locations gave different amplicon patterns. Sequenced the selected samples by using the Sanger method and we analyzed the data to correlate the presence, prevalence, and geographical distribution of *B. tabaci*.

Conclusion: We concluded that Asia II 1 mostly present in all selected areas and Asia II 5 was also observed only from Kabirwala location.

Keywords: *Bemisia tabaci*, PCR, mtCOI gene, Biotype.

SPP-IPM-107

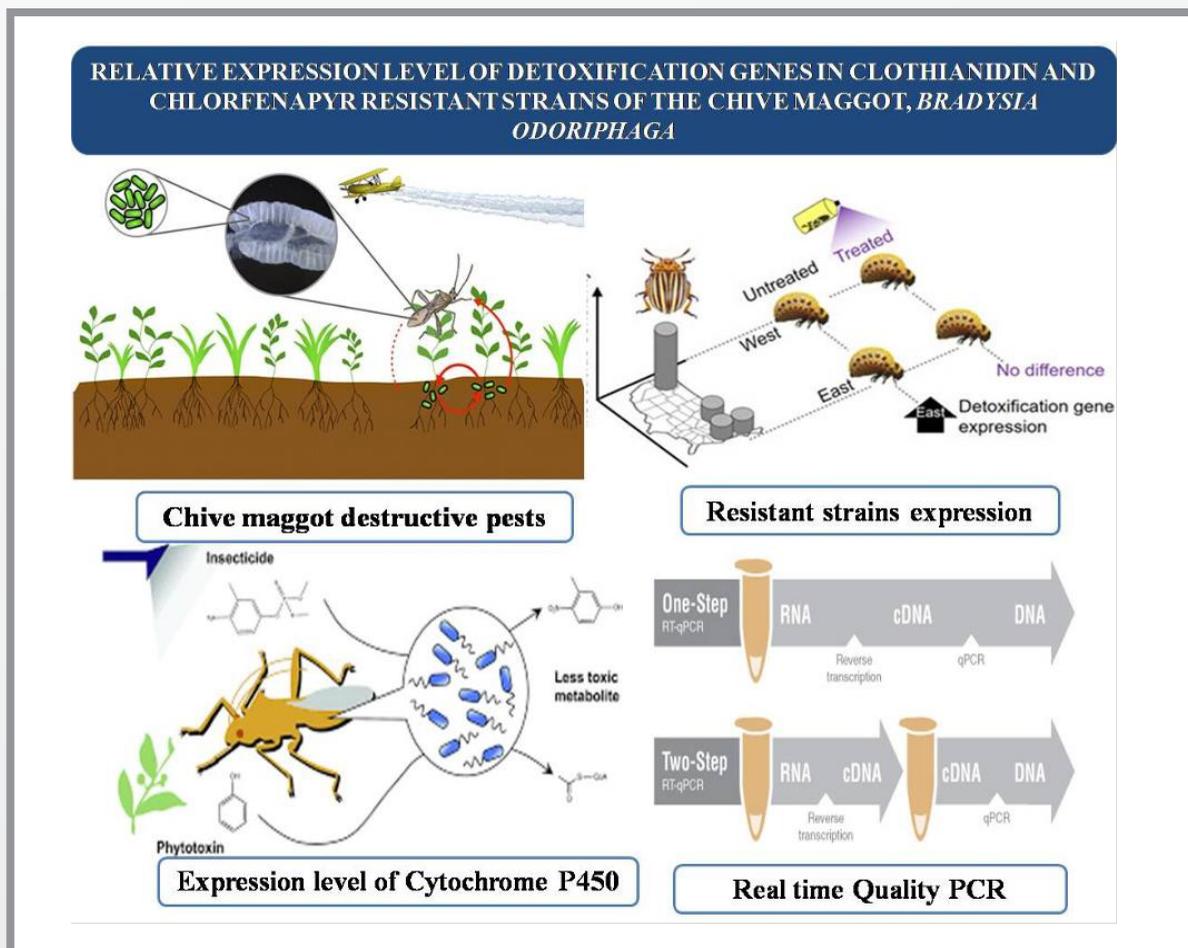
Relative expression level of detoxification genes in clothianidin and chlorfenapyr resistant strains of the chive maggot, *Bradysia odoriphaga*

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ABSTRACT

Background: The chive maggot *Bradysia odoriphaga* Yang et Zhang (Diptera: Sciaridae) is a destructive pest influencing more than 7 plant families and 30 plant species, including Chinese chive (Liliaceae). Clothianidin is a second-generation neonicotinoid insecticide with a stomach and contact insecticidal activity and is widely used to control *B. odoriphaga*. Chlorfenapyr is a halogenated pyrrole insecticide and is broadly used to manage *B. odoriphaga* that interferes with mitochondrial oxidative phosphorylation. In this study, the expression levels of cytochrome P450 (CYP3356A1 and CYP6FV12) and GST genes in clothianidin and chlorfenapyr resistant strains of *B. odoriphaga* were investigated.

Methods: Quantitative Real Time PCR (RT-qPCR) was carried out to analyze the expression of CYP3356A1, CYP6FV12 and GST genes in clothianidin and chlorfenapyr resistant strains compared to susceptible strain of *B. odoriphaga*.

Results: In the present study, the expression level of CYP3356A1 and CYP6FV12 were significantly up-regulated in clothianidin resistant strain compared to susceptible strain of *B. odoriphaga*, while the mRNA level of GST gene was statistically same. Moreover, in chlorfenapyr resistant strain, the expression level of CYP3356A1 was increased, while no effects were observed on CYP6FV12 and GSTs genes.

Conclusion: Our results showed that CYP3356A1 and CYP6FV12 genes are potentially involved in clothianidin resistance while CYP3356A1 might be involved in chlorfenapyr resistance development. This study could be useful to understand the molecular basis of clothianidin and chlorfenapyr resistance mechanisms in *B. odoriphaga*.

Keywords: cytochrome P450 monooxygenase, insecticide resistance, resistance mechanism, gene expression.

SPP-IPM-108

dsRNA mediated management of *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae)

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ABSTRACT

Background: RNA interference is a highly sequence-specific silencing process and has the ability to inhibit specific gene function in targeted insect pests by utilizing dsRNA. To combat crop losses from damaging insect pests, dsRNA-based technologies proved to be an efficient and promising insect pest management strategy. Here we describe a dsRNA-based approaches in different insect orders (i.e.: lepidopteran and coleopteran) dsRNA preparation, methods of dsRNA delivery (sprayable, plant mediated, bacterially expressed) and specific gene silencing of insects as a pest management strategy. Tomato is the seventh most important crop species after maize, rice, wheat, potatoes, soybeans and cassava. Insect pests of tomatoes are a continuous threat to the crop. Tomato leafminer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is a devastating insect pest of tomato and turkey as the fourth largest country for producing tomatoes.

Methods: In this study using dsRNA technology two vital genes (AChE1, Sec23) of *T. absoluta* were targeted for the first time to make tomato crop resistant against its insect pest like *T. absoluta*. Acetylcholine esterase1 (AChE1) in insects' functions in neurotransmission, and Sec23 protein in insects is one of the components of the coat protein complex II (COPII) which promotes the formation of transport vesicles from the endoplasmic reticulum (ER).

Conclusion: Targeting AChE1 and Sec23 would result in larval mortality/suppression when dsRNA will be ingested by targeted insects.

Keywords: dsRNA, tomato, mortality.

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SPP-IPM-109

Field evaluation of the *Bactrocera cucurbitae* attractant with different trap shapes and colors

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ABSTRACT

Background: Bitter melon (*Momordica charantia*. L) is the most cultivated crop in Asian region and it has remarkable value because of its nutritional and medicinal value. Bitter melon quality and production decreases by fruit fly (*Bactrocera cucurbitae*). Fruits affected and contaminated by fruit fly are unfit for human consumption. Almost more than 40 percent loss occurs by fruit flies throughout the world. Fruit flies become a major quarantine pest throughout the world.

Methods: Studies were carried out for comparison of methyl eugenol and cue lure attractant for monitoring the activity of fruit flies. For this purpose, traps installed in the field and on a weekly basis data recorded trial was conducted under Randomized complete block design. Studies were conducted during 2019 and 2020 at farmer fields. Different experiments were performed to determine *B. cucurbitae* trap attractant, different shape of trap and color preference under field conditions. Weight of healthy fruits and infested fruits taken in a field to evaluate the effect of *B. cucurbitae* attractant on production of bitter melon crop.

Conclusions: Results conclude that *B. cucurbitae* is less attracted by traditional lures used like methyl eugenol. *B. cucurbitae* catches more in cue lure traps in comparison with methyl eugenol.

Key Words: Monitoring, Fruit fly, Lure, *Bactrocera cucurbitae*, Trap Shapes

SPP-IPM-110

Status of Fall armyworm *Spodoptera frugiperda* (Lepidoptera, Noctuidae) in South Punjab, Pakistan

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ABSTRACT

Background: The Fall armyworm (FAW), *Spodoptera frugiperda* is a sporadic and polyphagous pest, typically feed on maize crop. It is native to America, but it has currently become a new invasive species in Africa and also reported in many Asian countries.

Methods: The present study was conducted in the four different maize growing areas at different cropping stages in south Punjab, Pakistan, to monitor the presence and damage status of FAW on maize crop. Damage was recorded by observing the larval presence and damage symptoms caused by larvae. Larvae collected from a maize field were identified in the laboratory by using their morphological characters and were reared to adults. Adults of FAW were monitored by using light traps in all the above-mentioned areas of south Punjab.

Results: The presences and damage of FAW was confirmed (morphological base identification) from all four locations. Field monitoring results showed that highest damage (38.5 to 39%) was recorded at 8-12 leaves crop stages while damage was decreased as the crop goes toward maturity. The percentage damage 30 to 25% was recorded at crop stages having 16 to 20 leaves, respectively. This decrease in the damage might be dependent on the crop stage and temperature. Similarly, the light traps results exhibited that the number of moths per trap decreased throughout the

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cropping season depending on the temperature.

Conclusion: The results of this study confirm the existence of FAW in south Punjab, Pakistan. And results showed that its population is dependent on cropping stage and as well as temperature.

Keywords: sporadic, armyworm, morphological character.

SPP-IPM-111

Induced expression of heat shock proteins (Hsp90, Hsp70 and Hsp60) is associated with thermotolerance in three rice plant hopper species

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ABSTRACT

Background: The three rice planthopper species (SBPH, BPH and WBPH) exhibit different heat tolerance trends and heat shock proteins (Hsps) protect them from thermal damage.

Methods: To investigate the survival rate, we exposed adult females of three species at different temperatures 5°C, 15°C, 33°C, 37°C and 26°C (as control) for as long as 21 days. Results indicate the significant difference of survival with SBPH and BPH are the most heat tolerant. Furthermore, to explore the induced expression levels of Hsps, relative expressions of Hsp90, Hsp70 and Hsp60 were studied at different heat and cold shocks with the investigation of different recovery periods. In our results, heat stress (33 and 37°C) up-regulated the relative expressions in all species, with even higher expressions at 37°C. Hsp90 produced the highest expression level in BPH at 37°C (3.6-fold increase), when compared with the control group (26°C). Conversely, cold shock at 5°C and 15°C did not change the expression profiles of Hsp90 genes in any species. During 3 h recovery, relative expression was up-regulated in SBPH (2-fold at 5°C and 2.6-fold increase at 33°C) when compared with (0 h of recovery period) but decreased at 6 h recovery in all three species. Hsp70 was not significantly up-regulated except BPH (0.9- fold increase) at 37°C, while recovery of 3 h induced (1-fold increase) in WBPH when compared with control (0 h of recovery period). Relative expression of Hsp60 was significantly induced in WBPH at all temperatures with highest at 37°C (2.2-fold increase) against control at 26°C.

Conclusion: These results validate the involvement of three Hsps genes in heat tolerance in three species and their induction and expression levels are different under cold and heat shock stress, the effect of recovery time is fundamental on gene expression profiles.

Keywords: planthopper, heat shock proteins, tolerance

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INSECT PEST MANAGEMENT

SPP-IPM-112

Insecticidal and growth inhibitory potential of phytofabricated nanoparticles of titanium dioxide against *Cryptolestes ferrugineus*

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ABSTRACT

Background: The current study was carried out to check the response of *Cryptolestes ferrugineus* toward different combinations of nanoparticles and plant extracts under laboratory conditions.

Methodology: Extracts of neem, eucalyptus and niazbu were used to prepare nanoparticles of titanium dioxide followed by green synthesized method. Four concentrations of nanoparticles prepared by three plant extracts were treated on the commodity before release of the test insects. Mortality data were observed after 3, 5, 7 and 9 days of treatment of the commodity with phyto fabricated nanoparticles.

Results: The maximum percent adult mortality of *C. ferrugineus* was 100, 96.67 and 93% was observed at 400 ppm concentration of *Azadirachta indica*, *Eucalyptus globulus* *Ocimum basillicum* extract respectively after 9 days post treatment exposure. Whereas the minimum mortality of *C. ferrugineus* was 45.67, 34.67 and 32.67% with 100 ppm concentration of *A. indica*, *E. globulus* and *O. basillicum* extract respectively after 3 days post treatment exposure. Moreover, the nanoparticles also caused significant reduction in post treatment progeny development of *C. ferrugineus* when used in combination with plant extracts. After 60 days of post treatment progeny development, the results of growth inhibition show that maximum growth inhibition (73.67%) was recorded with the treatment of nanoparticles prepared by the extract of neem (*A. indica*) while minimum growth inhibition was 48.67% caused by the extract of niazbu (*O. basillicum*)

Keywords: Mortality, *O. basillicum*, Progeny Development

SPP-IPM-113

Diversity of Soil Inhabiting Mites (acari) of Mango Orchards from Dera ghazi khan, Pakistan

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ABSTRACT

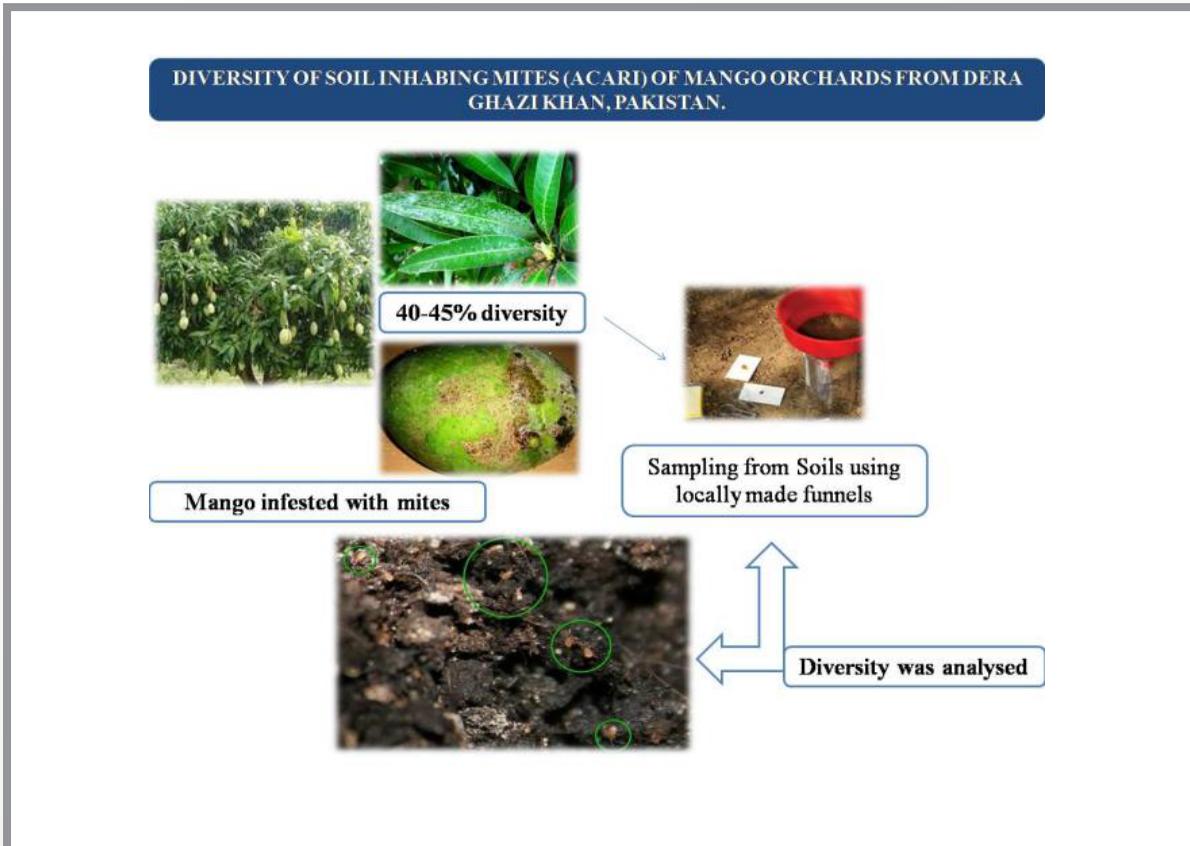
Background: Mango is a prime fruit having a great economic importance in the world. This crop is damaged by both invertebrate and vertebrate organisms including Arachnids, which contribute 45-50% of total arthropod diversity of the land. Mites belong to the well-developed category of arthropods due to variability in natural territory and richness in the soil.

Methods: Sample was collected from 4 mango orchards of Pakistan (Dera Ghazi Khan). Unique Berlese funnels were applied to extract soil Arachnids from collected samples. Glass slides were used for the mounting of extracted specimens and specimens were classified up to order and family level. Experimental statistics were applied to estimate variety, seasonal variation and influence of intercropping within mango gardens on the population of under soil mites. Variations were examined by diversity index (Shannon, 1948).

Results: A total of 1898 soil inhabiting mite specimen were collected and after identification of 1423 slides, 08 families like Laelapidae, Pachylaelapidae, Ameroseiidae, Macrochelidae, Parasitidae, Phytoseiidae, Uropodidae, Melicheridae were

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identified. Maximum diversity of soil mites ($H=2.12$) was recorded from Mana Ahmadani (A3). Kot Chutta locality showed minimum Shannon diversity index value ($H=1.87$). Maximum abundance recorded from Kotla Gurmani (A1) with values 28.62 and minimum abundance was recorded from Basti Halla (A4) with value 17.64. Maximum richness from mango orchards of Basti Halla (A4) with value $S=6.03$, while minimum was observed from Kotla Gurmani (A1) with value $S=4.00$.

Conclusion: Results showed that Ameroseiidae, Macrochelidae, Laelapidae have negative correlation with relative humidity, while positive correlation with maximum and minimum temperature. Only family Parasitidae have negative correlation with maximum and minimum temperature ranges.

Keywords: diversity, soil mite, meso-stigmata, arachnids.

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Comparative efficacy of *Bacillus thuringiensis*, *Trianthema portulacastrum* Extracts and Pyriproxyfen against *Aedes albopictus* larvae

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ABSTRACT

Background: Mosquitoes are death-dealing organisms in the world, vectoring many infections in humans at large scale. In addition to chemical control, new approaches to control mosquitoes for a safer environment and non-target organisms are the need of hour.

Methods: Current study was designed using different solvent based *Trianthema portulacastrum* extracts, Pyriproxyfen (IGR), and Biogard® (*Bacillus thuringiensis*) with upper and lower doses to evaluate their larvicidal potential against 3rd instar larvae of *Aedes albopictus* under laboratory conditions.

Results: Maximum mortality was recorded as $90 \pm 5.77\%$ after 72h of exposure using 0.02 ppm concentration of pyriproxyfen. Biogard having *B. thuringiensis* as active ingredient (16,000 IU/mg) also showed significant larval mortality as $96.66 \pm 3.33\%$ after 72h after exposure with a concentration of 5 g/L. *T. portulacastrum* is a common weed in the farmlands of South-Punjab and exploited for its insecticidal efficiency against 3rd instar larvae of *A. albopictus* mosquito. Its 2% ethanol-based extract caused $96.66 \pm 3.33\%$ after 72h of treatment. Aqueous extract of *T. portulacastrum* was not found much influential over larval mortality of *A. albopictus*. However, the highest mortality was observed up to $96.66 \pm 3.33\%$ after 72h using 2% solution of plant extract. A surge in mean mortality was recorded up to $96.66 \pm 3.33\%$ later the application of 2% plant extract of ethyl acetate-based extract.

Conclusion: It was concluded that pyriproxyfen can exhibit fruitful results in the control of mosquitoes with minimum possibilities of non-target organism damage. Similarly, it is suggested that bioinsecticide Bioguard® can be used in urban areas to control mosquitoes. However, *T. portulacastrum* should be further studied for its biochemical properties and potential usage

Keywords: Mosquito, Biological control, plant extracts, insecticide, BT

SPP-IPM-115

Insecticidal induced instability of DNA and antioxidant enzymes in honeybees

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ABSTRACT

Background: In practical agriculture, honeybees are being exposed to many toxic chemicals including insecticides. Insecticide toxicity is an important negative factor in declining honeybee populations in the agro-ecosystem. This exposure may exert genotoxic as well as physiological stress in the honeybee populations.

Methods: Insecticide residues, DNA damage, and some enzyme activities were evaluated in two honeybee species, *Apis florea* and *A. dorsata*. Insecticide residues were determined with optimized analytical approaches of gas chromatograph-

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mass spectrometry (GC–MS) and high-performance liquid chromatography (HPLC).

Results: Seven insecticides, namely, acetamiprid, chlorpyrifos, chlorfenapyr dimethoate, emamectin, imidacloprid, and phorate were detected in seven samples of *A. florea* and five samples of *A. dorsata* (i.e. 22.22% of honey bee samples). Chlorpyrifos was the most frequently detected insecticide (7.4% samples) with a concentration ranging from 0.01 to 0.05 $\mu\text{g/g}$ and an average concentration of 0.03 $\mu\text{g/g}$. DNA damages were analysed through the comet assay at the level of a single cell. Comet tail lengths of DNA in *A. florea* and *A. dorsata* samples were significantly ($P < 0.05$) higher in response to insecticidal exposures. The highest comet tail length ($19.28 \pm 2.67 \mu\text{m}$) was detected in DNA of *A. dorsata* from the insecticide-treated zone as compared to the lowest ($3.18 \pm 1.46 \mu\text{m}$) from insecticide-free zone. The activities of catalase (CAT) and glutathione S-transferase (GST), the antioxidant enzymes, showed that the activity of catalase (CAT) did not differ significantly between honeybee samples from both areas while the activity of glutathione S-transferase (GST) exhibited a substantial decrease in response to insecticide exposure. Significant interactions ($P < 0.05$) were noticed between enzyme activity and insecticide concentration in both the honeybee species.

Conclusion: It was concluded that insecticidal exposure at sublethal levels must not be underestimated in honeybees, as they possibly can induce physiological impairments in honeybees.

Keywords: DNA damage, enzyme activity, genotoxic effects, insecticides

SPP-IPM-116

Monitoring of citrus fruit fly in IoT based system

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ABSTRACT

Background: The fruit fly is one of the most damaging pests all over the world that affects fruits and vegetable production and quality.

Methods: This study proposes an IoT based pest management device for citrus fruit fly monitoring in citrus orchards and species identification. This device enables farmers and researchers to automatically monitor the presence of fruit fly in the orchard without manual surveys. It also identifies the species of fruit flies to assist farmers in precise control management. The sensor data is automatically stored in a central database and generates alerts to the farmers through a mobile application. From these alerts, the farmer is able to make a precise and efficient decision about the area and time when the pesticides are used for citrus fruit flies' control.

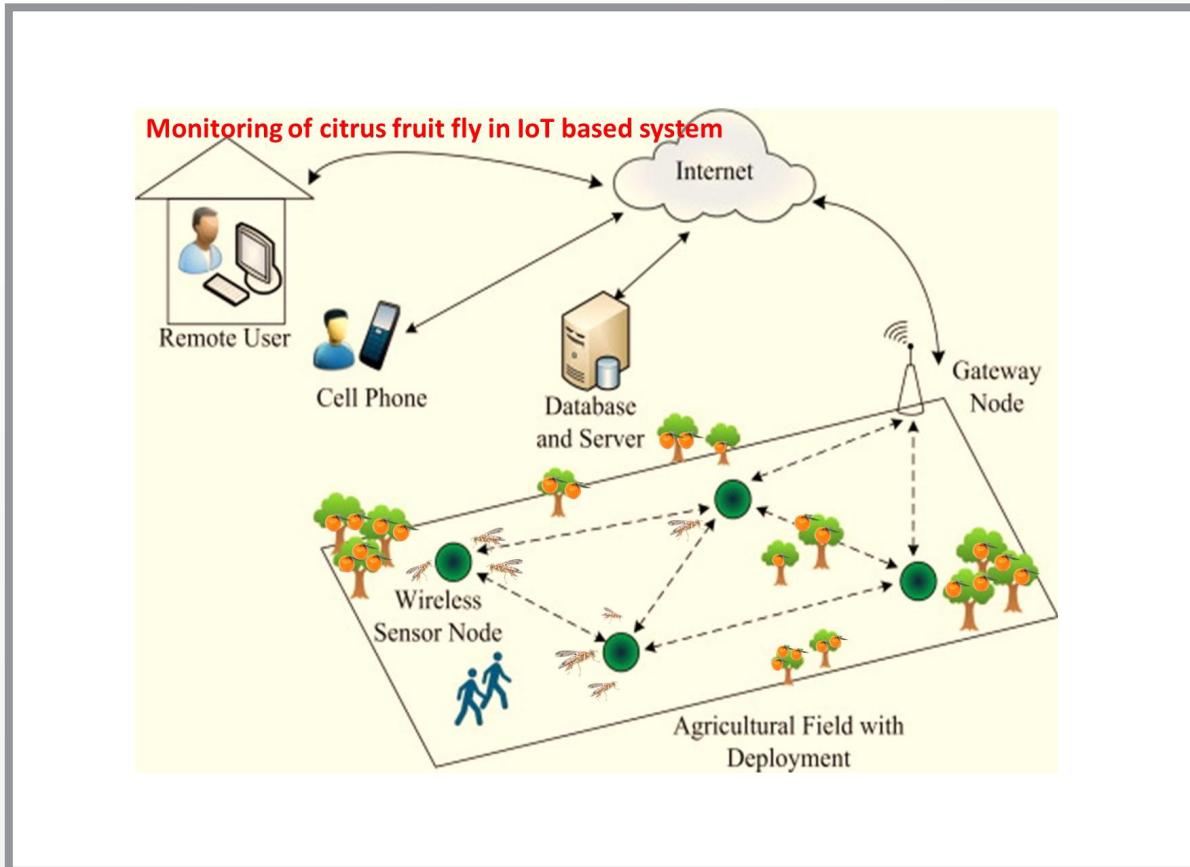
Results: Deep learning algorithm Yolo has been used for species identification, which can help in the identification of the exotic species of citrus fruit flies that may be proven more dangerous for fruits in the future. Yolo applies a single neural network on an image and divides the image into regions. On the behalf of these regions, it predicts bounding boxes around the species with their names. Temperature sensor readings help farmers to predict the fruit fly life cycle.

Conclusion: Experimental results show that this smart trap is helpful for both researchers as well as for growers. This smart trap helps researchers to identify the major species of fruit flies without going to the laboratory. It also captures fruit flies due to which minimizes the effect of these on citrus yield.

Keywords: fruit fly, monitoring, identification

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Self-resistance in wheat against grain aphid (*Sitobion Avenae* F) (Homoptera: Aphididae) relates to amino acids concentration in wheat genotypes

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ABSTRACT

Background: Plant resistance to insects relies largely on metabolites that exert toxic, antinutritive, or repellent effects. Insects could perceive most of these compounds by chemoreceptors and decide to accept or reject a host. The association between the concentrations of total amino acid contents in winter wheat cultivars to the grain aphid *Sitobion avenae* (F.) was studied in the field.

Methods: Ten wheat cultivars were selected, and the amino acid contents were estimated in flag leaves and ears at the milking stage, and in the whole plant at maturity. Average aphid population per tiller and percentage of infested tillers was

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recorded in all genotypes from booting to late dough stage at one week interval.

Results: The highest aphid population per tiller was recorded at milking stage in the middle of March. A positive correlation between total quantity of amino acid present in wheat and aphid population (0.71 *) and plant height (0.75**) was observed while the association between plant amino acid composition and plant resistance against grain aphid was also observed. Seventeen amino acids were identified in all wheat cultivars. The contents of amino acids such as aspartic acid, threonine, serine, glutamic acid, glycine, tyrosine, alanine, leucine, isoleucine, phenylalanine and lysine showed a positive association with aphid population while valine and methionine showed positive correlation with plant resistance to aphid attack.

Conclusion: Hence, aphid attack on wheat depends on the quantity and quality of amino acids present in wheat.

Keywords: Grain aphid, Wheat, Amino acid

SPP-IPM-118

Insecticidal potential of eco-friendly mycoinsecticides for the management of fall armyworm (*Spodoptera frugiperda*) under in-vitro condition

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ABSTRACT

Background: The invasive polyphagous pest fall armyworm *Spodoptera frugiperda*, (Lepidoptera: Noctuidae) is a migratory pest of maize crop in Asia and other countries including Pakistan.

Methods: It can be managed by different control strategies including physical, biological, mechanical Eco-friendly Mycoinsecticides fungus *Beauveria bassiana*, *Trichoderma* and *Metarhizium anisopliae* instead of chemical control methods.

Results: According to in vitro bioassay of entomopathogenic fungi like *Beauveria bassiana*, *Trichoderma* and *Metarhizium anisopliae* under control condition *Metarhizium anisopliae* was found very effective on Fall armyworm 1st 2nd 3rd and 4th instar larvae and mortality percent was recorded 85.5% on 1st 2nd and 3rd instar larvae at 40ppm dose while minimum mortality was recorded 18.6% on 10ppm dose of *Trichoderma* during bioassay under control condition Fig 1. During second instar larvae of bioassay entomopathogenic fungi *Metarhizium anisopliae* was recorded very effective and showed mortality of FAW up to 83.3% at dose of 40ppm after exposure of three days at 25C approximately. While minimum mortality of FAW was recorded at 10 ppm after exposure of three days. In 2nd instar larvae exposer *Metarhizium anisopliae* was found entomopathogenic potentials and Cause highest mortality of FAW the minimum mortality was recorded 48% on 10ppm dose exposure of *M. anisopliae* after three days at 25C and approximately 53% humidity. The studies show that entomopathogenic potentials of fungi decrease with increasing larval instars. On 3rd and 4th instar larvae only *M. anisopliae* was recorded effective and mitigate the larvae population 78.5% at 40 ppm and 55.8% mortality was observed on 4th instar larvae after exposure of three days among all *Metarhizium anisopliae* was found potential insecticidal properties as compare to *Beauveria bassiana* and *Trichoderma*.

Conclusion: This comparative study shows that *M. anisopliae* was found to have the highest insecticidal properties as compared to *Beauveria bassiana* and *Trichoderma*.

Keywords: insecticides, Mycoinsecticides, fall armyworm

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Role of different crops intercropping in management of *Leucinodes orbonalis* in brinjal crop

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ABSTRACT

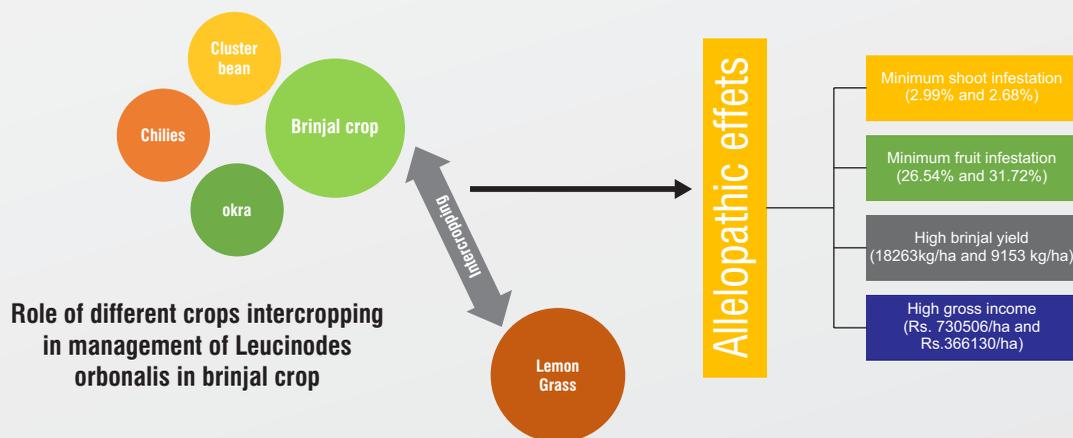
Background: Ecologically safe and sustainable pest management strategies are attaining interest over excessive use of synthetic agrochemicals and increasing concerns of health hazardous effects on humans. Implementation of polyculture/intercropping practices is a suitable alternative to conventional farming systems. This study was planned to evaluate the different theoretical approaches regarding use of intercropping for management of *Leucinodes orbonalis* Guenee in a field laboratory at two locations.

Methods: Five crop combinations including four crops (cluster bean, chillies, okra and lemon grass) and a brinjal sole crop were transplanted into 4:1 (brinjal: intercrop) ratio. Each treatment was replicated four times in a randomized complete block design. Data regarding plant height(cm), number of shoots/plants, shoot infestation, fruit infestation, single fruit weight and no. of natural enemies/plant were recorded on a weekly basis for a total 23 weeks. The marketable yield of brinjal and other crops was converted into per hectare yield and gross income was also estimated.

Results: Results revealed that poly culture has no significant influence on plant growth except lemon grass which impose allelopathic effects to some extents but statistically at par with other crop combinations. Brinjal + lemongrass resulted minimum shoot infestation (2.99% and 2.68%), minimum fruit infestation (26.54% and 31.72%), high brinjal yield (18263 kg/ha and 9153 kg/ha) and higher gross income (Rs.730506/ha and Rs. 366130/ha) at both locations Rawat farm and URF Koont respectively. Higher number of natural enemies was observed on polyculture brinjal crop except brinjal + lemon grass intercropping.

Conclusion: This study revealed that brinjal + lemon grass intercropping is economical and sustainable alternative to chemical management of *Leucinodes orbonalis* Guenee in brinjal crop.

Keywords: agrochemicals, allelopathic, infestation.



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Ethogram and localization of gustatory sense of *Camponotus* spp. (Hymenoptera: Formicidae) to sugars

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ABSTRACT

Background: Until now, ethogram and gustatory sense of fire ant to sugars still remain unclear. In the management of the red imported fire ant, *Solenopsis invicta* Buren, one of the notorious invasive species of ant all over the world, the most effective control measure is the broadcast application of baits, which consist of attractants, like sugar and fatty oil. In this study, we raised the hypothesis that gustatory sense of fire ant workers to sugars is localized mainly on antennae and foreleg tarsi based on feeding behavioral sequence and bioassay.

Methods: Firstly, the preferred sugar among several saccharides was disaccharides like sucrose in the laboratory. Secondly, the feeding sequence of the fire ant workers on sucrose solution was observed and categorized in detail for the first time. Thirdly, antennal ablation and HCL treatment on foreleg tarsi were chosen for blocking the sensitivity of gustatory sensilla on both appendages.

Results: It is indicated that foreleg tarsi of workers were responsible mainly for detecting the sweet compound, their antennae partially for feeding behavioral analysis and feeding time. In addition, we found out the possible gustatory sensilla, basiconic (basiconic I and II), trichoid I and II, and chaetic were on antennae flagellum, and meanwhile sensilla chaetic only found on foreleg tarsi.

Conclusion: Sensilla chaetic and basiconic have clear pore at their tip. It is inferred that the potential gustatory sensilla are sensilla chaetic on foreleg tarsi. This study provides a substantial basis for elucidating the gustatory function of antennal and tarsal sensilla on appendages of workers to sugars and further bait improvement for the management of pest ants.

Keywords: attractant, feeding behavior, sensilla, bioassay.

SPP-IPM-121

Pathogenic microorganisms in locust plague control

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ABSTRACT:

Background: The biology, infection mechanisms, epizootics, and potential application of entomopathogen are crucial aspects for development of microbial control agents in locust plague management. Entomopoxviruses, *Nosema locustae*, *Entomophaga grylli*, *Metarhizium* spp., *Beauveria* spp. and *Aspergillus* spp are focused to be reviewed. Entomopoxviruses and *Entomophaga grylli* are difficult to be developed into biocontrol agent because of high production cost and short survival time of conidia in vitro, respectively; *Nosema locustae*, *Metarhizium* spp. and *Beauveria* spp. have been successfully developed as microbial pesticides and widely used in locust plague control. *Aspergillus oryzae* was recently identified as a new pathogen of locust and has the potential to be developed into a biocontrol agent due to their high virulence, sporulation quantity and heat resistance etc.

Conclusions: Finally, it is respected that exploration of new resources of pathogen and formulation, development of high

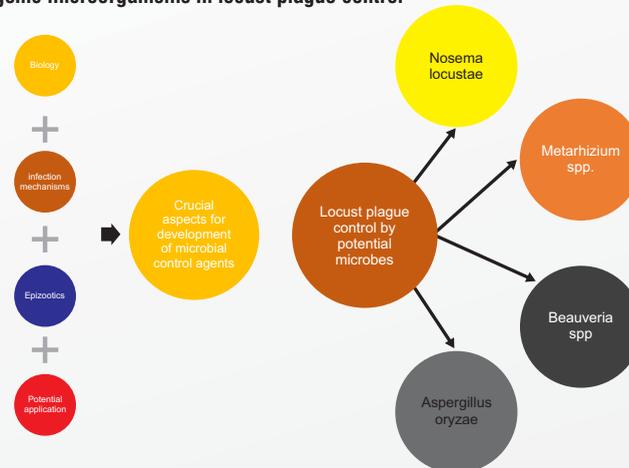
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efficient mass production technology, prolonging product shelf life for promotion microbial control of locust plague in future.

Key Words: Locusts, Biological control, Entomopathogen, Fungus, Protozoa

Pathogenic microorganisms in locust plague control



SPP-IPM-122

Earliness index in cotton for the sustainable management of pink bollworm infestation

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ABSTRACT

Background: Pink bollworm (*Pectinophora gossypiella*) is recognized as an important pest of cotton and it can damage flowers and bolls of both Bt and non- Bt cultivars. Cry-1Ac in Bt cultivars is considered to be very effective in controlling lepidopterous larvae, therefore, the present study was carried out to investigate the impact of Cry1-Ac and earliness index on the natural incidence of *P. gossypiella* at Cotton Research Institute, Faisalabad.

Methods: During 2015-16, ten cultivars were used to determine the incidence of pink bollworm infestation. The experiment was repeated for two years. During the next year, Cry1-Ac and earliness traits of selected cultivars were also observed to determine their impact on pink bollworm.

Results: Coefficient of correlation results regarding days to first flower (r -value= 0.66) as well as earliness index (r -value= -0.62) exhibited a strong association with pink bollworm but Cry1-Ac had weak association (r -value= -0.058) with pink bollworm. The coefficient of determination (R^2) explained that variability of pink bollworm due to Cry1-Ac, earliness index, and days to the first flower was 18.0, 38.5, and 43.5%, respectively. Principal Component Analysis results depicted that the first two PCs expressed 87% of the total variability. Clusters made on the basis of studied parameters revealed that Cluster-2 and Cluster-3 consisted of the cotton cultivars that possess earliness traits as compared with cluster-1.

Conclusion: Therefore, it can be concluded that earliness index in cotton is an important component for the sustainable management of pink bollworm infestation and its need is unending in the era of climate change to escape pink bollworm problem.

Keywords: Cry1-Ac, infestation, cultivar.

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Response of the peach fruit fly, *Bactrocera Zonata* (Saunders) to some synthetic proteinaceous food bait attractants

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ABSTRACT

Background: Peach fruit fly, *Bactrocera zonata* (Saunders), is a serious pest, attacking fruits and vegetables causing large quantitative and qualitative damages throughout the world. Fruit fly required proteinaceous food for sexual maturation and eggs development. Therefore, food bait attractants are widely used for detection, monitoring, mass trapping and controlling fruit flies.

Methods: Screening out the most suitable synthetic proteinaceous food bait attractants to volatiles distinguished by the fruit fly antennae through Y-olfactometer (Behavioral assays) was performed. The response of *B. zonata* adults male and females to some ammonium compounds (Ammonium acetate, trimethylamine and putricine) that mixed with certain food attractants were evaluated under laboratory conditions from 5 to 30 days old flies. To find out potential mixtures that might be beneficial in developing fruit fly bait attractants for male and especially for females, four base baits developed by mixing protein hydrolysate with jaggery, papa powder, kachri powder, KOH and guava pulp.

Results: Olfactometer bioassays indicated that protein hydrolysate + Jaggery and Protein hydrolysate + Jaggery + Ammonium acetate + Putricine were effective both for male and female throughout the adult life span when jaggery was used as base baits. Similarly, protein hydrolysate + Guava pulp + Ammonium acetate + Trimethylamine and protein hydrolysate + Guava pulp + Ammonium acetate + Putricine were also effective for the attraction of both male and female from 5 to 30 days life span when guava pulp was used as base baits.

Conclusions: Jaggery + ammonium acetate + protein hydrolysate could be used for the early detection, monitoring and mass trapping of *B. zonata*. Moreover, throughout the life cycle, *B. zonata* depends upon the physiological and olfactory cues of the host.

Key words: Fruit fly, bait, attractants, olfactory cues.

SPP-IPM-124

Monitoring desert locust in Africa and Asia

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ABSTRACT

Background: Food security has always been a top concern in the international community. In the context of climate change, the scope and prevalence of pests have noticeably expanded and increased. Locusts are a major migratory pest worldwide, and since 2018, the abnormal climate has caused desert locusts to reproduce freely in the southern Arabian Peninsula and gradually sweep across the Horn of Africa and Southwest Asian countries.

Method: An indicator system for monitoring desert locusts with remote sensing was established with quantitative remote sensing extraction and time-series analysis of indicators closely related to the reproduction, development, and migration of locusts. This includes pest sources, hosts, and their environment. A habitat suitability model was constructed to

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extract locusts' core breeding areas at a large scale by integrating multi-source data, e.g., global land use, ground surveys, GIS analysis, geo-statistics, and spatiotemporal data fusion methods and algorithms. Then, locust migration paths were monitored by coupling Earth observation data, meteorological data, crop calendar, and planting data with an insect dispersal dynamics model. Finally, locust damage distribution and area were extracted based on the vegetation growth curve analysis of the past 20 years along with pest dispersal mechanisms. Also, more detailed monitoring of locust damage was conducted in some severely affected countries, such as damaged vegetation type (crop, grass, shrub), spatial distribution, and total damaged area.

Results: At the beginning of March 2020, locust swarms in Kuwait continued to spread to southeastern Iraq, and swarms on the eastern coast of Saudi Arabia spread to the west coast of the United Arab Emirates. At the same time, swarms in southern Ethiopia began to migrate north. In mid-March, immature locust swarms were found on the coast of the Red Sea in southeastern Egypt. At the end of the month, immature locust swarms appeared on the east coast of Djibouti. In April, there was heavy precipitation in eastern Africa and locusts continued to reproduce in spring and mature into groups. Swarms in Ethiopia and Somalia continued to move north, swarms in the northern Arabian Peninsula spread to central Iraq, and the density of locusts on the border between Iraq and Pakistan continued to increase. In May, locust eggs continued to hatch and reproduce, and by mid- to late-May, swarms began to migrate from spring breeding areas such as Kenya, Ethiopia, and western Pakistan to summer breeding areas such as central Sudan, southwestern Saudi Arabia, and the Indo-Pakistan border. At the end of the month, swarms migrated eastward from the border to northern India. From mid to late June to July, locusts in spring breeding areas such as Kenya, Ethiopia and Somalia migrated west or northwest to central Sudan, and northeast to the Indo-Pakistan border for summer breeding. At the same time, locusts from southern Iran migrated eastward into western Pakistan, while locusts from northern India continued to reproduce and spread eastward. As of April 2020, desert locusts in Pakistan harmed 2.4174 million hectares of vegetation area, seriously affecting wheat. The locusts harmed 2.6315 million hectares of vegetation in Somalia, mainly cropland, shrubland, and grassland. As of May 2020, desert locusts have harmed 5.3977 million hectares of vegetation area in Ethiopia. The Great Rift Valley, known as the granary of Ethiopia, has suffered serious losses. The harmed area in Kenya was 6.1045 million hectares, mainly located in the Rift Valley Province and Eastern Province. From January 2019 to May 2020, desert locusts have invaded 20 provinces in Yemen, with a harmed vegetation area of 2.0652 million hectares (Figure 2.7–Figure 2.11). Verified by ground survey data provided by FAO, the locust plague monitoring accuracy was higher than 80%.

Conclusion: In terms of technological innovation, this case used an international shared remote sensing dataset to conduct systematic research on the extraction of large-scale desert locust breeding areas, long-term quantitative monitoring of locust migration paths, and quantitative monitoring of locust plagues through big data analysis and processing on the Digital Earth Science Platform. In terms of application and promotion, the FAO adopted the monitoring results of the core breeding area and migratory path of desert locusts in Africa and Asia from 2018 to 2020, as well as the plague monitoring results in the key countries (Pakistan, Somalia, Ethiopia, Kenya, Yemen). The results provided informational support for multi-country joint prevention and control of pests to sustain agricultural production.

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SPP-IPM-125

Impact of polymorphism and abiotic conditions on prey consumption by *Harmonia axyridis*

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Abstract

Background: Polymorphic diversity, such as elytra patterns of insects, is regarded as an external phenotypic characteristic driven by both genetics and environmental pleiotropy. The multicolored Asian ladybird, *Harmonia axyridis* (Coleoptera: Coccinellidae), both an efficient natural enemy of herbivores and an invasive species with a worldwide distribution, shows a multitude of elytral patterns and strong environmental adaptability. Some studies have documented differences of ecological adaptability among *H. axyridis* morphotypes, but none compared their predatory performance under differing environmental conditions, to further understand the evolutionary significance of elytral pattern diversity. We evaluated predation (number of prey consumed per time unit) on three different herbivores by malonic/succinic and male/female adults of *H. axyridis*, under different temperatures (10, 15, 20, 25, 30, 35°C) and photoperiods (4:20, 8:16, 12:12, 16:8, 20:4). We found significant differences in prey consumed by the predator between gender and polymorphic types, including under comparable environment parameters. Furthermore, there were also significant differences in predation when temperature and photoperiod regimes varied.

Results: Hinted a high plasticity in prey consumption relative to polymorphic type and gender in *H. axyridis*. These findings could be informative for developing further biological control programs relying on *H. axyridis*, notably for optimizing the effectiveness of predator releases according to polymorph to be used and environment targeted.

SPP-IPM-126

Molecular unpinning the resistance to extreme temperatures by undergoing thermal hardening at nonlethal temperatures in *Bactrocera* spp

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ABSTRACT

Background: Many insects have the capacity to increase their resistance to extreme temperatures by undergoing thermal hardening at nonlethal temperatures. Although this response is well established, its molecular underpinnings have only been investigated in a few species where it seems to relate at least partly to the expression of heat shock protein (Hsp) genes. Here, we studied the mechanism of hardening and associated transcriptional responses in larvae of two invasive fruit fly species in China, *Bactrocera dorsalis* and *Bactrocera correcta*.

Results: The result of heat hardening in both species showed heat hardening under 34-40°C led to the hardening response which could increase their resistance to extreme high temperature. Based on the survival rate, *B. dorsalis* performed better than *B. correcta* and 38°C with the highest survival rate, while *B. correcta* reached the highest survival rate at 35°C. About cold hardening, both species responded to the hardening treatments from 5 to 15°C. For *B. dorsalis*, temperatures above 9°C can further enhance cold resistance. *B. correcta* larvae hardened at temperatures above 5°C can significantly enhance the cold resistance and maintain a relatively constant level of cold resistance in the subsequent temperature treatment. 5°C shows a significant increase in survival rate starting point. The transcriptional analyses on thermal hardening, which highlighted expression changes in a number of genes representing different biochemical pathways, but these changes and pathways were inconsistent between the two species. Overall *B. dorsalis* showed

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expression changes in more genes than *B. correcta*. We found that Hsps were the largest family responding to stress among all the DEGs in these two species with the highest levels of expression, especially Hsp23 on heat hardening. The different patterns of gene expression in these two species at different hardening temperatures highlight the diverse mechanisms underlying hardening even in closely related species.

Conclusions: This study provides a starting point for understanding the genomic basis of climate adaptation in invasive fruit flies and the functional studies in particular need to be expanded to other gene families. Eventually, these types of studies may indicate targets for genetic manipulation to eventually control these pests.

Key words: expression plasticity, hardening response, Hsps, invasive species, thermal adaptation

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Toxicology of diatomaceous earth, phyto oils and their nano-emulsions against adults of *Tribolium castaneum* (Herbst)

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ABSTRACT

Background: Synthetic insecticides are a major threat to human health, environment and the ecosystem. The development of some smart tools is needed to minimize the use of hazardous chemicals. Being an alternate, development of nano-biopesticides is on its way. Nano-emulsions are expressed as sustained release of insecticidal components to achieve maximum efficacy and low residual toxicity.

Methods: This study explains the development of nano-emulsions using some plant essential oils (*Cymbopogon citratus* (DC.) Stapf, *Ocimum basilicum* L., *Curcuma longa* L., and *Trachyspermum ammi* L.), diatomaceous earth (DE), and their nano-emulsions against *Tribolium castaneum*. The above-mentioned oils were chosen for two attributes: striking pesticidal activity and safe for food commodities.

Results: Essential oils and DE were tested at four (100%, 50%, 25%, and 12.5%) concentrations with and without nano-emulsions and data was recorded at 6, 12, 24, 48 and 72 hours intervals, respectively. The mortality observed in essential oils of *C. citratus*, *O. basilicum*, and *C. longa* without nano emulsion after 72 hours of treatment at highest concentration was 98%, 95% and 85%. While DE and *T. ammi* caused 65% mortality of *T. castaneum* after 72 hours at 100% concentration. Insecticidal activity of nano-emulsioned essential oils increased to 100%, 98%, 90%, and 68.3% for *C. longa*, *C. citratus*, *O. basilicum*, and *T. ammi*, respectively.

Conclusions: The results support that these nano emulsions could be used as an alternative to synthetic insecticides in conventional formulations.

Keywords: Emulsions, Commodities, Diatomaceous earth, *Tribolium castaneum*

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Biocidal activities of plants collected from salt range of Pakistan against the subterranean termites: A potential organic wood preservative against termites

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ABSTRACT

Background: Bio-pesticides are emerging as eco-friendly control practices against many insect pests. Undoubtedly, the use of synthetic insecticides has increased the farmer's production and improved their monetary benefits, but they are very hazardous to man and animals. Termite is a notorious pest of crops, timber and trees. The current study was aimed at identifying plants present in the Salt Range of Pakistan and determining their toxicity against subterranean termites (*Odontotermes* spp.).

Methods: The plants were collected from the Soone Valley, Punjab. After identification, plant extracts were prepared using soxhlet apparatus followed by rotary evaporation. The extracts were used for screening bioassays to determine the most potent plant under laboratory conditions. Toxicity bioassays were performed by using the most potent plants to determine their LT_{50} and LC_{50} .

Results: Our results showed that out of 40 plants, 7 plant extracts exhibited more than 50% mortality against termites. The highest mortality caused by the plant extract of *S. officinalis* with LC_{50} of 7.12% after 72 hours followed by *M. longifolia*, *M. arenaria*, *P. aphylla*, and *R. smithii*, *S. asper* and *N. indicum*.

Conclusion: The presence of alkaloids, diterpenes, flavonoids, polyphenols, saponins, triterpenic acids were considered as toxicity markers against termites. These plants have potential to control the termites, hence, recommended for non-chemical control of termite and as organic wood preservative.

Keywords: Termites; Alkaloids, Terpenoids, Secondary metabolites, Biopesticide, Termiticide

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Management of *Pectinophora gossypiella* resistance against Bt Cotton

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ABSTRACT

Backgrounds

Globally, *Pectinophora gossypiella* is a severe threat to both non-transgenic and transgenic cotton. It causes losses of one million bales per year. Due to the attack of this pest and some sucking pests, Bt cotton production decreased by 6.9% in 2020 as compared to 2019 in Pakistan. In China and USA, *P. gossypiella* has evolved resistance in laboratory tested progeny while in India, *P. gossypiella* has developed resistance in field. There is dire need for *P. gossypiella* resistance management in Bt cotton for better yield of cotton in Pakistan.

Materials: The present study was designed with the aim to evaluate the best management strategy either by introduction of refuge or gene pyramid for control the *P. gossypiella*. To fulfil the objectives different single, double and triple gene Bt cotton varieties were sown in field in MNS University of Agriculture Multan. Non Bt cotton (20% refuge) was also sown in

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different layouts (such as rows, block, border, and seed mixes). Infestation of *P. gossypiella*, was observed on all research trials after one-month interval and over all yield of all experimental plots were also recorded.

Results: The results showed that infestation of *P. gossypiella* was recorded on all cultivated single, double, and triple gene Bt cotton varieties along with refuge of non Bt sown in defined pattern. The infestation of *P. gossypiella* was recorded less on Bt cotton as compared to non Bt cotton. Seed mix strategy found effective for cultivation of refuge among all tested layout followed by rows, block and border.

Conclusions: Outbreak of *P. gossypiella* found all single double and triple gene Bt Cotton varieties. Refuge strategy should be adopted as it counters the evaluation of Bt resistance in *P. gossypiella* as well as lower costs of insecticides.

Keywords: Bt cotton, Gene Pyramid, Insect Resistance Management, *Pectinophora gossypiella*, Refuge Strategy.

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Bio-Efficacy of some acaricides for controlling red spider mite, *Tetranychus Urticae* Koch (Acari: Tetranychidae) on Eggplant

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ABSTRACT

Background: Brinjal (*Solanum melongena* L. Solanaceous) commonly known as eggplant, is an important vegetable crop grown in the tropical and subtropical areas. It is vulnerable to several pests, and recently red spider mite (*Tetranychus urticae* Koch) has emerged as a major pest causing great economic loss annually. Traditional acaricides have not provided sufficient control in fields, so selections of newer acaricides are essential for the management of mites.

Methods: The research was conducted in the farmer's field in a Randomized Complete Block Design (RCBD) with five acaricides viz., Azocyclotone, Fenpyroximate, Diafenthiuron, Hexythiazon and Abamectin along with control at Multan in 2019. Two sprays were done at 15 days intervals with a knapsack sprayer after calibration. The data was recorded before spray and then after 3, 5 and 7 days of spray application, respectively. Six plants were randomly selected, and data were observed from upper, middle and lower leaf from each plant using magnifying glass.

Results: Among the tested acaricides, Hexythiazon showed the highest percent mortality of mites i.e. 41.42 %, 55.56 % and 37.90 % after first spray at 3, 5 and 7 days, respectively. After the second spray, 15 days interval Hexythiazon also gave the best result and recorded mites mortality were 41.65 %, 39.33 % and 16.40 % at 3, 5 and 7 days, respectively.

Conclusions: All the tested acaricides gave more or less satisfactory percent reduction of mite population but maximum mortality was recorded by Hexythiazon. Hence, therefore, application of Hexythiazon can be used as an effective chemical tool for the control of mites.

Keywords: Acaricides, Hexythiazon, Subtropical Pests

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Effect of imidacloprid on the life history traits of *Dysdercus koenigii* (Hemiptera: Pyrrhocoridae)

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ABSTRACT

Background: *Dysdercus koenigii* Fabricius (Hemiptera: Pyrrhocoridae) is a sucking pest of cotton and commonly known as cotton stainer. Both nymphs and adults feed on seeds of developing cotton bolls, leaving a stain on lint. It is supposed that the major cause of cotton staining is *D. koenigii* and insecticides are common practice for controlling this notorious pest.

Methods: The current experiment was planned to estimate the life history changes of *D. koenigii* after treatment with imidacloprid. Adults and nymphs of cotton strainer collected from *Gossypium hirsutum* fields were placed in plastic cages under controlled conditions along with moist fuzzy cotton seeds for feeding. Seed dip bioassay was performed on fifth nymphal instars of this notorious pest with imidacloprid under laboratory conditions and survival data was recorded on a daily basis. Eggs were kept at 29 °C in Petri dishes until hatching.

Results: The results revealed that increasing levels of imidacloprid decreased the fecundity, longevity and hatching in the selected population as compared to the control population.

Conclusion: The study disclosed the potent ability of imidacloprid for the better management of *D. koenigii*.

Keywords: *Dysdercus koenigii*, Imidacloprid, Cotton, Development, Cotton strainer, Red Cotton Bug

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Toxicity of biosynthesized silver nanoparticles (AgNPs), bio-insecticide (*Bacillus thuringiensis*) and commercial insecticide Triazophos against *Pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae)

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ABSTRACT

Background: Pink bollworm, *Pectinophora gossypiella* is an important pest of cotton worldwide. Traditional management measures used by farmers are proved worthless to effectively combat this notorious insect pest.

Methods: This study was conducted on finding an effective alternative to conventional insecticides and to evaluate the efficacy of some non-conventional pest control agents i.e. silver nanoparticles (AgNPs), bio-formulation (*Bacillus thuringiensis*) and a commercial insecticide (Triazophos) under laboratory and field conditions. Biosynthesis of AgNPs was carried out through the chemical action of aqueous leaf extract of Neem plant (*Azadirachta indica*). Synthesized AgNPs were characterized by UV-visible spectroscopy, Fourier transform infrared (FTIR) spectroscopy and zeta sizer analyzer and confirmed the formation of silver nanoparticles. Single and combined applications of AgNPs, Bt and Triazophos were evaluated against 2nd and 4th instar larvae of pink bollworm in laboratory conditions and mortality rate was recorded at different time intervals i.e., 1d, 2d and 5d.

Results: Results indicate that treatment AgNPs+Triazophos (40ppm+50ppm) exhibited > 90% larval mortality as compared to other treatments. Under field conditions, treatment triazophos +AgNPs 40ppm (500ml + 100ml) was the highest effective treatment as compared to others.

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Conclusions: It was evident from the results that nanoparticles are efficient larvicidal agents for *P. gossypiella* control.

Keywords: Larvicidal, Conventional insecticides, Commercial Insecticides

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Management of red palm weevil *Rhynchophorus Ferrugineus* by using attract and kill approach

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ABSTRACT

Background: The date palm (*Phoenix dactylifera* L.) belongs to family Arecaceae. It is considered a sign of life in deserts; because as compared to other fruit crops it stands in extreme temperatures and survives in drought and salinity conditions. The Red Palm Weevil *Rhynchophorus ferrugineus* is a notorious insect pest of date palm (*Phoenix dactylifera* L.). The *R. ferrugineus* generally referred as concealed tissues borer; complete its life cycle inside the palm tree Different pesticides are widely used for the management of RPW.

Methods: Attract and kill approach used effectively throughout the world for the management of red palm weevil. The traps are set in plastic buckets of size 20 L and 26, 20 cm diameter at top and bottom, respectively. Each bucket trap had four equidistant rectangular (3 x 7 cm) openings to allow the entrance of *R. ferrugineus*. Red palm weevil aggregation pheromone [(Tripheron)] will be attached to the top of the bucket with the help of a wire. Talstar (Bifenthrin) @ 5 ml mixed in 5 L of water was placed in the trap for the killing of attracted weevils. One trap was baited with pheromone and fungus, one trap was baited with pheromone and pesticides, one trap was baited with pheromone, entomopathogenic fungus and pesticides. One trap was used as control. The traps were buried near to the base of a date palm tree to protect the traps from extreme heat for their continuous and long-term efficacy against the weevils. Data was recorded on a weekly basis.

Results: The trap was baited with insecticide (Bifen+Tripheron) captured more weevil (1.89±0.03) as compared to other treatments. Minimum weevil's population was captured (0.97±0.16) in traps baited with only pheromone Tripheron.

Conclusions: The result of the study indicated that the attract and kill approach can be used for the management of red palm weevil.

Keywords: Date palm; Entomopathogenic Fungus; Attract and kill approach

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Identification, farmer perception survey regarding fruit borer of mango

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ABSTRACT

Background: Mango fruit and shoot borers have become a major insect pest of mango in mango growing areas of Southern Punjab.

Methods: The present study was designed to know the perception of farmers regarding mango fruit borer, it's identification, damage symptoms and its biology on different diets for suitability of host plants. Survey was carried out in district Multan.

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Results: The results revealed that majority of farmers cultivated mixed varieties with major share of Dosehri, Anwar Ratul, Langra, Chaunsa and Sindhri. About 89 % mango growers know about the pest while only 11% don't know about it. Majority farmers were of the view that it's attack had recently emerged, one year (44 %), 2 years (48%) i.e., 2017-2018, 7% replied it started from the last 3 years and only 2% replied from the last 4 years. The most damaging stage was flowering (22%), fruit setting (48%), fruit maturity (89%) whereas most affected part of the plant was fruits (93%), shoots (89%), flowers (16%), and leaves (12%). About 90 % farmers agreed its damage appeared in April to August while few believe it appeared in March (16%). The preferred method of MFB control was chemical control (47 %), cultural control (36%), and physical control (10%). Among most used chemicals are bifenthrin (30%), Emamectin benzoate (23 %), others (9 %) while don't know the chemical name (38 %). According to farmers perception MFB attack observed more on Sindhri (98%), Summer Bahisht Chaunsa (89%), Dosehri (89%) and Anwar Ratul (79%). Damage pattern of MFB in the field scattered (59%), field margins (24%) and certain varieties (61%). Infestation percentage, 78% farmers (1-25%), 21 % farmers believe that it will damage almost 26-50 % in 2018. Samples of mango fruit borer were collected from mango orchards of Multan and identified on the basis of morphological traits which confirmed that it was *Citripestis eutrapphera* (Meyrick) 1933 (Lepidoptera: Pyralidae).

Conclusion: It is concluded that it could successfully survive on fresh mango leaves during February-April, then on mango fruits and phalsa during May to September, in South Punjab. It completed its life cycle in 40 to 42.5 days on mango and phalsa fruit. Percentage of survival was 60-70 % on mango and phalsa fruits. Timely management of this insect pest employing different techniques like using light traps, egg parasitoids like *Trichogramma chilonis*, larval predators like *Rhychium attrisimum* chemical insecticides, clean cultivation and bagging of fruits are recommended for better management of this insect pest.

Keywords: farmer perception, varieties, survival rate, mango fruit borer

SPP-IPM-135

Survival potential of pink bollworm, *Pectinophora gossypiella* (Saunders) on Bt cotton in Southern Punjab

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ABSTRACT

Background: Cotton (*Gossypium hirsutum* L.) cultivated as oil seed crop after soybean worldwide. Pink bollworm (PBW), *Pectinophora gossypiella* (Saunders) is a major cotton pest responsible for yield loss and decline of lint quality. Gradually pink bollworm developed resistance against Cry1Ac.

Methods: Different districts of Southern Punjab like Multan, Khanewal, Lodhran, Vehari, Bhawalnagar, Bahawalpur, Layyah, Rahim Yar Khan and Rajanpur were surveyed. Fifty bolls were collected randomly from one acre per farmer field (2 bolls/plant). These bolls were dissected after five days for PBW infestation. In second experiment, survival potential of PBW in cotton bolls of cultivars of Bt Cotton expressing Cry1Ac, named IUB-2013, MNH-886, MNH-996, GEMB-33, BS-15 and SS-32 and non Bt, Cyto-124 through boll assay using plastic cups under laboratory conditions. First instar larvae of PBW were released on cotton bolls. Bolls were dissected after two weeks inoculation. Entry holes and live larvae of pink bollworm were observed by dissecting bolls. Survival percentages of PBW larvae were calculated.

Results: Maximum green bolls infestation of PBW in Sept.-October were recorded in samples collected from District, Lodhran, (80%) followed by Multan (75%), Vehari (73%), Khanewal (69%), Bhawalnagar (65%), Bahawalpur (63%), Layyah (68%), Rajanpur (62%) and District, Rahim Yar Khan (47%) respectively. Boll assay results revealed that

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maximum survival recorded on MNH-996 (60%), followed by MNH-886 (56%), Lalazar (54%), CEMB-33 (54%), BS-15 (48%), SS-32 (43%) and IUB-2013 (35%) whereas in non-*Bt* there was 89% survival of pink bollworm.

Conclusion: Pink bollworm has strong potential to survive on *Bt* cotton expressing Cry1Ac. It is also recommended to allow transgenic varieties with double gene expression i.e., Cry1Ac and Cry2Ab to overcome the resistance of Cry1Ac in pink bollworm. It is recommended to manage this insect pest by using integrated approaches like cultural control, mass trapping through pheromone traps, and installation of PB ropes, refuge strategy and chemical control at farmer fields.

Keywords: Cry1Ac, Bt Resistance, Infestation, Pink Bollworm, Survival potential

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Population dynamics of insect pests on genotypes and efficacy of insecticides on soybean

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ABSTRACT

Background: Soybean crop is of great importance having worldwide acceptability with economic benefits. Its oil content is being used in various forms. However, the crop is attacked by a number of insect pests. These pests reduce the yield of the soybean crop.

Methods: Research trials were conducted at the research farm of MNS-University of Agriculture, Multan. Ten genotypes were sown in RCBD with three replications. Data of insect pests were taken for the whole season. Efficacy of insecticides against whitefly, soybean grasshopper and armyworm were evaluated. These treatments were applied when the population of pests was reached at ETL level. Each insecticide was applied two times on the same plot after fifteen days of interval. Data were recorded before treatment, 3 days and 7 days after treatment.

Results: NARC-2 is a relatively tolerant genotype against whitefly, soybean grasshopper, armyworm followed by other varieties Ajmeri, 205/3, 203/2, 204/1, 301, 111, 283, Dawson and wilkin. Among insecticides, Pyriproxyfen @ 500 g was the most effective insecticide against whitefly (1.6 / leaf) upto 7 days followed by Ulala (flonicamid) @ 80 g (2.15 / leaf). Buprofezin @ 500 g (3.19 / leaf). Lufenuron and Emamectin benzoate @ 200 ml / acre each found effective against armyworm on soybean crop. Jaggery + chlorpyrifos was the most effective against soybean grasshopper, whereas wheat bran + chlorpyrifos and jaggery + Bifenthrin were equally toxic respectively as compared to control (untreated plot).

Conclusion: Genotype NARC-2 showed tolerance against whitefly, grasshopper and armyworm than other varieties. Toxicity of insecticides against whitefly were in the order of Pyriproxyfen > Buprofezin > Ulala (flonicamid) on soybean. Lufenuron and Emamectin benzoate @ 200 ml / acre each found effective against armyworm on soybean crop. Jaggery + chlorpyrifos > wheat bran + chlorpyrifos and jaggery + bifenthrin were equally toxic against soybean grasshoppers.

Key Words: Soybean, Insect Pests, whitefly, Armyworm, grasshopper Varietal resistance, insecticides

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Evaluation of novel insecticides against *Spodoptera exigua* H. (Lepidoptera: Noctuidae) in alfalfa seed crop

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ABSTRACT

Background: *Spodoptera exigua* is an important insect pest of several vegetables, cash crops and fruits.

Methods: A field experiment was conducted to evaluate the efficacy of eight new chemistry insecticides viz; Radiant (spinetoram), Coragen (chlorantraniliprole) Marshal (lufenuron), Runner (methoxyfenozide), Emamectin (emamectin benzoate), Belt (flubendiamide) steward (indoxacarb) and Talstar (bifenthrin) against an active infestation of army worm *S. exigua* (Hübner) larvae on Lucerne (alfalfa) seed crop at the Fodder Research Institute, Sargodha during three consecutive years of Rabi 2015-16 to 2017-18. The data was recorded before the treatment and then 3, 6, 9 and 12 days after treatment. Percent mortality was 92% for belt; 91% for coragen; and 88% for lufenuron at 3 days of post treatment.

Results: Percent mortality was 95% for lufenuron, 94% for belt, and 92% for coragen at 6 days of post treatment. Percent mortality was 84% for lufenuron and 82% mortality for belt at 9 days of post treatment.

Conclusions: It is concluded that lufenuron, belt and coragen are suggested to be sprayed on alfalfa seed crops against armyworm for better management.

Key words: Insecticides, alfalfa, *spodoptera exigua*

SPP-IPM-138

Efficacy of various levels of salicylic acid treatments on growth of canola plants and its impact on canola-aphid (*Lipaphis erysimi*)

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ABSTRACT

Background: The study was designed to determine the impact of salicylic acid on the growth and yield of canola crop and its pest *Lipaphis erysimi*.

Methods: For this, an experiment was designed in the field condition of BZU Bahadur Sub Campus Layyah, College of Agriculture. The canola seed was sown in rows by adopting Randomized Complete Block Design (RCBD) with 7 treatments including one control treatment viz., 0 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm, 300 ppm, and 400 ppm in three replications. The length of a row was 6 feet, with row-row distance 40 cm and plant-plant distance 5 cm. Each block was separated from the other block with 60 cm path.

Results: Result indicated that, the maximum plant height (210.45 cm) was observed with the application of the high concentration of the SA (400 ppm). The maximum numbers of the pods per plant (575) and number of seeds per pod was (31.65) were calculated with the application of 300 ppm of salicylic acid. The considerable increase in the thousand seed weight (3.75 g), biological yield (23715.5 kg -1), and seed yield (3660.4 kg⁻¹) was observed with the application of 400 ppm SA. The harvest index of the canola plants increased up to

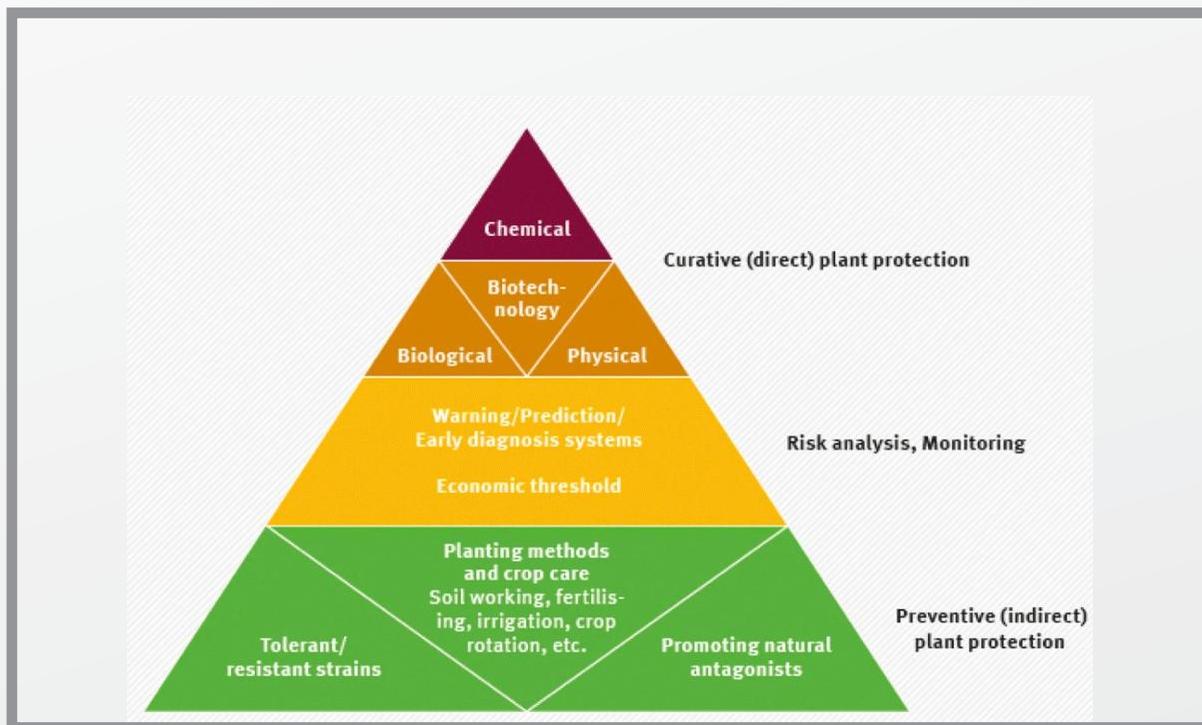
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(19.6) with the foliar application of 250 ppm SA as compared to the control. The foliar application of SA treatments increased the mortality rate of the 1st, 2nd and 3rd nymphal instar considerably. The highest mortality of 1st, 2nd and 3rd nymphal instar were observed 43.65%, 68.4% and 79.39% respectively with the application of 400ppm SA as compared with 0 ppm SA application. The highest honey drops of the aphid per plant was 58.77%, while nymph survival was 71.2% and reproductive period of the aphid 24.5% were recorded of the control treatment. Whereas, with the foliar application of 400 ppm SA concentration, the minimum honey drops 15.9%, nymph survival 61.5% and reproductive period 16.5% were observed.

Conclusions: It was concluded that the exogenous application of salicylic acid has effective results on canola plants and also better effect on the biology of canola-aphid.

Key words: canola, mortality, foliar application.



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Efficacy of different synthetic insecticides against *Phenacoccus solenopsis* under laboratory conditions

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ABSTRACT

Background: Cotton *Gossipium hirsutum* (L.) is the golden cash crop of Pakistan. It contributes significantly to Pakistan's economy. Cotton is attacked by numerous sucking and chewing pest from sprouting to picking stage. Cotton mealybug, *Phenacoccus solenopsis* Tinsley is a destructive pest of cotton. It is a polyphagous pest that attack on cotton, fruits, vegetables and ornamental plants. The farming community feels difficulty to manage the pest.

Material and Methods: Current trial was designed to test the efficacy of different synthetic insecticides, i.e. (profenofos, chloropyrifos, pyriproxyfen, imidacloprid and lambda cyhalothrin) at recommended dose under the laboratory condition.

Results: Among all tested insecticides at recommended dose, imidacloprid remain first in performance causing (88%) mortality of the pest which was statistically in accordance with profenofos resulting (86.6%) mortality of the pest. While chloropyrifos remain second in their effectiveness causing (71.66%) mortality followed by pyriproxyfen which resulted (56.6%) mortality of the pest. While minimum mortality (46.6%) was recorded by lambda cyhalothrin after 72 hrs of exposure period.

Conclusion: It was concluded from the results that pest mortality increased with the increase in the exposure time to pesticides.

Key words: insecticides, mortality, cotton

SPP-IPM-140

Effectiveness of different plant extracts against early instar of *Phenacoccus solenopsis* under laboratory conditions

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ABSTRACT

Background: Pakistan is an agricultural country. Its economy is based on different agricultural cash crops. Cotton *Gossipium hirsutum*(L.) is a cash crop of Pakistan. It provides numerous raw materials to different agro- based industries. Cotton is attacked by several sucking and chewing pest from sprouting to picking stage. Among sucking pests, cotton mealybug, *Phenacoccus solenopsis* Tinsley is a dangerous pest of cotton. It is polyphagous in nature and attack on cotton, horticultural crops and ornamental plants. The farming community feels difficulty to tackle the pest.

Methods: A research experiment was conducted under laboratory condition to test the effectiveness of different plant extracts against early instar of *Phenacoccus solenopsis*. Different biopesticides such as Neem (*Azadirachta indica*), Bakain (*Melia azdarach*), Tobacco (*Nicotina tabacum*), Tumha (*Citrullus colocynthis*) and sufaida (*Eucalyptus*) were tested at three different concentrations (1, 3 and 5%) for the management of early instar of P. solenopsis.

Results: Among all the five tested plant extracts at three different concentrations (1%, 3% & 5%) against the second nymphal instar of mealybug, Neem and tobacco extract at 5% concentration caused (90%) mortality of the pest after one week of exposure time, while sufaida extract was found to be least effective against the pest under laboratory conditions.

Conclusions: All the plant extracts cause mortality of the pest at all the tested concentrations after different exposure time. An increase in the pest mortality was observed with the increase in the exposure period and concentration of plant extract.

THEME-1:

INSECT PEST MANAGEMENT

Key words: polyphagous, plant extract, mortality

SPP-IPM-141

Prevalence of aphids (Hemiptera: Aphididae) at various growth stages of wheat

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ABSTRACT

Background: Wheat plants undergo different growth stages and are vulnerable to sap-sucking aphids (*Rhopalosiphum padi*, *Schizaphis graminum* and *Sitobion avenae*) that cause huge yield reduction.

Methods: The aphid infestation began from the seedling stage and its population increases gradually as plant progressed to tillering, stem elongation, heading, dough and ripening stages.

Results: The most susceptible growth stage is heading having 21.89 aphids/tiller followed by stem elongation (14.89 aphids/tiller) and dough stages (13.56 aphids/tiller). Punjab-2011 showed performed best in comparison with Faisalabad-2008, Sahar-2006, Lasani-2008 and Shafaq-2006. *Rhopalosiphum padi* appeared early in mid-February, whereas *S. graminum* and *S. avenae* appeared late in the first week of March. Furthermore, significant differences were found in losses for grains/spike and 1000 grain weight among six cultivated wheat varieties. Among seed dressers, Hicap @ 100 gm/acre was proved to be the best followed by Hombre @ 100 ml/acre and Husk @ 100 ml/acre, while Tumba and Moringa plant extracts exhibited greatest efficacy in this class of insecticides. The seed dressers are more efficacious because they inhibit the aphid colonies established on wheat plants.

Conclusion: Seed dressers including Hicap and Hombre can be used as an ideal ecofriendly component in the integrated wheat aphid management.

Key words: yield, aphid, seedlings, infestation

SPP-IPM-142

Effect of sublethal dose of Lufenuron on the biology of *Spodoptera litura*

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ABSTRACT

Background: Armyworm (*Spodoptera litura*) caused substantial loss to different crop due its polyphagous nature.

Methods: Lufenuron act as chitin synthesis inhibitor, proved effective at lethal dose, comprised of fifty percent mortality at 608.2 ppm. The sublethal doses including LC₁₀ (228.1 ppm), LC₁₅ (182.36 ppm) and LC₂₀ (136.6 ppm) applied to *S. litura* through leaf dip and topical application method.

Results: The findings indicated that after administration of treatment, the duration of life stages including, larval, prepupal, pupal, male adult has been increased gradually and consistently. While female longevity and fecundity reduced.

Conclusion: It was also observed that topical application method was fast-acting and potent than leaf dip application method. The data also revealed that oviposition duration and capacity has been decreased consistently from LC₁₀ to LC₂₀ and leaf dip treatment to topical application treatment.

Key words: chitin, fecundity, polyphagous.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-142

Efficiency of pheromonal traps against *Bactrocera* species (Tephritidae: Diptera) in mango orchards at district Multan

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ABSTRACT

Background: Mangoes are cultivated in a large area of Pakistan and is the 5th largest producer of mango in the world as well as it is our national fruit. Fruit flies have wide distribution, rapid propagation, and polyphagous behavior which attack on all type of fruits and vegetables.

Methods: Pheromonal traps were provided from the Department of Entomology, University of Agriculture, Faisalabad. Pheromonal traps were used at three heights (ground level, 1m and 2m). At every height one, two and three traps were hung and, in each trap, 2ml, 4ml and 6ml of methyl eugenol used as treatments with three replications. Factorial design was used in experiment and two factors were studied one was dose of methyl eugenol and other height of traps.

Results: All the results were highly significant. In one trap application in an acre maximum average number (98.67) *Bactrocera* species were collected at trap height of 2m with 6ml of methyl eugenol after one day of application of trap and minimum means number (15) collected after 10 days of application of treatments at ground level (GL) with 2ml of methyl eugenol. In two traps application in an acre maximum means number (128.33) *Bactrocera* species at 2m traps height with 6ml of methyl eugenol one day after application of traps and minimum means number (73.33) *Bactrocera* species were collected at ground level (GL) with 2ml of methyl eugenol after 10 days of traps application. In three traps maximum means number (153.3) *Bactrocera* species were collected at 2m of traps height with 6ml of methyl eugenol 3 days after installation of traps and minimum means number (25.33) *Bactrocera* species collected at ground level (GL) with 2ml of methyl eugenol 10 days after installation of traps. Overall maximum means number (153.33) *Bactrocera* species were collected at 2m of traps height with 6ml of methyl eugenol 3 days after hanging of three traps while minimum means number 15 *Bactrocera* species collected after 10 days at ground level when 2ml of methyl eugenol was used in one trap.

Conclusion: This study has a significant importance of fruit fly in field condition and reduced the damage of fruits caused by fruit flies.

Key words: Fruit fly, Pheromone, Mango

SPP-IPM-143

***Chrysoperla carnea* (Neuroptera: Chrysopidae) as a potential biocontrol agent of *Diaphorina citri* based on age-stage, two-sex life table**

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ABSTRACT

Background: Green lacewing *Chrysoperla carnea* Stephen (Neuroptera: Chrysopidae) is a biological control agent which feeds on different insect pests like aphid, white fly, thrips and citrus psylla *Diaphorina citri* Kuwayama (Liviidae: Hemiptera).

THEME-1:

INSECT PEST MANAGEMENT

Methods: The life table parameter and predations of *C. carnea* on *D. citri* was evaluated under laboratory condition at $26 \pm 2^\circ\text{C}$, $60 \pm 5\%$ RH and L12: D12 h.

Results: The larval (first, second, and third) instar of *C. carnea* consumed (22.1, 47.5, and 119.2, respectively), *D. citri*. The developmental duration of egg, larva, pupa, male, and female (2 ± 0.04 , 9.00, 7.67 ± 0.08 , $18 \pm .72$, 32 ± 0.46 days, respectively) of *C. carnea* was observed when fed on *D. citri*. The life parameters of *C. carnea* like fecundity (204.95 eggs), intrinsic rate of increase (0.152d⁻¹), finite rate of increase (1.16 d⁻¹), net reproductive (90.18 d⁻¹), and mean generation time (29.68 days) was observed when fed on *D. citri*.

Conclusion: The results showed that *C. carnea* can complete development and life cycle on *D. citri* successfully. For the conservation of *C. carnea*, *D. citri* can be used as an alternate prey. In this way, in off seasons *C. carnea* can be conserved effectively. Moreover, *C. carnea* can effectively be used for the management of *D. citri* in citrus.

Key words: Fecundity, Biocontrol agent, management

SPP-IPM-144

Impact of semiochemicals on the tritrophic interaction of *Chrysoperla Carnea* (Neuroptera: Chrysopidae), *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae), and cotton plant

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ABSTRACT

Background: Green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is an important predator of cotton mealybug, *Phenacoccus solenopsis* (Tinsley) (Hemiptera: Pseudococcidae). Response of predator towards damaged plants by its prey is very crucial. So far, no studies have been done to check the tri-trophic interaction i.e., cotton-cotton mealybug-green lacewing. There is need to confirm the role of volatiles in the attraction of *C. carnea* toward plant and herbivore.

Methods: Four arm olfactometer was used to assess the role of volatiles released by plants in response of herbivore damage. Different plant parts (new leaves, old leaves, flower, boll, and fuzzy seed) were used to check the response of *C. carnea* on plant and herbivore. These plant parts (undamaged and damaged by mealy bug) were used in different combinations in olfactometer. In all bioassays, odor source was compared with combination, individual plant part and with control.

Results: When un-infested plant parts were given, the highest response was observed towards new leaves and old leaves, followed by flower and boll. While, when damaged plant parts were given the maximum attraction was observed towards flower and new leaves. Whereas minimum response was noted on fuzzy seed.

Conclusion: These findings recommended that, during host finding green lacewing use volatiles released by plants in response of herbivore feeding. Future work should consist of the identification of plant volatiles induced by mealy bug feeding and pheromones of mealy bug.

Keywords: predator, bioassay, plant volatiles.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-145

Mediation of tritrophic interactions by herbivore-induced plant volatiles and their potential application against *Diaphorina citri* (Hemiptera: Aphalaridae)

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ABSTRACT

Background: The role of different prey and host plant semiochemicals in the management of vegetable and cereal crop pests was studied. Previously few studies have been performed to understand the impact of semiochemicals in the management of fruit crops. *Diaphorina citri* is a major pest of citrus fruit and also a vector of citrus greening disease. For the management of *D. citri*, mostly chemicals are used which have side effects i.e., environmental pollution, public health issues, resistance in pest. That is why for healthier and residual free citrus fruits there is a need to evaluate the role of semiochemicals as safer methods of control of *D. citri* in citrus orchards.

Methods: A study was performed to check the effect of plant volatiles on the tritrophic interaction i.e., plant-prey-predator. In the present study the role of volatiles of different *Citrus reticulata* (Blanco) parts, prey, and combination of different plant parts with prey was investigated. Moreover, the response of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) larva to these volatiles was also studied. Different plant parts (fresh leaves, old leaves, orange peel, and orange fruit) with and without *Diaphorina citri* (Kuwayama) (Hemiptera: Aphalaridae) were used as a treatment. The response of *C. carnea* larva was assessed in four arm olfactometer under laboratory conditions ($25 \pm 2^\circ\text{C}$ and $65 \pm 5\%$ RH).

Results: Results showed that *C. carnea* discriminated between the volatiles of plant parts and citrus psylla. In all tested combinations (I-V) both in absence and presence of citrus psylla, all three (1st, 2nd, and 3rd) larval instar of *C. carnea* preferred the volatiles of fresh leaves and old leaves over other plant parts. Further, olfactory results showed that all three instars of predator significantly preferred the area having volatile of citrus psylla. In this tritrophic interaction, volatiles of citrus plant parts and citrus psylla can play an important role in chemotaxis behaviour of *C. carnea*.

Conclusion: These volatiles can be used in the management of psylla in citrus orchards. Moreover, this tritrophic interaction could play a vital role in developing integrated pest management (IPM) strategies for the management of citrus psylla. There is a need to understand how volatiles of different plant parts complex can influence the response and tritrophic interaction of a predator.

Key words: citrus, resistance, tritrophic interaction.

SPP-IPM-146

Age-stage, two-sex life table of *Cheilomenes sexmaculata* (Coccinellidae: Coleoptera) on four different aphid species

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ABSTRACT

Background: The Zigzag ladybird beetle, *Cheilomenes sexmaculata* (Fabricius) (Coleoptera: Coccinellidae), is a biological control agent that feeds on a variety of aphid species.

Methods: Life table and predation data of *C. sexmaculata* were collected under laboratory conditions at $25 \pm 2^\circ\text{C}$,

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INSECT PEST MANAGEMENT

60±5% RH and L14: D10 h in connection with feeding on four different aphid species; *Lipaphis erysimi* (Kaltenbach), *Myzus persicae* (Sulzer), *Aphis nerii* (Boyer de Fonscolombe) and *Diuraphis noxia* (Mordvilko).

Results: Larval development of *C. sexmaculata* was long when fed on *M. persicae* (12.18 days) and shorter on *D. noxia* (10.64 days). The male's lifespan was longer on *M. persicae* (26.70 days) and shorter on *L. erysimi* (23.67 days). Fecundity was maximum when the beetle was fed *D. noxia* (316.8 eggs/female) and minimum on *M. persicae* (199.1 eggs/female). Net reproductive rate, intrinsic rate of increase and finite rate of increase were highest on *D. noxia* with values of 158.4 (offspring individual⁻¹), 0.22 d⁻¹, and 1.24 d⁻¹, respectively whereas the respective parameters were lowest on *L. erysimi* (99.5 offspring individual⁻¹, 0.19 d⁻¹, and 1.20 d⁻¹, respectively). However, the mean of the generation (T) was shorter on *A. nerii* (22.48 d⁻¹) and longer on *M. persicae* (24.68 d⁻¹). Based on life table parameters obtained under laboratory conditions, the most appropriate host of *C. sexmaculata* was *D. noxia*.

Conclusion: This study should help us to improve mass rearing and use of *C. sexmaculata* in the biological control of aphids on different crops.

Key words: biological control, rearing, reproductive rate.

SPP-IPM-147

Does the change in temperature in tropics have an influence on the biology of *Spodoptera litura* (Lepidoptera: Noctuidae) and its predator?

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ABSTRACT

Background: The ecological effect of climate change differs with different geographical locations of the world. In the tropics a small change in temperature is likely to have the serious effects on tropical insects as they are very sensitive to temperature fluctuations. The armyworm, *Spodoptera litura* (Fabricius) is a most dangerous and destructive pest of many crops in tropical regions of the world. It is a polyphagous pest and feeds on more than hundred different plant species.

Methods: Five different temperatures (15, 20, 25, 30, and 35 °C) were used to check the developmental duration, diet consumption, and reproduction. The results showed that the developmental duration of eggs, larvae, pupae, and adult longevity was decreased with the increase of temperature. Similarly, total developmental duration was highly affected and decreased with the increase of temperature. Likewise, total life span (egg to adult) of *S. litura* was 73.96, 30.1, 28.18, 19.68, and 14.32 days at 15, 20, 25, 30 and 35 °C, respectively. The maximum 95.45 % eggs hatching was recorded at 25°C.

Results: The predation results showed that the predation rate of *Chrysoperla carnea* (Stephens) increased with the increase in temperature from 15 to 35 °C. The maximum predation was recorded by third instar at 30 and 35 °C on eggs without hairs and first instar larvae of *S. litura*, respectively.

Conclusions: It can be concluded that the life history parameters of *S. litura* were highly effected and predation of *C. carnea* was also increased due to variation in temperature that could be used in Integrated Pest Management (IPM) strategies.

Key words: IPM, polyphagous, longevity, predation.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-148

Does the change in temperature in tropics have an influence on the biology of *Spodoptera litura* (Lepidoptera: Noctuidae) and its predator?

Muhammad Zakria¹, Muhammad Shah Zaib¹, Khalid Abbas¹, Syed Muhammad Zaka¹, Hafiz Muhammad Safeer¹, Aiman Ishfaq¹, Saqib Ali Siddiqui¹

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ABSTRACT

Background: The ecological effect of climate change differs with different geographical locations of the world. In tropics a small change in temperature is likely to have the serious effects on tropical insects as they are very sensitive to temperature fluctuations. The armyworm, *Spodoptera litura* (Fabricius) is a most dangerous and destructive pest of many crops in tropical regions of the world. It is a polyphagous pest and feeds on more than hundred different plant species.

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Conclusions: It can be concluded that the life history parameters of *S. litura* were highly affected and predation of *C. carnea* was also increased due to variation in temperature that could be used in Integrated Pest Management (IPM) strategies.

Keywords: temperature, ecology

SPP-IPM-149

Development of *Spodoptera frugiperda* (Lepidoptera: Noctuidae) on different host plants

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ABSTRACT

Background: Fall armyworm, *Spodoptera frugiperda*, is a major pest with high efficiency to cause serious damage on various crops.

Methods: The present study was designed to evaluate the developmental biology of *S. frugiperda* on castor bean (*Ricinus communis*) and Potato (*Solanum tuberosum*) host plants. The experiment was performed under the laboratory

THEME-1:

INSECT PEST MANAGEMENT

conditions 26 ± 2 °C and $65 \pm 5\%$ RH. Adults were fed with honey-water mixture.

Results: All developmental stages of *S. frugiperda* showed significantly different response when provided with two different hosts. The larvae and pupae of *S. frugiperda* exhibited less (13.5 and 8.5 days, respectively) developmental time on potato leaves as compared to castor bean leaves (15.5 and 10.5 days, respectively). Longevity of adults on potato and castor bean leaves was 16.5 and 13.5 days, respectively. The significantly maximum (2209 eggs) fecundity was recorded on potatoes as compared to castor bean (1602 eggs).

Conclusions: It is concluded that potato is a suitable host of *S. frugiperda* and can develop effectively on potato as compared to castor bean plant. So, it is recommended that effective control measures should be taken in potato field against *S. frugiperda*. Moreover, alternate host plant should be removed to prior control managing strategy. It can be used as a potential trap crop in the maize field.

Keywords: Potato, castor bean, biology, trap crop

SPP-IPM-150

Monitoring of insecticide resistance status in Asian citrus psyllid (Hemiptera: Psyllidae) populations using bottle bioassay

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ABSTRACT

Background: Around the globe, the Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae) is one of the most important citrus pests. The populations of *D. citri* are developing resistance towards different insecticides in Punjab, Pakistan. A quick technique elaborating early warnings and the need of growers to modify their chemical control planning is needed against this pest in Pakistan.

Methods: Therefore, the present study was conducted to identify the status of the insecticidal resistance of 10-insecticides in *D. citri* populations by using a bottle bioassay method. Every insecticide was tested from 5-15 concentrations.

Results: The highest resistance ratio was recorded in dimethoate (168 folds) in Rajanpur population followed by dinotefuran (96.13 folds) in Bahawalnagar population and bifenthrin (92.50 folds) in Multan population while lowest resistance was found against matrine (2.33 folds) in Bahawalnagar population. The LC_{50} values among all the tested insecticides showed significant positive correlations between nitenpyram and thiamethoxam, dinotefuran and matrine, fenpropathrin with both thiamethoxam and nitenpyram proposing the existence of cross-resistance. The results presented that Matrine is a newly entered chemical so, should be used with other management techniques to manage resistance issues in *D. citri* effectively. This research also presented that a bottle bioassay is better way for assaying resistance status in adults of *D. citri* under both the laboratory and field conditions.

Conclusion: It is a simple and rapid method of testing insecticide resistance in the probability of insecticide failure. This method may also allow trained professionals to monitor insecticide resistance rapidly commercial locations at *D. citri* population hot spots.

Key Words: Resistance, Metrine, LC_{50} , Cross resistance

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-151

Biological control of *Bactrocera zonata* (Diptera: Tephritidae), by the cues of *Messorhimal ayanus* (Hymenoptera: Formicidae) under lab conditions

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ABSTRACT

Background: Fruit Fly, *Bactrocera zonata* S. (Diptera: Tephritidae), is the most damaging specie of many fruit crops in Asian countries including Pakistan. It causes serious problems by attacking more than 40 species of horticultural crops.

Methods: The present study investigated predatory effect of ant *Messor himalayanus* F. (Hymenoptera: Formicidae), on fruit fly under laboratory conditions at $26 \pm 2^\circ\text{C}$ and $60 \pm 5\% \text{R.H.}$ Studies included number of landings, time spent and ovipositional rate of gravid fruit flies. Guava exposed to ant individuals for 24 hours in a plastic jar after than this guava exposed with gravid female fruit flies in cages.

Results: Our results indicated that the number of landings and the time spent by fruit flies on guava were significantly affected after exposure of ants as compared to control. Number of landings and the time spent decreased with the increases of ant numbers. The highest ovipositional rate of gravid females was observed on those guavas which are unexposed to the ants.

Conclusions: From these results, it isconcluded that *M. himalayanus* is considered as an effective biological control agent against *B. zonata*.

Key words: Biocontrol, guava, fruit fly, olfactometer, behavior

SPP-IPM-152

Effect of short-term cold temperature stress on developmental biology of *Antilochus coqueberti* (Hemiptera: Pyrrhocoridae)

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ABSTRACT

Background: *Pyrrhocorid Antilochus coqueberti* Fab. (Hemiptera: Pyrrhocoridae) is the specialist predator of *Dysdercus* spp. As the environmental conditions is changing throughout the world, there is need to work on the effects of different environmental conditions i.e, (temperature, humidity etc) on the insects.

Methods: In the present study, the developmental biology of *A. coqueberti* was examined by exposing all immature stages and adults to very low temperature. All the developmental stages of *A. coqueberti* were exposed to different temperatures i.e., (0°C to 12°C) for 3 hours and then shifted to normal laboratory conditions.

Results: The results showed that the developmental duration of *A. coqueberti* was significantly increased and survival rate was reduced with the decrease in temperature. Higher survival rate was observed in female than male. As the temperature decreases the mating percentage, fecundity rate and hatching percentage was also significantly decreased.

Conclusion: According to these results, we concluded that the short-term low temperature stress has significant impact on developmental duration, survival rate and reproduction of *A. coquebertii*.

Key words: Predator, environmental conditions, developmental stages, *Dysdercus* sp.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-153

Improved delivery system of *Beauveria bassiana* through development of foam formulations for managing *Bactrocera zonata*

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ABSTRACT

Background: *Bactrocera zonata* Saunders (Tephritidae: Diptera) is one of the biggest constraints for mango production in Pakistan. It deteriorates quality and quantity due to premature dropping. Yellow warning issued to Pakistan in 2013 due to Fruit fly in export shipments. The presence of maggots in the mangoes make it rejected and unfit for the consumption of human.

Methods: Present study aimed at the colour preference of *Bactrocera zonata*, evaluating pathogenicity of entomopathogenic fungus, *Beauveria bassiana* and biorational insecticide malathion alone and in combination under laboratory and field conditions. Further the delivery of *B. bassiana* was improved by applying it in foam-mixed formulation. The study was conducted at Muhammad Nawaz Shareef University of Agriculture, Multan and orchid of Mango Research Institute, Multan. Pathogenicity of *B. bassiana* and malathion was tested on larval (L2), pupal and adult stage of *B. zonata*. Growth and development (larval duration, pupal duration, adult longevity), mortality, pupation, adult emergence, eclosion, mycosis and sporulation were recorded.

Conclusion: The findings of study would be helpful for farmers in monitoring of *B. zonata* and hence lowering of oviposition in mango.

Keywords: Fruit fly, Mango, Entomopathogenic Fungus, Traps, Methyl eugenol.

SPP-IPM-153

Efficacy of Metronidazole, Secnidazole, Nitazoxanide and *Allium sativum* extract against Balantidiosis in Bovine Calves at dairy farm

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ABSTRACT

Background: Balantidiosis is caused by *Balantidium coli* which can infect bovines, equines, humans and wild animals. In Pakistan, the major cause of death in calves is diarrhea and *B. coli* has been reported as one of the main causes of protozoal diarrhea in calves. The present study was conducted to check the efficacy of Metronidazole, Secnidazole, Nitazoxanide and *Allium sativum* extract against Balantidiosis in Bovine Calves at dairy farm under the control management.

Methods: Fecal samples of the diarrheic calves having history of intermittent diarrhea, muscular atrophy, loss of appetite, retarded growth, loss of BCS, weight loss and clinical signs such as loose to foetid diarrhea were collected from the dairy farms of thesail Pattoki, District Kasur, and examined at the Laboratory of Veterinary Teaching Hospital, University of Veterinary and Animal Sciences, A Block, Ravi Campus from Feb 2018 to July 2018 (6 months). To evaluate the effective treatment against *B. coli* the trials were conducted in the clinical cases. For the therapeutic trial n=120 calves (n=60 cow, n=60 buffaloes) of different ages were divided into 5 groups (A-E) with 12 calves of each species in each group. To check the efficacy, fecal samples were collected on day 0 and day 10 for the number of *B. coli* cyst detection.

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Results: The maximum efficacy was shown by Nitazoxanide (100%) followed by, *A. sativum* 81.7%, Secnidazole 79 % and Metronidazole 43.2% in cattle calves while efficacy was 100%, 72%,81%,29.3% in buffalo diarrheic calves respectively.

Conclusions: Nitazoxanide, *A. sativum*, and Secnidazole proved as a good anti-protozoal drug against *B. coli* infection in bovine calves while metronidazole failed to clear the infection.

Keywords: Belantidiosis, Drug efficacy, Metronidazole, Secnidazole, *Allium sativum*, Nitazoxanide.

SPP-IPM-154

Taxonomic studies of Tenebrionidae (Coleoptera) of district Rajanpur

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ABSTRACT

Background: The most diverse group among the insects is Coleoptera that contains beetles and weevils. About 20% of total insects containing over 400,000 recorded species belong to Coleoptera. Tenebrionidae commonly referred to as darkling beetles are among the important families of beetles with over 20,000 described species worldwide, but still this family has not attracted the attention of the scientists like other large families (Curculionidae, Chrysomelidae, Carabidae etc.) of Coleoptera. The taxonomy of Tenebrionidae is important because this family includes pests of stored grains, phytophagous, scavengers, fungus feeders, vectors, predators and recyclers, etc. Great diversity is exhibited by adult tenebrionids. Some of them are sometimes imperfectly identified in preliminary sorting because they resemble to some species of other families like Carabidae and Chrysomelidae.

Methods: The taxonomic research work is conducted on Tenebrionidae by collecting the samples using hand collection and pitfall traps from the dry rotten woods, leaves debris, and under the logs and stones. Rajanpur is one of the most important districts of Pakistan from an agriculture point of view with a multi-cropping landscape and average urban population hence depicts a diverse range of habitats. The area has a diverse tenebrionid fauna which is explored.

Results: More than 100 specimens were collected and identified using different taxonomic keys. From which genus, *Tribolium* and *Alphitobius* were dominant.

Conclusions: This research provides basic knowledge related to the identification of many important species. The basic knowledge of any insect, its taxonomy, and proper identification are most important for the proper advantageous use of these species.

Key words: Darkling beetles, tenebrionidae, coleoptera, taxonomy.

SPP-IPM-155

Effect of chemosterilants to peach fruit fly, *Bactrocera zonata* Saunders (Diptera: Tephritidae)

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ABSTRACT

Background: Peach fruit flies, *Bactrocera zonata*, are the most economically important pest of fruits and vegetables throughout the world. Different conventional control measures are taken to manage this pest. Sterilization of fruit fly with insect growth regulators (IGRs) is an alternate approach used against this pest.

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Methods: Fruit fly pupae were collected from the field. Then pupae were kept in cages until new adults emerged. From the time of emergence, the adults were fed on natural and artificial diet. Male and female were separated and were treated with different concentrations (50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm, and 300 ppm). These treatments were applied to check the fecundity and fertility of fruit fly.

Results: The aim of these experiments was to assess the effect of chemosterilant on fecundity and fertility in *B. zonata*. Two chemicals were tested in this study. In case of tracer, the dose 250 ppm reduces the fecundity when crossed both treated male and female 55.45% and also reduced the fertility 10.3% as compared to untreated male cross untreated female (control). But in case of fipronil, a dose of 300 ppm reduced fecundity and fertility that is 10.1% and 3.8%, respectively.

Conclusions: Fipronil produced a slight effect on the fecundity and fertility of females with respect to tracer. But on the other hand, tracer causes the maximum reduction in fertility and fecundity on dose 300 ppm.

Key words: Peach fruit fly, chemosterilant, bait, fecundity, fertility.

SPP-IPM-156

***Bemisia tabaci* population flares up by pyrethroids application for pink bollworm management in cotton**

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ABSTRACT

Background: Cotton is the backbone of Pakistan's economy which contributes 0.8% in GDP and 4.5% in value addition. Whitefly and Pink Bollworm (PBW) are two major challenges in cotton now a day in Pakistan. Besides all the possible factors regarding outbreak of whitefly population, the major one is widespread use of insecticides which not only cause the resistance development in whitefly but also cause mortality of beneficial insects. Several excessive chemicals spray along-with pyrethroids are being used in cotton for whitefly and PBW management.

Methods: To evaluate the impact of pyrethroids on the whitefly population, four different spray schedules were followed under field conditions. Each schedule included three sprays of different pesticides of PBW which were applied after a seven days interval. Treatment 1 included 1st two sprays of selective new chemistry insecticides (Spintoram and Abamectin) and 3rd spray was organophosphate (Triazophos). Treatment 2 included three selective new chemistry insecticides (Chlorantraniliprole, Spinetoram and Abamectin) while Treatment 3, had two pyrethroid sprays with last spray of selective new chemistry insecticides (Gamma Cyhalothrin, Lambda Cyhalothrin) and 3rd spray was selective new chemistry insecticides (Abamectin). Treatment 4 included three pyrethroid sprays (Bifenthrin) which is a common practice of farmers while an insecticide free plot was maintained for comparison. Data of whitefly and pink bollworm was collected after 1, 3 and 7 day of spray while predator's data was also recorded.

Results: The maximum population of whitefly (adult+nymph) was observed in treatment no. 4, followed by treatment No. 3, and No. 1, while minimum population was observed in treatment No. 2. Predatory spider and *Chrysoperla carnea* populations were observed maximum in treatment No.1, followed by treatment No. 2, while minimum population was observed in treatment No. 4, of both predators. Predatory beetles were observed maximum in treatment No. 2 while minimum population was observed in treatment No. 4, as compared to control. PBW infestation was observed maximum in control followed by treatment no. 4, while minimum in treatment No. 1.

Conclusions: Spray schedule No.1, which includes 1st two sprays of selective new chemistry insecticides (Spintoram and Abamectin) and 3rd spray of organophosphate (Triazophos) is significantly better for both whitefly and PBW management followed by schedule no.2. Stopping the application of Pyrethroids especially the Bifenthrin is encouraged

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INSECT PEST MANAGEMENT

as are too toxic to beneficial fauna, which ultimately favor the management of whitefly to colony development instantly.

Key words: *Bemisia tabaci*, chemical control, cotton, organophosphates

SPP-IPM-157

Significance of taxonomy/systematics in Integrated Pest Management programs of Pakistan

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ABSTRACT

Background: Taxonomy is the science of classifying organisms into groups and subgroups. It provides new discoveries and identification of basic units of biological systems and their relationships with other organisms. It is a starting point for all important studies on integrated pest management programs, bio-control programs, biodiversity and quarantine etc. Before starting any sort of studies, it is extremely crucial to know the correct scientific name of the pest species or bio-control agent on which the studies are initiated. Identification of both the insect pest and the biocontrol species is of great importance when natural enemies are imported from one county to another in biological control of insect pests. History has already revealed that lack of taxonomists was a cause of the collapse of several IPM programs.

Results: It resulted in remarkable loss of money and agricultural goods because identification of pest species or natural enemies was not done before initiating the IPM programs.

Conclusion: Bio-control workers may execute numerous mistakes without the taxonomist's expertise. They may unintentionally trade in species of bio-control agents that may already exist in the country, may spend a lot of hard work in breeding and shipping the wrong biocontrol species. They may fritter some days studying biology of a pest species that may have previously been done and hidden in synonymy of the species. In this manuscript, strategies to avoid the loss of efforts, time and money have been suggested, which is only possible with the help of taxonomists in this time of pest outbreaks in Pakistan.

Key words: Taxonomy, IPM.

SPP-IPM-158

Systematics and notes on *Empoasca* complex of family Cicadellidae (Typhlocybinae: Empoascini) infesting Malvaceae

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ABSTRACT

Introduction: Empoascini is a diverse tribe of family Cicadellidae (Homoptera), within the subfamily Typhlocybinae. Sixty-five genera consisting more than 1000 species have been described worldwide. The members of the tribe have both generic and species complex not only in Pakistan but also have cosmopolitan distribution worldwide. Empoascan species are major pests of different cultivated crops such as cotton, okra, eggplant and potato. Empoascan leafhoppers can be distinguished from other tribes by forewing without an appendix, hindwing longitudinal veins reaching submarginal veins but submarginal veins not exceeding vein R+MP. 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

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INSECT PEST MANAGEMENT

measures vary with each different species.

Methods: Leafhoppers were collected from the specified host plants with the help of an aspirator and sweep net. Samples were preserved in 70% ethanol. Permanent mounted slides are prepared for future researchers.

Results: In the present study, identification of the *Empoasca* complex has been done by following authentic keys. To resolve the issues of synonymy and their identity up to species level, an illustrated key has been given. *Amrasca biguttula* infest cotton and eggplant, subspecies *A. biguttula biguttula* is a destructive pest of okra and *Empoasca fabae* feeds on potato leaves. Other than these species, few specimens of the genus *Dialecticopteryx* spp. have been also found infesting okra.

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

Key words: Systematics, Taxonomy

SPP-IPM-159

Pathogenicity of entomopathogenic fungi to eggplant fruit and shoot borer

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ABSTRACT

Background: Eggplant (*Solanum melongena* L.) is an important vegetable crop throughout the world particularly in tropical and subtropical regions. Different insect pests attack on it from the date of sowing to harvesting and *Leucinodes orbonalis* (Guenee) is one of the most damaging insect pest. A single borer can infest 4 to 7 fruits and various shoots of plant during its lifecycle. Synthetic pesticides are the preferred choice of farmers irrespective for hazard to human health and environment. Excessive use of insecticides makes eggplant fruit as a big source of toxic residues. Under these circumstance, eco-safe agents such as entomopathogenic fungi (EPF) are best alternate for its management.

Methods: An experiment was conducted to evaluate the efficacy of EPF against *L. orbonalis*. For this purpose, *Beauveria bassiana* and *Metarhizium anisopliae* were evaluated under different treatments which are [*B. bassiana* @ 2.5 g/L and 3.5 g/L, *M. anisopliae* @ 2.5 g/L and 3.5 g/L]. Data was recorded 1st, 3rd, and 7th day of treatments.

Results: Our results depicted that *B. bassiana* provided highest mortality at 3.5 g/L concentration as compared to other treatments.

Conclusion: Hence, *B. bassiana* can be recommended as a bio-control agent in integrated pest management component on eggplant because of effective and environmentally friendly.

Keywords: Eggplant, *Beauveria bassiana*

SPP-IPM-160

Evaluation of two insecticides (Pyriproxyfen, Acetamiprid) against cotton whitefly *Bemisia tabaci* (Homoptera, Alleyrodidae) in field conditions

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ABSTRACT

Background: Cotton *Gossypium hirsutum* L. (Malvaceae; Malvales) is a most important cash crop of Pakistan. Cotton crop mainly contributes for food and agriculture. It is attacked by different insect pests, among these sucking pests are very important. The damage cause by sucking pests extends from weakening to the death of entire plant. The loss due to

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INSECT PEST MANAGEMENT

sucking pests is approximately up to 21%. The population of sucking insect pests increases or decreases due to environmental factors. Whitefly always present underside of the leaf and laying eggs underneath of leaf. They cause damage by feeding on the cell sap of leaf. When disturb the infested leaf, the small sized insect rising above. Jassid sucks the cell sap and cause upward curling on the leaves. Plant become weaker and their fruit fall. Thrips stunt the growth of the plant and delay maturity. They suck the content by rupturing the leaf lamina and silvery appearance appears.

Methods: This study was conducted to observe the population dynamics of whitefly, thrips and jassid under field condition and also check the correlation with abiotic factors we check in present research the relation between the natural enemies of cotton and sucking pest of cotton because at the same time the natural enemies of cotton control the damage of insect pest of cotton when they are at peak level. The present research work aimed to study the population dynamics of cotton whitefly and their natural enemies at the Research Farm of BZU Bahadur Sub Campus Layyah during 2019.

Conclusions: Densities of insect pests and natural enemies peaked from June to October.

Key words: *Gossypium hirsutum*, curling.

SPP-IPM-161

Management of *Bemisia tabaci* (Homoptera, Aleyrodidae) in field conditions

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ABSTRACT

Background: Cotton, *Gossypium hirsutum* L. (Malvaceae: Malvales) is currently the leading plant fiber crop worldwide and is grown commercially in more than 50 countries. There are many reasons and factors of low production of cotton but mainly this is due to the attack of insect pests. There are many insect pests which cause damage to the crop and sucking pest complex is the major which cause damage to the cotton crop both conventional and transgenic crop and sucking complex is the major cause of reduction in cotton yield. The loss caused by the sucking pests is up to 21.20%. Sucking insect pests suck the cell sap and make the plant more and more weak due to which the infestation cause and finally plant wilting and shedding of the leaf occur. Jassid, Thrips, whitefly and mites are major problem for increasing yield and productivity of crop. Whitefly is polyphagous pest and feeds on vegetable, cotton and other agricultural crops. The damage to the crop is due to direct feeding on the plants, transmission of plant diseases and contamination of crop with sticky honeydew. *Bemisia tabaci* is a worldwide pest of many fields and green house crop and is considered a limiting factor for the production of Cotton and some vegetable (especially tomato) and ornamental plant.

Conclusion: However, because of increasing selection pressure from insecticides *Bemisia tabaci* has developed resistance to all major chemical groups and is starting to develop resistance to some of newer insecticides such as buprofezin and pyriproxyfen. The chloronicotinyl insecticides, two of which are imidacloprid have a broad spectrum, excellent systemic and translaminar properties and high residual activity and compared Buprofezin and conventional. The present research work aimed to study the population dynamics of cotton Whitefly and their natural enemies at the Research Farm of BZU Bahadur Sub Campus Layyah during 2019.

Key words: Screening, Whitefly

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SPP-IPM-162

Entomopathogenic fungi as an IPM tool for the management of *Aedes aegypti* (Diptera: Culicidae)

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ABSTRACT

Background: The mosquito *Aedes aegypti* is widely dispersed now than at any time in the past, placing billions of humans at risk of infection with one or more of the four dengue viruses. Dengue fever (DF) is responsible for significant human morbidity and mortality throughout the world. Dengue transmits to humans through the bites of infected mosquitoes (mainly *Aedes aegypti* and *Aedes albopictus*). *Aedes* eggs, larvae, and pupae are usually targeted using organophosphates, insect growth regulators, and microbial control agents. In last few decades, myco-insecticides is reviving due to heavy rate of application of insecticide and their resistance.

Conclusion: Synthetic insecticide is a source of global warming and environmental hazards for biota. All these problems lead to adaptation of biological control. In this article, it is stated that entomopathogenic fungi are potential candidate for the control of mosquito. This review reveals discussions on published data on mosquito-pathogenic fungi, their interactions and also its available formulation in market. In future, this strategy may be helpful to minimize the population of mosquitoes.

Key words: Entomopathogenic fungi, IPM, *Aedes aegypti*

SPP-IPM-163

Use of ammonium sulphate fertilizer against the larvae of *Aedes aegypti* (Diptera; Culicidae)

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ABSTRACT

Background: Mosquito is an urban pest and it is a vector of several diseases and viruses. *Aedes aegypti* is a vector of various viruses including yellow fever, zika, chikungunya and specially dengue. In all over the world millions of people are affected each year. For the management of this mosquito only insecticides are used including synthetic pyrethroids, organophosphates as well as new chemistry insecticides. This species of mosquito has developed high resistance against chlorpyrifos-ethyl, temephos, deltamethrin, lambda cyhalothrin and permethrin. Now, there is a need for a new management strategy for the control of this notorious pest.

Methods: Larval bioassays were conducted to assess the potential role of nitrogenous fertilizer against the larvae of *Ae. Aegypti*. Ten larvae of 3rd and 4th instar were used in one replication. Both treatments were replicated four times.

Results: Nitrogenous fertilizer caused larval mortality. Larval bioassays showed a high mortality rate against ammonium sulphate as compared to control.

Conclusion: The results of larval bioassays addressed the potential role of fertilizers in the management of this annoying pest.

Keywords: *Aedes aegypti*, Ammonium Sulphate, Larval Bioassays, Management Strategy

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Plant extracts as an ecofriendly management of Whitefly, *Bemisia tabaci*

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ABSTRACT

Background: Cotton is among the important economic crops grown in Pakistan and is the backbone of Pakistan's economy which contributes 0.8% in GDP and 4.5% in value addition. One of the major threats to the crop across the globe is the whitefly (*Bemisia tabaci*). Besides all the possible factors regarding outbreak of whitefly population the major one is widespread use of insecticides which not only cause the resistance development in whitefly but also cause mortality of beneficial insects. Fifteen different plant extracts are being used in cotton for whitefly management.

Methods: To check the impact of plant extract on whitefly population under laboratory conditions, an aqueous solution was extracted from the plant leaf material by using Soxhlet apparatus. For seed extraction, concentration was prepared by dissolving the seeds in water and kept it for two days. After two days, the mixture was grinding and sieve. This concentrated extract/mixture of plant seeds material was placed in a plastic bucket as stock solution. For adult bioassay, each plant was treated as a single concentration and each treatment was replicated four times including a distilled water control. These treated plants were place in the insect rearing laboratory under the environmental condition and 20 adults was released in cage. The data was recorded after 12, 24, 48 and 72 hrs by counting the live adults. For nymph bioassay 50 whitefly was transfer on cotton plant in clip cages for 24 for egg laying, after which the adults were removed. The cotton plant containing eggs was place in growth chamber for ten to twelve days until nymphs reached second instars and nymph on cotton plant per leave was counted using a stereomicroscope. leave containing nymph was dipped in different concentration of plant extract for 5 sec. Each plant was treated as a single concentration and each treatment was replicated four times including a distilled water control. These treated plants were place in the insect rearing laboratory under the environmental condition and data was recording after 12, 48, 24 and 72 hrs by counting the live nymph.

Results: The maximum population mortality percentage against whitefly (adult) was observed in neem leaf was 55% at 30% concentration and Bitter Apple Fruit was 51.66% at 30% concentration. The maximum population mortality percentage against whitefly (nymph) was observed in neem leaf was 52 % at 30% concentration and Bitter Apple Fruit was 48.18 % at 30% concentration.

Conclusion: All plant extracts were very effective against whitefly, but neem and bitter Apple fruit is significantly better for whitefly adult and nymph management. Besides all the possible factors regarding outbreak of whitefly population the major one is widespread use of insecticides which not only cause the resistance development in whitefly but also cause mortality of beneficial insects, so plant extract is very effective against whitefly.

Key words: Whitefly, Plant Extracts, Bioassay

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-165

Effect of iron and nitrogen rich additives on the growth, yield and nutritional composition of *P. pulmonarius* on wheat straw.

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ABSTRACT

Methods: In the present studies, *Pleurotus pulmonarius* was grown on wheat straw with iron and nitrogen rich three supplementary materials. This study was conducted to evaluate the most suitable substrate for the production of Oyster mushroom. As for the time taken to complete spawn running, the treatment amended with cottonseed cake T5 took a minimum number of days (19.33). As for the time taken for emergence of primordia, cottonseed cake T5 took a minimum number of days (24.38). The time taken for harvesting stage, cottonseed cake T5 took a minimum number of days (27.28). The number of fruit bodies cottonseed cake T5 took maximum number of fruit bodies (5.56) while wheat straw T1 took minimum number of fruit bodies (4.00).

Result: Total yield of mushroom, cottonseed cake T5 produce maximum yield (315g). Proximate analysis of *P. Pulmonarius* which grown on cotton seed cake amended T5 showed maximum moisture content (88.67%), while dry matter percentage was maximum (13.33%) in T5 treatment. Crude protein was higher in T5 treatment (28.33%). Fiber content showed the best results in both T5 and T6 treatment (13.67%) and (13.33%) respectively. Ash content was maximum in T5 (14%). Fat content was maximum in T5 treatment amended with cottonseed cake (4.33%) while the carbohydrate maximum content (31%) was in cottonseed cake amended substrate. Mineral analysis show N (4.32%), P (1.3), and K (1.31%) in T5 treatment, while calcium (33.56) mg/100g, manganese (20.85) mg/100g, iron (41.57) mg/100g, zinc was (28.16) mg/100g maximum recorded in cottonseed cake amended substrate.

Key words: *Pleurotus pulmonarius*, nitrogen, Fat content.

SPP-IPM-166

Effect of press mud and zinc heavy metal on bio transfer in brassica plants (*Brassica napus* and *Brassica campestris*) and its impact on mustard aphid infestation

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ABSTRACT

Background: Aphids are a notorious pest of oilseed crops. A number of approaches are used to control aphids and eliminate damage from oilseed. Integrated pest management including host plant resistance and biological control are possible environment friendly ways to overcome insect pest infestation including aphids. Plants from brassica species are well known for their pumping efficiency of heavy metal from soil due to their biomass. Plants with a certain amount of heavy metals content in sap poses significant impact on pests especially sucking insects.

Methods: Present research work was laid out under laboratory conditions to evaluate the effect of press mud and zinc heavy metal on bio transfer in brassica plants (*Brassica napus* and *Brassica campestris*) and its impact on mustard aphid infestation was observed. Experiment with five treatments including control i.e. Zn @ 0 (control); Zn 250 mg kg⁻¹ + press mud 1 kg; Zn 400 mg kg⁻¹ + press mud 1 kg; Zn 250 mg kg⁻¹; Zn 400 mg kg⁻¹; were used in this experiment. The Zn accumulation in both plant species and aphids were detected by employing atomic adsorption spectrophotometer

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INSECT PEST MANAGEMENT

(AAS). The developmental instability extent was calculated as fluctuating asymmetry (FA). Fluctuating asymmetry of four different bilateral characteristics was measured by determining the absolute difference between both left and right sides of aphids.

Results: The maximum zinc heavy metal uptake up to 347.67 ± 4.33 mg kg⁻¹ in *B. napus* after the application of Zn 400 mg kg⁻¹ as compared to Zn+PM (400 mg kg⁻¹ + press mud 1 kg) treatment, where zinc uptake was observed as 310.33 ± 4.91 mg kg⁻¹. While the minimum zinc heavy metal uptake was recorded up to 55.67 ± 3.48 mg kg⁻¹ in control treatment. Maximum zinc heavy metal uptake up to 360.67 ± 5.24 mg kg⁻¹ was observed after the application of Zn 400 mg kg⁻¹ as compared to Zn+PM (400 mg kg⁻¹ + 1 kg) treatment, where zinc uptake was measured as 323.00 ± 6.03 mg kg⁻¹ in *Brevicoryne brassicae* after feeding on heavy metal contaminated *B. campestris* plants. Zn heavy metal uptake posed an important impact on body mass of *B. brassicae*. Maximum mean body mass was calculated from Zn 400 mg kg⁻¹ treatment up to 518.33 ± 10.13 μ g, while the minimum mean body mass was found in control treatment as 283.33 ± 6.66 μ g.

Conclusion: The study concluded that certain levels of zinc applied to *B. campestris* and *B. napus* plants can lead to morphological abnormalities in *B. brassicae*. The ultimate result of this can reduce the farmer's expenses on pest management activities and proved as environment friendly

Key words: Integrated Pest Management, Infestation, Morphological Abnormalities

SPP-IPM-167

Cooccurrence of mycotoxigenic fungi, *Callosobruchus maculatus* F. (Coleoptera: Bruchidae) and temperature in stored *Cicer arietinum* L. (Fabales: Fabaceae)

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ABSTRACT

Background: Environmental factors (biotic and abiotic) are major sources of grain reserve depletion. Fungi and insect pests both damage grains synergistically in the store. Fungal and insect pest infestations persuaded nutritional damage to the stored food which became unpalatable for the consumer. There is a need to develop a timeline for synergistic damage caused by insect pests and mycotoxigenic fungi to manage them in stored products.

Materials: For this purpose, the interaction of mycotoxigenic fungi (*Aspergillus flavus*, *Aspergillus niger*, *Penicillium digitatum*, and *Alternaria alternata*) along with *Callosobruchus maculatus* (F) (Bruchidae: Coleoptera) was studied by altering temperature. Life stages of *C. maculatus* were assessed on inoculated and non-inoculated *Cicer arietinum* seeds under different temperatures.

Results: All the tested life stages of *C. maculatus* were increased in fungal inoculated *C. arietinum* grains. The pupation was lower than the larvae emergence and oviposition rate but higher than adult emergence. Infestation of *A. flavus* and *A. niger* was also increased with different life stages of *C. maculatus* at all checked temperatures. *Penicillium digitatum* and *A. alternata* infestation were increased in the *C. arietinum* at 27 °C and 30 °C respectively.

Conclusions: This study will help in measuring the control practices of fungi and insect pest infestations in stored *C. arietinum* in Pakistan.

Key words: Pest infestations, *C. maculatus*,

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Toxicity of selective insecticides against sap-sucking insect pests of cotton (*Gossypium hirsutum*)

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ABSTRACT

Background: The most devastating cotton crop pests including sucking insect pests like jassid, *Amrasca biguttula* and aphid, *Aphis gossypii*. The severe attack of these sucking pests in Pakistan causes yield losses of about 28 per cent to the cotton crop. Chemical control such as the use of various insecticides is mainly practiced in order to minimize yield losses in cotton crops. Here we evaluated the toxicity of some selective insecticides under field conditions to screen out an effective insecticide against these sucking insect pests of cotton.

Methods: The insecticides tested were Imidacloprid 250ml/acre, Acetamiprid 150ml/acre, Nitenpyram 200ml/acre, Movento 250ml/acre, Buprofezin 600gm/acre and Chlorfenapyr 225ml/acre.

Results: The results of this study revealed that all the insecticides tested were effective against *Aphis gossypii* aphids, after 96 hours of spray except Buprofezin and Movento the other insecticides caused immature and adult mortality. Nitenpyram and Buprofezin exhibited the highest mortality rate of adult Aphids after 24 h of spray. When spraying Nitenpyram@200ml/acre, Acetamiprid@150ml/acre, and Imidacloprid@250ml/acre, the highest mortality of *Amrasca biguttula* adults was recorded after 96 hours of spray. Imidacloprid, Acetamiprid, Nitenpyram and Buprofezin were statistically equally effective at immature stage with mortality of *Amrasca biguttula* after 96 hours of spraying.

Conclusion: Acetamiprid and Nitenpyram were more effective after 24 hours of spray but Imidacloprid, Chlorfenapyr, Movento and Buprofezin were less effective and showed low mortality at immature *Amrasca biguttula* stage.

Keyword: *Aphis gossypii*, Insecticides, *Biguttula* Stage

SPP-IPM-169

Automated pest monitoring in Integrated Pest Management. A Review.

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ABSTRACT

Background: Monitoring insect pest population is a fundamental principle in integrated pest management. Earlier, monitoring was done manually in infested areas which take much time in detection and labor-intensive job. In large plantations, periodical surveys were done by disseminating traps.

Methods: The need of the hour is to automate the monitoring of pest populations using advanced technologies to save time and reduce labor costs. In a modern automatic system, many sensors like image sensors, wireless sensors, voice sensors, temperature sensors, thermal and infrared sensors are used. In image sensors, high-resolution cameras are used to capture precise images of the pest and send these images using a high signal transmission system to a remote central system for identification, monitoring, and counting the exact pest population. Similarly, thermal and infrared

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sensors sense the right insect based on temperature and light spectrum feed to the central control and command system. An insect communicates using different kinds of wavelengths, which are easily detected using voice sensors. Traps will be set to catch those insects with suitable wavelength and frequency. This automated system gave real-time detection and kept data using the central database system for future predictions based on spatiotemporal data.

Results: All the information regarding the pest population and their infestation rate is recorded with real time imaging system and kept saved in the database. All this has led to improved monitoring systems in IPM.

Keywords: Monitoring, automated system, sensors, database, IPM.

SPP-IPM-170

Management of fall armyworm *Spodoptera frugiperda* by using multi-cropping system

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ABSTRACT

Background: *Spodoptera frugiperda* (Noctuidae: Lepidoptera) is an invasive polyphagous pest of many economic crops including wheat, sorghum, sugarcane, cotton, rice, and particularly maize. Young larvae feed on tender leaves, stems, and reproductive parts, including spikes, ears, and cob. Many management techniques are used, but a multi-cropping system is found very effective. The known attributes of a multi-cropping system are repellence, which pushes the pest away and attracts the pest using a suitable crop.

Methods: The plants used in the Push-pull strategy emit certain chemicals that repel the insects and deter them to lay eggs. For this intercropping of *Desmodium intortum* (M.) A green leaf plant and *Brachiaria* is done around the crop to make borders. These crops produce certain semio-chemicals in the repel pest species that are pulled by border crops.

Results: By using technology, astonishing results are recorded in different maize agro-ecological areas of the world. Climate adapted plots showed significant reductions of larvae to about 82.7% and also 86% plant damage per plot observed. This technique proved to enhance yield up to 2.7 times compared with monoculture maize plot. This technique is found very effective in dry and hot climatic conditions of Pakistan to tackle the challenges posed by climate change. The growth of these crops is found very fast with less amount of water and has tolerance against dry conditions.

Conclusion: The conclusion insights into the importance of push-pull technology in maize producing areas of Pakistan; in order to control this notorious pest effectively.

Keywords: Polyphagous, multi-cropping system, *Desmodium intortum*, semio-chemicals

SPP-IPM-171

Data recording and record keeping in integrated pest management

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ABSTRACT

Background: In Integrated Pest Management, data collection, forecasting, timely decisions, proper action plans, and decisions based on observations are prerequisites to identify and understand its biology, scouting method, monitoring, devise threshold level, and management technique. For pest management research, record-keeping involves the collection of data based on factors that include weather, crop conditions, pest population, pest stage, and integrated approaches to control.

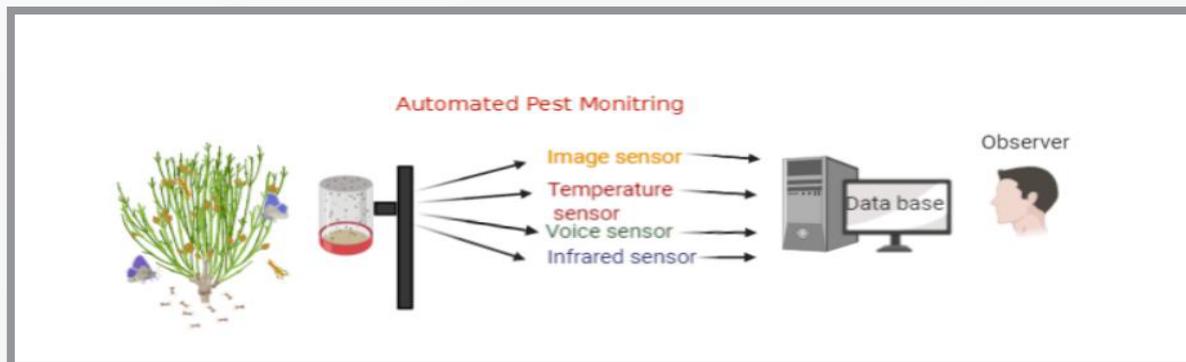
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Methods: In data recording, along with gathered information and decision techniques, a variety of preventive and curative methods are used to construct a complete plan for pest management. Different applications are used for data collection according to intimate crop surveys, analysis of data, and quick reports. Team scope a data collection app for case management, data visualization, also see data offline. Open data kit (ODK) open-source software allows multiple types of data to record. Kobo Tool Box and ENKETO easily shared projects with colleagues. Synchronize data via SSL not read by a third party and cannot lose any data. RED cap, a secure electronic data capture solution for managing databases, also empowers researchers to manage their data without need of technical knowledge. Magpi is a mobile data app that allows users to create data with no accidental errors.

Conclusion: By using these data recording apps we can collect data offline and while on the go. By offline data, the researcher can easily assess data where the internet is unreliable.

Keywords: Data collection, pest management, case management, recording application



SPP-IPM-172

Climate change and its impact on pollinators

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ABSTRACT

Background: Agriculture is the backbone of our country's economy. About 60% of the population's livelihood is depending upon agricultural crop production. But now climate changes have adverse effects on agricultural productivity. The consequences are reduced food security, temperature fluctuations, and reduced water resources threatening the most. Deforestation is the major cause of climate change that deliberately enhances sources of Carbon in an atmosphere that was earlier absorbed by trees. Because of climate change, weather patterns are disturbed, resulting in unusual rainfall, periodic floods, and harsh drought conditions. Climate change has marked which influences the pollination. Crop pollination is as important as it produces many fruits and vegetables with a total economic value of about 150 billion Euros annually. During the last 50 years, the area under pollination depending on the crop has increased by 300 percent worldwide. Insect visitation improved crop production as 75-80% of food crops are depending upon pollinators.

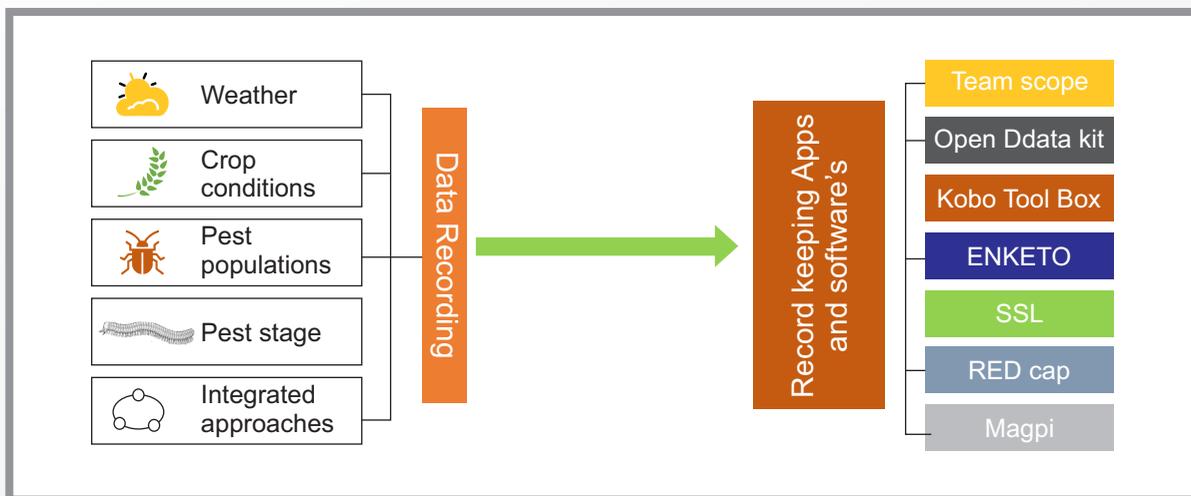
Conclusion: Climate change is found to be a threat to pollinator diversity that changes its composition, extent, the configuration of habitat. The pollination services are highly deteriorated by sudden rise in global temperature that affect pollinator fauna to extinction like many ground beetles and ground-nesting wild insects. These extreme conditions not

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only affect individuals but can also adversely reduce the total population of the insect and individuals. It is expected from the pollinator experts to study pollinator physiology affected by climate change regimes to better understand and predict suitable control measures for continuous ecosystem services. It is hoped that the Government of Pakistan with their partner department will work on the safety and assessment of this challenge against the losses of pollination services.

Keywords: Climate change, Pollinator, Crop production, Food security



SPP-IPM-173

Climate smart-pest management an approach to cope with climate change

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ABSTRACT

Background: Climate change is causing long term extreme weather conditions by altering the weather patterns, precipitation/ rainfall patterns, and the global shift in temperature. It is directly or indirectly affecting the severity, potential, biology, outbreak, and distribution of insect pests across all natural like pastures, forests, and agricultural land globally, mainly affecting the crop production. Insect pests cause damage to over 40% of the food supply, to save global food security, novel insect pest management is crucial. It requires analytical thinking, up-to-date regulation, climate change information, and new pest management practices.

Conclusion: Climate-smart pest management CSPM is an approach whose goals are to reduce the crop losses induced by an insect pest, decrease greenhouse gasses emission, and strengthen the resilience of agricultural systems to overcome the effect of climate change. Implementing this approach improves crop production, research, extension, and policy act and leads to a more efficient food production system. It also mitigates climate change by balancing the greenhouse gases and reduces pest-related yield losses.

Keywords: Climate change, Climate-smart pest management, Crop production, Greenhouse gases emission

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Impact of climate change on biocontrol agents and future perspective

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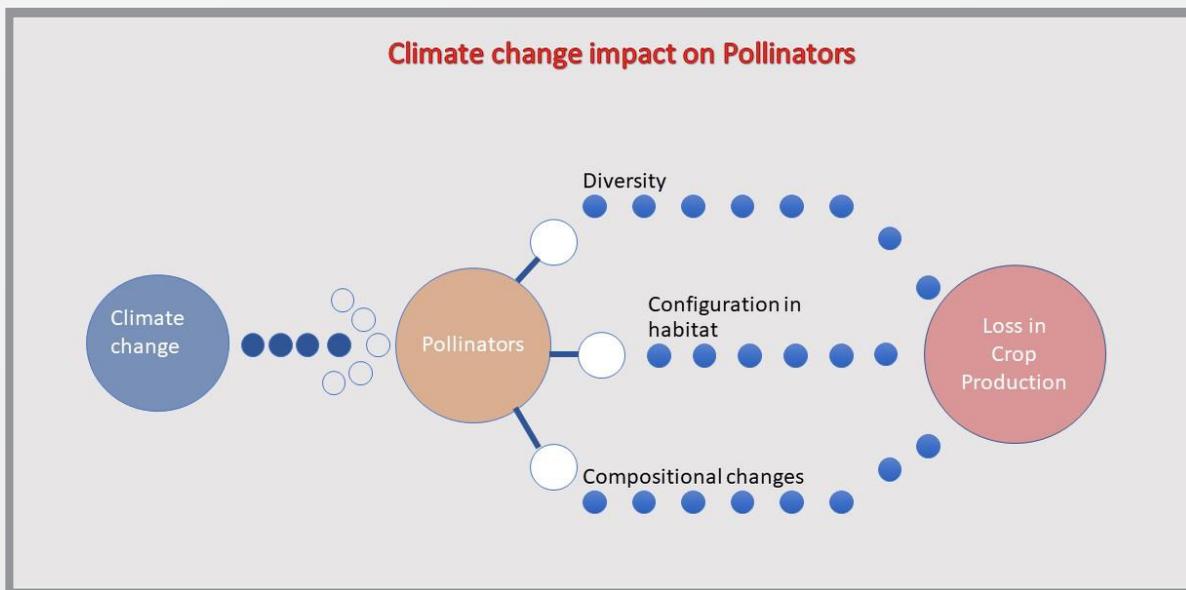
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ABSTRACT

Background: Globally, climate change directly affects the nature and productivity of crops, orchards, pastures, and forests by increasing the extreme climatic events, drought, flooding, and it is known obvious that there are changes in the global average temperature, rainfall patterns. These seasonal and long-term weather changes affecting the flora, fauna, species extinction, biocontrol agents, and crop protection measures. It is a threat to the sustainability of the natural and productive environment by disturbing the distribution, composition, and phenology of biocontrol agents and increases the severity, outbreak, and potential of the pest. Biocontrol agents are a natural contribution to control insect pests, mites, and plant diseases. They provide an Eco-friendly and effective approach to control the pest and pathogens. Contrasting to chemical control which pollutes the environment and causes detrimental effects on human beings and kills the non-target insect pest. The changing abiotic factors are directly and indirectly affecting the biological control agents by affecting their survival, dispersal, fecundity, parasitism, and modulation in development stages.

Conclusion: To cope with these changing climatic conditions, adaptive management strategies should be developed and adopted by the farmers to support the abundance and activity of beneficial fauna. These strategies should eliminate the incongruity of space and time between pests and enemies, which will increase the effectiveness of biocontrol agents. Transgenic plants should be produced because climate change is also reducing the efficiency of host plant resistance. There is a requirement to generate information about changing weather conditions and the development of effective pest management strategies that enhance natural enemies.

Keywords: Climate change, Biocontrol agents, Beneficial fauna, weather



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SPP-IPM-175

Knowledge, aptitude and practices about head lice in Multan division

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ABSTRACT

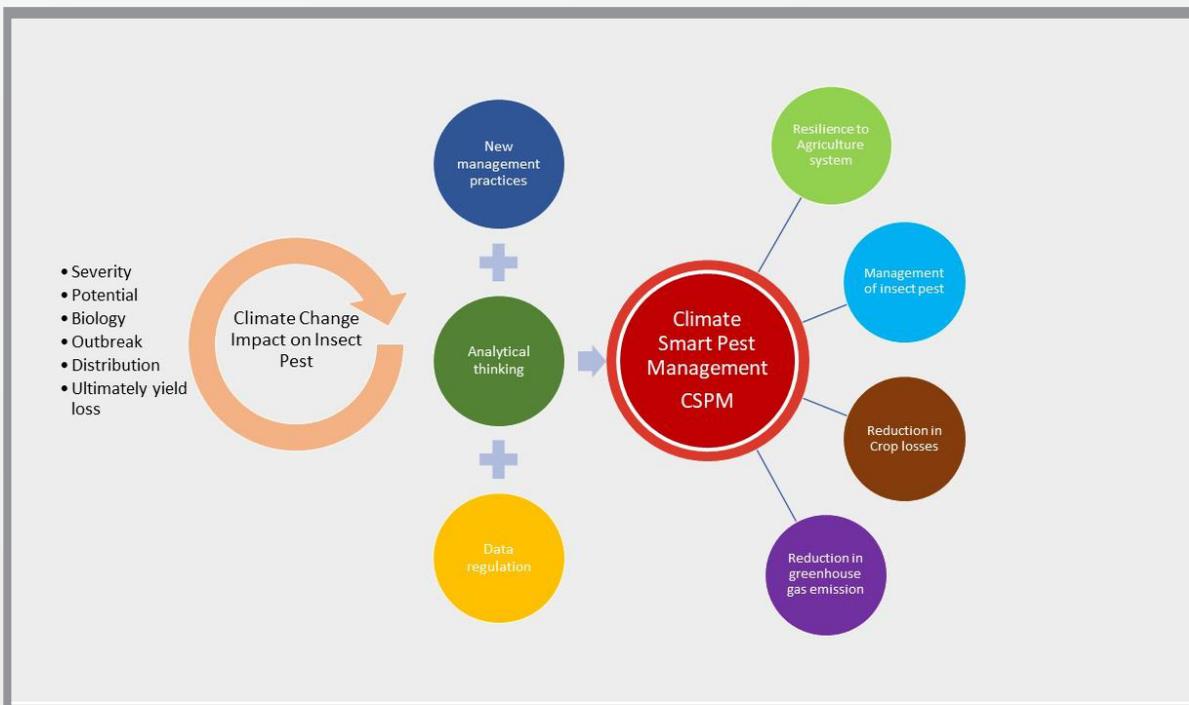
Background: Head lice (Pediculidae: Phthiraptera) are more problematic in tropical and subtropical regions. They cause blood loss, discomfort, social and psychological distress in children and adults. They are mainly managed by neem seed extracts, malathion, pyrethrins with piperonyl butoxide, MOOV head lice solution, ivermectin lotion, clove oil and eucalyptus oils are used for the control of head lice.

Methods: Questionnaires consisted of information regarding demographic characters, and knowledge, attitude and practices for head lice infestation. The targeted group include students of educational institutes, and children of colonies and slum places. This questionnaire collected the information about previously used anti lice products and their efficacy, hair type and daily hygiene routine.

Results: The results indicated that the children that maintain hygiene conditions and comb their hairs regularly were less prone to head lice infestation. The children in urban and semi urban areas have high infestation of head lice as compared to children in village areas. Most of the children use different oils (neem oil, tara mera oil) for the management of head lice while 25% of the infested children used anti lice shampoo (containing 1% permethrin).

Conclusion: The head lice infestation is related to sanitation and hygiene conditions. Regular combing after the application of oils/anti lice shampoo is the best method to manage head lice.

Key words: Head lice, pediculicides, infestation, control



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SPP-IPM-176

Importance of surveillance in Management of Locust *Schistocerca gregaria* (Orthoptera: Acrididae)

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ABSTRACT

Background: Introduction: The desert locust *Schistocerca gregaria* (Orthoptera: Acrididae) is a serious pest and famous by its gregarious behavior. However, it is complicated for researchers during recession periods, when the population is less in the solitarius phase. When these limited populations get favorable ecological conditions, these will be pioneer at invasion time. Due to the lack of knowledge about the solitarius phase of locusts, we cannot get preventive management of this pest.

Methods: Data collected in Pakistan from 2010 to 2020 were used to study the solitarius population and analyze its population dynamics across the different deserts where some outbreak areas are located, and these areas play an important role in invasion procedures. The results share many differences against previous empirical observations on solitary population's dynamics.

Results: First, a prominent difference is documented in between western and southern deserts of Pakistan in relating to locust dynamics and impact of environmental conditions. Due to runoff rainy water, it is clear to create suitable habitats for generations overlapping. Second, on the basis of an annual survey, we found solitarius populations on green vegetation at different locations. Third, statistical relationship between different locations indicates a clear regional dynamic.

Conclusion: Our study confirmed the importance of surveillance on solitarius populations over different deserts of Pakistan. First, we need a scalable and proper preventive system during the year, from one year to another with complete distinction between the western and southern deserts areas of Pakistan. In future perspective, this will be very helpful in management of desert locusts and reduces the use of insecticides.

Keywords: locust, Pakistan, Behavior

SPP-IPM-177

Organic pesticides; a need of hour

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Background: Agriculture plays a pivotal role in the economy of Pakistan whose 62% of total population is directly or indirectly linked with this profession. The demand for food is increasing day by day due to the increase in world population. Various crops are being cultivated in the world to fulfill the hunger of the world population as the majority of world population rely on these agricultural products, a major source of income for poor farmers and farm workers. The production of quality food is decreasing day by day due to various insects, pests and disease. Different management strategies (cultural, physical, biological, botanical and chemical) are being adopted to control them. The majority of farmers adopt chemical methods to control insects, pests and diseases to minimize crop losses. The excessive application of these chemicals causes environmental pollution, health problems and develops resistance in organisms against that particular chemical or insecticide.

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Conclusion: So, it's the time to motivate farmers to use eco-friendly organic based insecticides against insects, pests and diseases to reduce the negative impact of conventional synthetic chemicals on the environment and human health. The plant-based pesticides or phytochemicals are eco-friendly and safe for health. These phytochemicals are being practiced in various crops to control insect pests and diseases in developed countries to produce healthy organic foods. Additionally, plants-based pesticides are always species specific, cheaper, biodegradable and helpful to reduce resistance in pests. There is a crucial time to adopt such practices against insects, pests and diseases on various crops and such practices should be promoted at national and international level to produce good food.

Keywords: Phytochemicals, Biodegradable, Cheaper, Conventional pesticides

SPP-IPM-178

Toxicity of Two Pyrethroids against desert locust (*Schistocerca gregaria* Forsk.) (Acrididae) under lab conditions

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ABSTRACT

Background: The Desert Locust, *Schistocerca gregaria* (Forskål 1775) (Orthoptera: Acrididae) is found in various parts of the world extending from the Atlantic Ocean and North Africa to the Middle East and Southwest Asia. It is considered as the most destructive migratory pests in many regions of the world which has threatened the crops, pastures and fodder.

Methods: The toxicity of two pyrethroids: deltamethrin and lambda-cyhalothrin was evaluated against nymphs and adults of desert locust under laboratory conditions. Five concentrations of insecticides were prepared (125, 250, 500, 750 and 1000 ml/100 liter of water) were prepared in water and leaves of *Brassica compestris* (Canola) were individually dipped into insecticide solution for 30 seconds and air-dried at room temperature for 1-2 hr. For the control group, branches were treated with distilled water only. The branches were then placed in plastic jars and 6-10 adults/nymphs were shifted to each box. The boxes were placed at laboratory conditions and mortality data was recorded at 24 hr interval until to achieve 100% mortality.

Results: The current experimental result shows that deltamethrin and lambda cyhalothrin gives better results after 96 hours. After 72 hours, deltamethrin and lambda-cyhalothrin caused 100 % mortality of nymphs however they caused 100 % mortality to adults after 96 hr.

Conclusion: The current study reveals that deltamethrin and lambda cyhalothrin gives better results after 96 hours at all doses. Hence these insecticides should be used at lower doses (e.g. 250 ml/100 liter of water) instead of higher doses. This will cause less environmental contamination.

Keywords: Locust, Synthetic chemicals, Toxicity

SPP-IPM-179

Feeding preference of desert locust (*Schistocerca gregaria*) in different crops under lab conditions

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ABSTRACT

Background: Locust has been a big threat for agricultural crops and mankind since ancient times. This pest has the ability

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to form swarms of billion individuals that destroy the crops and pastures. In June 2019, the locust outbreak hit eastern Pakistan. The first locust attack recorded in Karachi in November 2019. On 29 January 2020, the provincial KPK government declared emergency in nine southern districts to control the spread of locust and on 1st February 2020, the Pakistani government declared a national emergency to protect crops and help farmers. In the current experiment, the preference of desert locust for nine plants was studied under laboratory conditions.

Materials: The locust nymphs were collected from Bhakkar and shifted to laboratory during 2020. They were kept in the laboratory for three days for acclimatization before use in experiments. The nymphs were starved for 24 hours. The preference was studied in no-choice and choice experiments. Fresh leaves of nine plants (maize, sorghum, rice, mango, citrus, alfalfa, cotton, neem, sunflower) were collected and cut into small pieces and weighed (5 gm). Then, these leaves were put into the corners and middle of the plastic cage and 50 nymphs of locust were released. The data of feeding was recorded after 2 hr and after 24 hr.

Results: The results of choice test indicated that fresh leaves of sunflower, sorghum and cotton were considered highly preferred because they were completely eaten by the nymphs within 24 hr. However, the least preferred leaves were of citrus and bakain. Almost similar results were obtained in the no-choice experiment.

Conclusion: The maize and sunflower are the most preferred crop of desert locust and can be used to trap and treat the desert locust in Pakistan

Keywords: Host preference, Desert Locust, Pakistan

SPP-IPM-180

Toxicity of four insecticides on Honeybee, *Apis florea* (Hymenoptera: Apidae)

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ABSTRACT

Background: Honeybees are considered as an important beneficial insect in terms of honey production and pollination of crops. It makes nests on trees near human dwellings and agriculture crops. During foraging in the field for nectar and pollen collection from agriculture flowering plants, honeybees may be exposed to pesticide sprays which may cause change in their foraging behavior and/or death of workers. In the current study, we evaluated three insecticides to check their toxic effects of three insecticides (Emamectin benzoate 1.9% EC, Imidacloprid 200 SL and fipronil 5% SC) on workers of *A. florea*.

Methods: There were 6-7 doses of each insecticide (causing 0-100 % mortalities) prepared in water and each dose was replicated four times. The experiment was conducted using a diet incorporation method in plastic bowls. There were 4-5 workers in each bowl and mortality data was recorded after every 12 hr for a total of 48 hr.

Results: Emamectin benzoate was found most toxic insecticide with lower LC90 values (8.41 mg/l) followed by spinetoram (17.01 mg/l), imidacloprid (21.33 mg/l) and fipronil (23.16 mg/l) after 36 hr.

Conclusion: The results showed that insecticides are very toxic to honeybees and should be used on agriculture crops with great care and during their period of less activity.

Keywords: Pesticides, Honeybees, LC90, Beneficial insects

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SPP-IPM-181

Population dynamics of mango hopper (*Amritodus atkinsoni* Leth.) during non-flowering season

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ABSTRACT

Background: Mango (*Mangifera indica* Linn.) is one of the most delicious and important fruits worldwide. Pakistan is one of the top producers of mango crop. Mango hopper (*Amritodus atkinsoni* Leth.) is very serious and one of the destructive pests of mango in Pakistan. It causes damage by sap sucking from leaves, shoots and inflorescence. In the current study, population dynamics of mango hopper was studied during 2018.

Materials and Methods: About 10 mango trees were selected which have a maximum population of mango hopper on the trunk of mango trees. Then, one square feet area was marked with the help of chalk on the trunk of the tree and the population of mango hoppers sitting in the marked area was counted. The data were recorded after every 4 hours in a day i.e. 8 am, 12 pm and 4 pm and repeated after every one week.

Results: The results show that the population of mango hopper was maximum at 4 pm (11.80%) but low population was shown at 12 pm (10.78%) and the lowest population was recorded at 8 am (7.07%). There was no population seen on mango leaves.

Conclusion: The present results show that the maximum population of mango hoppers were at 4 pm of day. So, we recommend to farmers, spray the field in evening time for getting the maximum results against mango hopper.

Keywords: Mango, Mango hopper, Population dynamics

SPP-IPM-182

Evaluation of insect growth regulators (IGRs) against nymphs of locust

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ABSTRACT

Background: The desert locusts (*Schistocerca gregaria*) are found mainly in Africa, through Arabia and West Asia, and extending into parts of South Asia. The desert locust shows periodic changes in its body form and can change, in response to environmental conditions. Desert Locusts usually fly with the wind at a speed of about 16-19 km/h depending on the wind. Swarms can travel about 5-130 km or more in a day. Locusts can stay in the air for long periods of time.

Material and Method: Current study was done under lab condition. The two IGRs were tested and a dip method was used. *Brassica compestris* (Canola) branches were individually dipped into IGRs solution for 30 seconds and air-dried at room temperature for 1-2 hr. For positive control, branches were treated with distilled water only. The branches were then placed in plastic jars and 6-10 adults/nymphs were shifted to each box. The boxes were placed at laboratory conditions and mortality data was recorded at 24 hr interval until to achieve 100% mortality.

Result: There was no mortality recorded after 24 and 48 hr in both IGRs. However, 72 hr after application, mortality was observed in both IGRs. There was more mortality in pyriproxyfen as compared to lufenuron treatment. After 168 hr (7 days), all nymphs were dead in pyriproxyfen boxes at all doses.

Conclusion: The current results show that pyriproxyfen and lufenuron give better results after 72 hours. All nymphs were dead after 168 hours.

Keywords: Desert Locust, IGR, Toxicology

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-183

Insecticidal activity of citrus limon plant extract mediated silver nanoparticles against dusky cotton bug

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ABSTRACT

Background: Nanotechnology is considered an emerging field of science in agriculture. Global population growth and the demands for more food have led to the need to maximize agricultural production by minimizing losses in crops due to attack of insect pests. The increased use of pesticides has become essential to maximize agricultural production. Despite their beneficial role in agriculture, pesticides are hazardous to humans, non-targeted organisms and are responsible for development of pest resistance. Many countries have switched over from chemical-based agriculture to green agriculture, where the utilization of bio-pesticides in combination with nanoparticles has an emerging role in insect pest management.

Methods: For synthesis of AgNPs, Citrus limon leaves extract was dissolved in 0.001 N Silver nitrate aqueous solution. Leaf dip bioassay method was used to assess the toxicity of biosynthesized nanoparticles and plant extract against dusky cotton bugs under laboratory condition.

Results: Successful results have been obtained by using *C. limon* mediated silver nanoparticles. The maximum mortality through *C. limon* leave extract was 28.75% whereas application of *C. limon* mediated silver nanoparticles showed maximum 53.75% mortality after 96 hrs against dusky cotton bug.

Conclusion: The present study is an effort to provide successful insights as an alternative approach to synthetic pesticides to manage insect pests. The use of bio-pesticides in combination with nanotechnology on nano-scale can increase effectiveness and could prove to be a suitable solution of pest control and to solve the problem of pest resistance in an eco-friendly way.

Keywords: AgNPs, Citrus limon, Dusky cotton bug,

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Evaluation of oriental fruit fly lure for the monitoring of *bactrocera zonata* (diptera: tephritidae)

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ABSTRACT

Background: Mango (*Mangifera indica* L.) is an important fruit crop of Pakistan. Pakistan has exported 77,000 tonnes in 2019 which is the 7-10% of its production and valued of US\$ 20 million per year. Mango crop is affected by many pests, but mango fruit fly *Bactrocera* species is the most destructive of all pests. In the current study, two lures were evaluated for capturing adults of *Bactrocera zonata*.

Methods: Mango fields located at Jalalpur Pwala Tehsil of Multan were selected. Two lures including oriental fruit fly lure and methyl eugenol were used with three replications. The treatments were applied in boxes and then hang on the shoot of tree at the height of 5 ft. The numbers of adults captured in each trap were counted weekly during the whole season.

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Results: The results shown that the oriental fruit fly lure captured maximum numbers of adults than methyl eugenol. Oriental fruit fly lure has shown maximum attraction of *B. zonata* (213.45 numbers/trap) and methyl eugenol has (128.15 numbers/trap).

Conclusion: *B. zonata* is developing resistance against methyl eugenol. So, we used a different pheromone for the monitoring of *B. zonata* and it has shown better results than M.E.

Keywords: *Bactrocera zonata*, Methyl eugenol, Oriental fruit fly lure, Pheromone

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EFFICIENCY OF NEW CHEMISTRY INSECTICIDES AGAINST BACTROCERA ZONATA (DIPTERA: TEPHRITIDAE)

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ABSTRACT

Introduction: Fruit fly is quarantine pest so infested fruit and vegetables restricted to export. Citrus fruit is important fruit crop in Pakistan which exports to other countries. Large numbers of insect pest are attacked to citrus fruit in which fruit fly is one of most major pests now days in Pakistan. Fruit fly have short life cycle, high fecundity and wide host ranges that why difficult to control. **Materials and Methods:** The current study was carried to check the efficacy of new chemistry insecticides against *Bactrocera zonata* and their behavior in citrus fruits. Fruit fly were collected from different fruit orchards and brought them into the laboratory. Fruit fly colony was maintained in the plastic jars to developed large population which need in the bioassay study. To check the efficacy of new chemistry insecticides bottle and leaf dip method were used. **Results:** Result demonstrated that maximum percentage mortality (50.00 ± 2.88 , 53.33 ± 4.40 and 60.00 ± 2.88) were recorded in trichlorfon treated bottle with 16ppm concentration n after 24h, 48h and 72h exposure of insecticides, respectively. **Discussion:** Trichlorfon was the most effective insecticide to control fruit fly in both bottle and leaf dip method at 16ppm dose while Emmamectin benzoate and spinosad were also effective as compared to others. **Feedings behavior** was more affected by trichlorfon treated plants as compared to remaining. **Conclusion:** So, it can be concluded that trichlorfon was the efficient insecticides to control fruit fly in citrus.

Key words: *Bactrocera zonata*, management, Insecticides, behavior, Insect pest

SPP-IPM-186

Development of artificial nesting of solitary bees for conservation in Multan, Punjab-Pakistan

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ABSTRACT

Background: Solitary bees account for 14000 species worldwide and are the largest group of wild bees. Solitary bees nest in aggregate human-made devices besides naturally occurring plant stem and wood. The materials used for nests are of wide range depending on the field durability and ease in maintenance. Nest boxes play a key role in studying various

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other aspects of bees including biology, ecology, diversity and response of bees to the changing landscapes. The effectiveness of nest boxes depends on various factors like nesting material, dimensions (Length and diameter), orientation, positioning, placement timing and landscape data.

Methods: Behavior of solitary bees was studied by using different traps like Clay Block (78), Drilled holes in wood blocks (468), two variety of Bamboo reeds (41), soda straw (351), wooden binder board (204), cardboard tubes (8) and plastic tubes (32). Each trap nest consisted of different sizes, length and diameter and was placed at different heights from the ground. All the trap nests of different lengths and diameter were analyzed critically according to their cavity dimensions, floral hosts, their patterning, colors, bees preferences, and their placement in the field.

Results: During two-year study, 73 nests were collected from different materials. Most of the nests were in cavities of 0.9 cm (71%) with 16% in 1.1cm and 12% in 1.3cm diameter. The most preferred materials for nesting was drilled holes in a wood (75%). The bees nesting in these materials were *Megachil hera* and *Megachile lanata*. *M. hera* proved an effective pollinator in *Medicago sativa* L. seed production due to its important characteristics.

Conclusion: Success of these bee species in colonizing trap nests makes it an interesting potential opportunity to use these species for pollination of cultivated plant species, like lucerne, sunflower, buckwheat and other pollination dependent crops. Conservation of the pollinators can boost crops production in Pakistan

Key words: Solitary bees, *Medicago sativa*, Conservation

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Application of electronic nose for detection of diseases in plants. A review

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ABSTRACT

Background: Plants are primary producers and source of energy for all kind of fauna. Domesticated plants are very sensitive to phyto-pathogens, which causes a significant decrease in crop production. A number of symptoms are used to detect the diseases which includes plant health, stunt growth, wilting, leaf color, size and shape. In recent years, diagnosing methods are changed and use of mechanical methods is now of worth importance, in which bio sensor are used in the plant disease detecting method. Bio sensor act as an electronic nose, inhales the volatile chemicals which result from the invading of the pathogen. In this article, we stated that electronic nose would be use in pest scouting technique for the detecting diseased plants and chemical analysis by inhaling of nose.

Conclusions: This is new approach which combined the use of electronic nose for in early-stage prophylactic disease screening with known disease biomarkers. Some future research required for bringing electronic nose into general practice.

Key words: Domesticated plants, pathogen, biomarkers

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Potential of bio-pesticides in agricultural sector

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ABSTRACT

Background: Pesticides are the synthetic chemicals normally used to manage or kill pests that interfered with human benefits, however, when pests are controlled by the use of living organisms or their by-products, they are termed as biopesticides. Chemical origin pesticides caused serious ecological problems not only to the environment but also to human health as well as beneficial microbes. With the development of new technologies and recent discoveries in this field from the last few decades, the global trend shifted towards biopesticides as they have the potential to manage pest population under economic threshold level effectively without causing any damage to human health as well as to non-target beneficial organisms, boosted its dissemination in the agricultural sector. They are available in many easy-to-handle forms like dust, granules, wettable powders, etc. as well as effectively integrated with Integrated Pest Management (IPM) programs and their annual production is now more than 3000 ton per year and rapidly increases day by day.

Conclusion: However, the use of biopesticides like other controlling methods has its pros and cons, which limited its use as well as opens new windows for researchers.

Keyword: synthetic chemicals, biopesticides

SPP-IPM-189

Locust; An imminent threat of 21st century to food security

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ABSTRACT

Background: Desert Locust or short-horned grasshoppers (*Schistocerca gregaria*) belong to family Acrididae, are found destructive as well as dangerous migratory pests because they live in swarm that migrate to long distances. They have an ability to change its physiology, behavior and morphology according to environmental changes. In their 2-6 months life span it undergoes in 3 different life

stages i.e., Egg, Nymph/Hopper and Adult. An average swarm size may extend up to 3-5km² and consist of 40-50million locusts nearly eat food of 35000 people in a single day. They attack on standing crops, pastures, fodder, fruit and vegetables crops, destroy agricultural belt and also has negative impact on soil which leads to soil erosion. In 2019-20 a severe outbreak of locusts was seen after 1992 in Pakistan at Sindh district Tharparkar, Dadu, Jamshoro Umerkot and Tando Allahyar, etc. These outbreaks decrease crop production majorly in rice up to 41%, 21% of wheat, 31% of sugarcane, 15% cotton production and also in many other crops. Many strategies were adopted such as smoke, beating

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drums, digging hole filled with poison, green cards, aerial spray etc.

Conclusions: However, no effective control strategy was developed against yearly locust attacks. Therefore, food prices increase and purchasing power of consumer decrease which leads to malnutrition/famine if this situation remained unchecked.

Keyword: found destructive, malnutrition

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Plant Protection with Natural Products: Right or Wrong Approach and Challenges

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Background: Agriculture not only depends on good crop seeds but good water quality as well to ensure nutrients movement throughout the crop cycle. Unfortunately, in the past few decades, as the issue of insecticide resistance increased in pests, so the water scarcity and quality of water deteriorated as well. To address these issues, our wastewater treatment systems ensure pathogen-free water suitable for all kinds of cropping and is eco-friendly. With reliance mainly on pesticides for pest management, not only resistance developed in many crop pests but more pesticide residues in the crop system as well. That means our food chain has been contaminated drastically.

Conclusion: Our state-of-the-art agriculture cropping systems synergize with the traditional methods of farming would result in less reliance on pesticides and increase crop production. These systems would improve the crop ecosystem and can earn farmers extra value on their input efforts.

Key words: wastewater treatment, state of the art agriculture cropping systems, food chain

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Review on smart monitoring and management of desert locust *Schistocera gregaria* under changing climatic scenario

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ABSTRACT

Background: Among locusts and grasshoppers, the desert locust is the deadliest pest of many crops worldwide. So, large outbreaks of desert locusts are the major consequence of climate change, which is often continued in many parts of the world. Socio-economic effects of desert locust have critical concern over food security in many developing countries. This involves many governing legal bodies; both at national and international levels have an increasing paradigm shift from management to smart monitoring for better control of locust outbreaks. During the early 90s, in Africa and southwest Asia, about 17 million hectares of agricultural land were infested and treated as the management cost was about 274 million US\$. Therefore, the control of desert locust is critical for national food security. The effective

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management tool is relying on better knowledge of pest biology and ecology. The early formation and active changes in locust affected areas vary using land use/ cover changes (LUCC). Also, the patch-based habitat suitability assessment (PHSA) is helpful in defining locust extraction points after the ending of green vegetation. Remote sensing and Geographic Information System (GIS) relate locust outbreaks to spatial patterns of local conditions that vary with time. These characteristic changes mapped into GIS to monitor early locust populations to establish and managed. The moderate resolution image Spectroradiometer (MODIS) is used to monitor spectral information based on thermal and infrared radiations of potential swarms.

Conclusions: The results from these tools are influential to predict outbreaks and develop targeted based management plan for better control.

Keywords: Locust outbreaks, food security, land use/cover change, remote sensing

SPP-IPM-192

Pesticide application and human health; a strong narrative to be on integrated pest management

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ABSTRACT

Background: Pesticides are the only way to get rid of the plant pests and diseases, in consequence, the expected yields of the products are directly gained. The use of pesticides has tremendous benefits in the agriculture sector, public health, and domestic use largely contributed to the country economy as well. Enhanced productivity, protection from crop losses, yield improvements, and control of many vector diseases are the serious attributes of pesticide applications. Future food security challenges in increased production of ample food and fiber credited by the application of pesticides, and then this includes significant health implications to humans and his ecosystem. There are many devastating shreds of evidence of potential risk to many life forms on earth and have side effects on the environment. The high-risk groups are the farmers and their close belongings. The children are likely to be more vulnerable to these pesticides. Long term and low dose exposure to these potential pesticides cause immediate as well long term health effects like cancer, brain, and nervous system damage. About 1 million humans every year died because of indirect exposure to pesticides acquiring many diseases like birth defects due to sterility and infertility, hyperexcitability, tremors, cardiorespiratory and gastrointestinal symptoms.

Conclusions: The preventive and curative approaches are based on integrated pest management as it kept the pest population very low with minimal or zero pesticide risk hazard to human and its environment. IPM is dynamic and flexible in improving food quality, health benefits, and socioeconomic welfare to the ecosystem.

Keywords: Pesticide application, health implication, potential risks, diseases

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Potential of entomopathogens and their products in integrated pest management

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ABSTRACT

Background: Entomopathogens are the most important natural entities which regulate insect populations naturally and are known to have much potential to control many pests of agricultural crops. The sole reliance on pesticides has led to negative impacts on humans as well as the environment. The world is now moving towards reduced pesticide application due to the increased development of resistance. This resistance has led to explore sustainable, environment-friendly, safe, and alternative methods of insect control. The demand for naturally occurring entomopathogens like fungi, bacteria, viruses, and nematode has increased as they appeared to be a ready-made component in Integrated Pest Management. They infect the insect's cuticle, get access to hemolymph, producing several types of toxins, and utilizing the host's nutrients avoiding insect responses. These entomopathogens are widely utilized as conidia, mycelium, toxins, and crystalline proteins which then cause mortalities. Up till now hundreds of products based on entomopathogens are registered comprising 60% fungal origin, 29% bacteria, 10% viruses, and 1% based on nematodes. Globally the biopesticide market is increasing day by day and in the future, it is predicted to touch nearly 8 billion dollars in upcoming 2021 with increased annual growth of 14%.

Conclusions: The biopesticides available to the market against many crop pests is ensuring better pest management in agro-ecosystems with no or little harm to the environment and human health. This has also led to the integration of these biopesticides with synthetic pesticides to avoid the resistance in integrated resistance management programs.

Keywords: Entomopathogens, pesticides, biopesticides, resistance, IPM

SPP-IPM-194

Biological control of diseases: A recent trend in Agriculture

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ABSTRACT

Background: The intentional use of living organisms or their metabolites is that to suppress, decrease or kill the population of invading disease-causing agents through non-target or host-specific biocontrol agents such as insects, bacteria, viruses and fungi, which is broadly termed as biological control or biocontrol. Biological control is considered safe for both humans as well as non-target organisms, effective, biodegradable and environment friendly. Due to intensified cropping to increase production, chemicals are used indiscriminately to control diseases, pests, weeds, etc. leading towards the harmful impact not only on humans and animals health but also on the environment through their residues. Public attitude is changing with increasing awareness of the detrimental effects of chemicals towards pollution free environment.

Conclusions: Many agrochemicals are removed from markets due to pressure created by many legislative and social

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platforms in concern to environmental sustainability. Among agricultural control measures, almost 1% of biological products control equally that 15% of synthetic chemicals can do. That's way, demand or acceptance of biological control gained momentum as a central component in Integrated Disease Management (IDM) programs as well as used as a suitable alternate for harmful chemicals.

Keywords: metabolites, Integrated Disease Management, free environment

SPP-IPM-195

Application of advance and innovative techniques in plant protection

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ABSTRACT

Background: The application of “Omics” techniques in crop protection, that has been expressed the potential for “omic” based technologies derive innovation in crop protection is powerful when applied to understanding plant pathogen interactions and genetic variation among crop genotypes and populations of target organisms (pathogens, weeds and microbes). Few advance ideas on using “omics” more extensively in conventional crop protection strategies that includes, using molecular approaches to optimize the integrated use of agrochemicals with crop varieties of differing genetic background (matching fungicides mode of action with host resistance). Identification of new crop protection targets for intervention in pathogens, pests, and weeds which may provide the basis for screening chemical and biological agents.

Conclusions: Beneficial entophytes and resistance elicitors enhanced crop protection and improve its efficacy. Exploiting natural “plant protection strategies” including, pest and disease resistance, as well as embracing less studied interactions such as allelopathy. Developing synergistic mixes and formulations of pesticides, and directly identifying novel bioactive natural products through bio-prospecting.

Keywords: Omics, agrochemicals, plant protection strategies

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Significance of Resistance in Plants

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ABSTRACT

Background: In the 21st century one of the greatest challenges is to develop resistant crop. The Plants are exposed to pest, pathogen, bacteria and viruses etc and face many issues due to lack of resistance. About 1/4 Part of total yield is lost due to pre-harvest pest and pathogen. we need climate-resilient crops. Genetic resistance in crop is necessary to avoid chemical control of pathogens.

Conclusions: Heavy dose of chemical also create resistance in pathogens and kill beneficial insect also which create problems. Resistance can be introduced many ways like breeding & genetic engineering technologies, resistance also introduced in plants against certain disease and targeted pathogens to control such type of threats.

Keywords: Resistance, Pathogens

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Plant protection products and their sustainable and appropriate uses

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ABSTRACT

Background: Protection of plants from pests, weeds, and diseases, plays a significant role in agricultural development and improvement, as an important part in planning policy of several countries. Meanwhile the plant protection products are mostly chemicals and might be not only toxic for humans and faunas, but they can also adulterate the water bodies, ground water and soil with perilous pollutants, its use has to be environmentally friendly and sustainable. The paper discusses few aspects of benefits and risks concerning the use of pesticides. As an important tool, for plant protection agents, Limitations and reductions of uses enthusiastic to the improvement of residue in plants, foods and quality of environment.

Conclusions: Pesticides are accessible as grouped mostly according to its mode of action and the way a pesticide destroys or control the target pest (insecticides, herbicides and fungicides), and its targets, characteristics, structure and categories are presented, along with its formulations in various usable products for satisfactory storage, effective application safety of user and an environment. Multiple indicators of sustainable use of pesticides are analyzed in terms of valuable effect of the product, and considering monitoring and pollution prevention and environment friendly.

Keywords: perilous pollutants, environment friendly

SPP-IPM-198

Factors Affecting the Epizootics of Entomopathogenic Fungi

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ABSSTRACT

Background: Entomopathogenic fungi specifically infect and kill insects and can serve as a potential biological control agent. Several biotic and abiotic factors affect the occurrence, persistence, and epizootics caused by entomopathogenic fungi. In biotic factors, fungi characters like host range, latency, spore density, and dispersal, mainly host-pathogen compatibility influence epizootics. There are a complex array of insect host factors like behavioral, morphological, and physiological, which directly reduce the pathogenicity and virulence of entomopathogenic fungi. There are many plant-mediated effects on insect pathogenic fungi including plant architecture, surface chemistry, and leaf topology which support or cause the barrier to myco-biopesticide. Among these biotic factors, there are physical and chemical soil properties that greatly influence the entomopathogenic fungi are, soil texture, pH, E.c, moisture, C/N content, and organic matter. Insect pathogenic fungi field persistence is mainly affected by environmental factors including temperature, sunlight, humidity, rainfall. Solar radiation UVA (320–400 nm) and UVB (290–320 nm) directly affect fungal persistence and cause damage to spore viability. Temperature (10oC- 35oC) probably does not adversely affect the entomopathogenic fungi but its extreme and low degree damage the spore viability. Humidity does not damage the fungi activity, lack of moisture affects fungi viability because >96% moisture is the primary requirement for conidia germination.

Conclusions: To use these fungi as a biocontrol agent, we have to overcome these factors by providing them nutrients, protectants, and using different control practices.

Keywords: Entomopathogenic fungi, Biotic factors, Abiotic factors, Epizootics, Biocontrol agent

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***Trichoderma*; A Multi-Dimensional Biocontrol Agent**

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ABSTRACT

Background: *Trichoderma* spp are infectious opportunistic, effective plant symbiotic fungal agents, and a well-known biocontrol agent widely used in agriculture applications. Its symbiotic relationship with the plants provides resistance against pathogens, encourages nutrient absorption, increases fertilizer use efficiency, improves growth process, and grain yield. To stimulate these processes, different metabolites are biosynthesized like antibiotics, siderophores, enzymes, and regulators. They can control the harmful pathogens by preventing their development, competition, antibiosis, and mycoparasitism and do not affect beneficial microorganisms and have a negligible impact on soil evenness. *Trichoderma harzianum* also reported pathogenic against some insect species, it attacks eggs, proliferates inside them, kills the larvae, and infect the adult stage by contact mode of action; it can be used as an effective tool for control of insect pests.

Conclusion: This biocontrol agent can be used in various applications, soil to foliar, seed coating to post-harvest. *Trichoderma* spp has received so much consideration from researchers and the commercial market. This comprehensive review summarizes the physiological and biochemical benefits of symbiosis, ecological significance, biological control of action, and production of myco-biopesticide. It can be used in different control measures and it is an eco-friendly, safe, and effective biocontrol agent.

Keywords: *Trichoderma* spp, Biocontrol, Pathogen, Symbiosis, Mycoparasitism, Insect pathogenic fungi

SPP-IPM-200

Plant Extracts as an Ecofriendly Management of Whitefly, *Bemisia tabaci*

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ABSTRACT

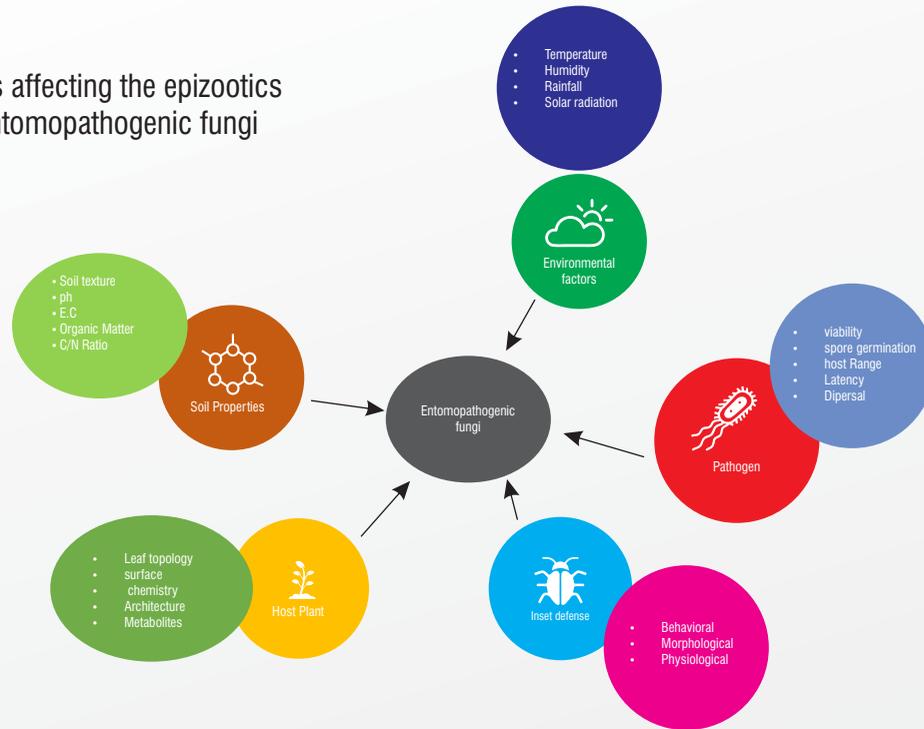
Background: Cotton is among the important economic crops grown in Pakistan and is the backbone of Pakistan's economy which contributes 0.8% in GDP and 4.5% in value addition. One of the major threats to the crop across the globe is the whitefly (*Bemisia tabaci*). Besides all the possible factors regarding outbreak of whitefly population the major one is widespread use of insecticides which not only cause the resistance development in whitefly but also cause mortality of beneficial insects. Fifteen different plant extract are being used in cotton for whitefly management.

Methods: To check the impact of plant extract on whitefly population under laboratory conditions. Aqueous solution was extracted from the plant leaf material by using Soxhlet apparatus. For seed extraction, concentration was prepared by dissolving the seeds in water and kept it for two days. After two days, the mixture was grinding and sieve. This concentrated extract/mixture of plant seeds material was placed in a plastic bucket as stock solution. For adult bioassay, each plant was treated as a single concentration and each treatment was replicated four times including a distilled water control. These treated plants were place in the insect rearing laboratory under the environmental condition and 20 adults was released in cage. The data was recorded after 12, 24, 48 and 72 hrs by counting the live adults. For nymph bioassay

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Factors affecting the epizootics of Entomopathogenic fungi



50 whitefly was transfer on cotton plant in clip cages for 24 for egg laying, after which the adults were removed. The cotton plant containing eggs was place in growth chamber for ten to twelve days until nymphs reached second instars and nymph on cotton plant per leave was counted using a stereomicroscope. leave containing nymph was dipped in different concentration of plant extract for 5 sec. Each plant was treated as a single concentration and each treatment was replicated four times including a distilled water control. These treated plants were place in the insect rearing laboratory under the environmental condition and data was recording after 12, 48, 24 and 72 hrs by counting the live nymph.

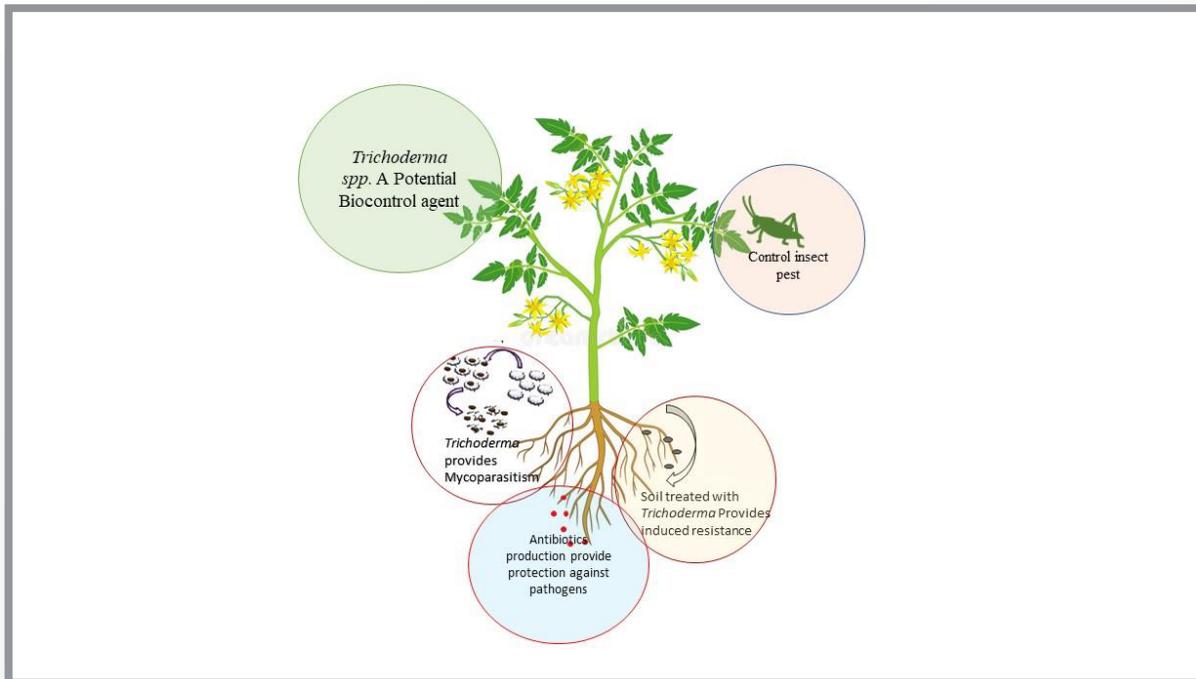
Results: The maximum population mortality percentage against whitefly (adult) was observed in neem leaf was 55% at 30% concentration and Bitter Apple Fruit was 51.66% at 30% concentration. The maximum population mortality percentage against whitefly (nymph) was observed in neem leaf was 52 % at 30% concentration and Bitter Apple Fruit was 48.18 % at 30% concentration.

Conclusion: All plant extracts were very effective against whitefly, but neem and bitter Apple fruit is significantly better for whitefly adult and nymph management. Besides all the possible factors regarding outbreak of whitefly population the major one is widespread use of insecticides which not only cause the resistance development in whitefly but also cause mortality of beneficial insects, so plant extract is very effective against whitefly.

Keyword: *Bemisia tabaci*, Concentration, Population

THEME-1:

INSECT PEST MANAGEMENT



SPP-IPM-201

Impact of Glyphosate on Ecosystem

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ABSTRACT

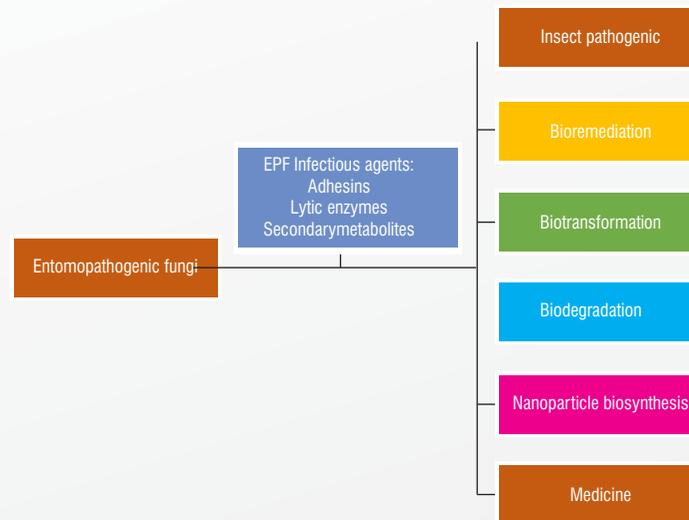
Backgrounds: Glyphosate is mainly used as broad spectrum, systemic, non-selective, and post emergence herbicide globally. Like all other pesticides, glyphosate has also negative impact on humans and other non-target organisms. A lot of research work conducted to evaluate the glyphosate impact on animals, livestock, humans, model organisms (rats and rabbits), crops and soils with different views. Here we reviewed the scientific literature to know the effects of glyphosate.

Results: Environmental Protection Agency (EPA) and European Food Safety Authority (EFSA) reported no adverse impact of glyphosate on environment and humans. But there are many researchers who disagree with EPA and EFSA verdicts. They experimentally proved that glyphosate has phyto-toxic effect, cyto-toxic effect, residual impact on human and animals. International Agency for Research on Cancer (IARC) also evaluated its carcinogenic effects on mammals.

THEME-1:

INSECT PEST MANAGEMENT

SIGNIFICANT AND DISTINCTIVE APPROACHES OF ENTOMOPATHOGENIC FUNGI



SPP-IPM-202

Evaluation of host plants of Fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae) larvae in Southern Punjab Pakistan under laboratory conditions

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ABSTRACT

Background: Fall armyworm, *Spodoptera frugiperda* is documented as one of the most important noctuid moth pests of agricultural crops in many countries and has recently become an invasive pest in Pakistan. It is the most destructive pest of crops belonging to Asteraceae, Fabaceae and Poaceae families. The detailed information of host plants plays a key role in understanding the ecology, biology and developing effective strategies to control the current pest.

Methodology: For this purpose, the current study was conducted to check the most suitable host (cabbage, potato, cotton, maize, lehli) of this emerging and invasive alien pest in the country.

Results: Among tested hosts, maize and cabbage were found most suitable for larval feeding. The incubation period was recorded 2.00 and 2.12 days on cabbage and maize, respectively. The developmental period of larvae was found longer on cabbage as compared to maize. Potato, cotton and lehli were not found suitable for pest rearing.

Conclusion: The study concluded that maize and cabbage are the most suitable hosts for *S. frugiperda* larvae under natural and controlled conditions.

Keywords: *Spodoptera frugiperda*, Invasive alien species, Host plants, Poaceae, Southern Punjab, Pakistan

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-203

Rearing of *Spodoptera frugiperda* under laboratory conditions by using new method that shows no larval cannibalism

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ABSTRACT

Background: The rearing of fall armyworm (FAW), *Spodoptera frugiperda* (Lepidoptera, Noctuidae) in the laboratory by using a new method shows that larval cannibalism is not mandatory.

Methodology: Larvae of the *S. frugiperda* can be efficaciously reared in a cohort-based manner with no cannibalism. Here we show that 40 second instar larvae to pupation were reared in rectangular plastic containers with 90% survival rate.

Results: The equal number of eggs were laid by females that reared from the cohort-based method as well as reared individually. In this method 90% fertility was recorded. cohort-based method is resource, space and time saving method as compared to individual rearing method. This is a new method that show potential to increase the efficiency of both small and mass FAW rearing.

Conclusion: The current study shows many other factors may be responsible for larval cannibalism that need to be studied.

Keywords: New method, *Spodoptera frugiperda*, Mass rearing, Food resources, cannibalistic behavior

SPP-IPM-204

Integrated aquaculture-pest management: need of the time

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ABSTRACT

Background: Pest management is not a new term in agriculture but this is not commonly known for aquaculture. Many animals from different groups act as pests in fisheries and aquaculture practices like snails, burrowing shrimps, lice and other insects. This is also important to be noted that fish are also used in management of pest and control in agriculture like in rice fields, fish can help in controlling weeds and insect pests from the field as it will feed on those insects or weeds. So not only the losses will be reduced but in terms of aquaculture production profit or economy will be improved. Pest management includes mechanical, biological, cultural and chemical control.

Conclusion: Before using chemicals in an integrated pest management system some important points must be considered like: safety of fish, bioaccumulation, persistent and degradation rates.

Keywords: Fisheries, snails, insects

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-205

Does plant nutrition affect pollinator's abundance and diversity along with crop yield?

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ABSTRACT

Background: Pollination is an important factor which enhances plant growth as well as reproduction whereas different plants vary in their requirements for insect's pollination. There are different pollinating groups i.e. bees, flies, butterflies, wasps etc has been reported. However honey bees have been reported the most effective group of pollinators. Few studies have been conducted regarding the interactive effect of pollination, nutrition and crop yield.

Methods: However, previous studies have reported positive effect of nutrition on pollinator foraging behavior and crop yield. Therefore, current study was planned to investigate the interactive effect of pollinators, nutrition and crop yield in pumpkin.

Results: In this study three different treatments of recommended fertilizers was used i.e. T1 (Lower than recommended dose), T2 (Recommended dose) and T3 (Higher than recommended dose). Abundance and diversity of insect pollinators, their Foraging behavior and crop reproductive success with free insect visits as well as no insect visits was recorded in all the three treatments. Our finding shows that the pollinator's abundance, Visitation rate, Fruit setting and fruit parameters (Fruit weight, fruit length, fruit diameter, Seed weight and number of Seeds) was higher at T2 (recommended dose).

Conclusion: From this study it is suggested that farmer should apply the recommended dose of fertilizer to get the maximum benefits of pollination (higher yield).

Keywords: Pumpkin, Bees, Fertilizer, Foraging behaviour

SPP-IPM-206

Effectiveness of local pollinators of south Punjab in *Luffa aegyptiaca*

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ABSTRACT

Background: *Luffa aegyptiaca* (Lufa gourd) is one of the important vegetables grown all over Pakistan. About 80% of the world's production of fruits and vegetables including lufa gourd depend upon insect pollinators.

Methods: Experiment was carried out at research farm of MNS University of Agriculture, Multan in order to find pollinator effectiveness in terms of foraging behavior (visitation rate and stay time) and abundance were evaluated.

Results: The results revealed that on staminate flowers Honeybee (*Apis dorsata*) was most abundant followed by Non-Apis bees (*Xylocopa* sp.) while on pistillate flowers Non-Apis bees were most abundant followed by honeybees. However, syrphid flies were least abundant on both staminate and pistillate flowers. Visitation rate of Honeybees was highest in both staminate and pistillate flowers (7.9 ± 1.03 and 1.2 ± 0.09 respectively) followed by Syrphid flies and Non Apis bees. While the stay time of syrphid fly (40.8 ± 2.02 sec) was higher than Non Apis bees (30.1 ± 1.32 sec) and Honeybees (28.1 ± 1.03 sec).

Conclusions: Conserving these native pollinators including honeybees, non-apis bees and syrphid flies may enhance the fruit production of lufa gourd in Pakistan.

THEME-1:

INSECT PEST MANAGEMENT

Keywords: Apis bee, Non-Apis bees, Pollinator effectiveness, Visitation rate, Stay time
SPP-IPM-207

Impact of wheat crop cues on interactions between *Diuraphis noxia* (Hemiptera: Aphididae) and *Chrysoperla carnea* (Neuroptera: Chrysopidae): A tritrophic interaction

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ABSTRACT

Background: Green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is an effective predator of aphid. Aphid is a pest of different crops i.e., wheat, cotton, mustard, maize etc. Wheat aphid, *Diuraphis noxia* (Mordvilko) (Hemiptera: Aphididae) causes damage by sucking sap and secreting honey dew on which sooty mold develops. Volatiles are released by plants due to feeding of *D. noxia*. Response of predators towards damaged plants by its prey is very difficult. Until now, no work has been conducted to check the tritrophic interaction i.e., wheat-wheat aphid-green lacewing. There is a need to confirm the role of volatiles in the attraction of *C. carnea* towards plants and *D. noxia*.

Methods: Four arm olfactometer was used to assess the role of volatiles released by plants in response to *D. noxia*. Different plant parts (leaves and spike) were used to check the response of *C. carnea* on plant and wheat aphid. These plant parts (undamaged and damaged by wheat aphid) were used in different combinations in olfactometer. In all bioassays, odor source was compared with combination, individual plant parts and with control.

Results: When plant parts were provided without *D. noxia*, the highest response was observed towards spike, followed by leaves. While, when plant parts were provided with *D. noxia*, a similar trend was observed as in without *D. noxia*, but comparatively greater than as in without *D. noxia* towards spike and leaves.

Conclusion: These findings suggested that, during host finding *C. carnea* use volatiles released by plants in response to *D. noxia* feeding. Future work should depend on the identification of plant volatiles induced by *D. noxia* feeding and pheromones of *D. noxia*.

Keywords: predator, volatiles, olfactometer.

SPP-IPM-208

Efficacy of Profenofos, citrus oil and their mixture against two key predators of citrus mealybug, *Planococcus citri* (risso) under laboratory conditions

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ABSTRACT:

Background: Synthetic insecticides used to manage the insect pests may disrupt the success of beneficial insects through residual toxicity. Assessment of sub-lethal and lethal effects of these pesticides on key biocontrol agents is essential before integrating them with other pest control methods.

Methods: Sub-lethal effects of profenofos, citrus oil and their mixture at their sub lethal concentration level (LC_{25}) observed for citrus mealybug were also assessed against adults of selected predators namely *Cryptolaemus montrouzieri* Mulsant (Coleoptera: Coccinellidae) and second instar larvae of *Chrysoperla carnea* under laboratory conditions through consumption of *P. citri* individuals exposed earlier to leaves treated with selected insecticides.

Results: Feeding rate significantly reduced when *C. montrouzieri* and *C. carnea* fed separately on treated prey with maximum daily prey consumption (40.15 ± 0.80 , 24.85 ± 0.30) observed in control (Untreated). Minimum prey

THEME-1:

INSECT PEST MANAGEMENT

consumption was in a mixture of profenofos with citrus oil (15.15 ± 0.80 , 7.75 ± 0.30) following moderate (33.10 ± 0.8 , 16.05 ± 0.30) in citrus oil treatment for both predators, respectively. Mortality of both predators was influenced by ingestion of treated mealybug such as less mortality (15%, 35%) was recorded with citrus oil while maximum (25%, 60%) in mixture compared to control (10%, 30%). Behavioral response revealed selected avoidance response towards insecticide and spent more time on leaves treated with citrus oil followed by profenofos whereas least on their mixture treated leaves.

Conclusion: We suggest that citrus oil alone at sublethal concentration may be utilized to control the *P. citri* compatible with both *C. montrouzieri* and *C. carnea*. Profenofos even at sub lethal concentration should be avoided for *C. montrouzieri* adults and larvae of *C. carnea* to suppress the mealybug infestation.

Keywords: insecticides, lethal effects, mortality.

SPP-IPM-209

Efficacy of different insecticides against gram pod borer, (*Helicoverpa armigera* Hubner) and their non-target effects on beneficial insects

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ABSTRACT

Background: Gram pod borer (*Helicoverpa armigera*) is a serious pest of Chickpea.

Methods: This study was conducted to determine the comparative efficacy of eight different insecticides viz; Novaluron 10 EC, Flubendiamide 480 SC, Emamectin benzoate 1.9 EC, Spinosad 240 SC, Bifenthrin 10 EC, *Bacillus thuringiensis* (Bt), Lufenuron 5% EC and Spinetoram 120 SC against the larvae of *H. armigera* and their safety to beneficial insects on chickpea in the experimental area of Entomological Research Institute, Faisalabad Pakistan were recorded.

Results: After 3 days of insecticidal application, Bifenthrin and Emamectin benzoate showed the highest reduction of the larval population (86.53%, 76.80%), after 7 days of insecticidal application Bt and Lufenuron showed the highest mortality percentages (84.97%, 77.33%) and then after 14 days with the application of Bt and Lufenuron (76.47%, 68.33%) mortality percentages were recorded. After 3 days, Lufenuron and Spinetoram give the highest population survival of the beneficial insects as compared to other insecticides. After 7 days, Bt and Spinetoram while after 14 days the highest survival percentages were recorded in Bt and Lufenuron.

Conclusion: Considering the results of the experiment *B. thuringiensis*, Bifenthrin and Lufenuron were found to be the most effective insecticide while Novaluron and Flubendiamide were the least effective insecticides for the control of *H. armigera*.

Keywords: insecticides, borer, chickpea.

THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-210

Comparative study of genitalia in four species of subfamily heliothinae (noctuidae: lepidoptera), Multan, Pakistan

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ABSTRACT

Background: The subfamily Heliothinae of family Noctuidae comprises 381 species that are distributed in the tropical and temperate regions of the world. The Heliothine larvae mostly feed on the fruits, seeds and flowers and cause great economic loss. Most of the species are morphologically similar but different on the basis of internal anatomy. Due to the insufficiency of information, it is necessary to improve the comparative study of subfamily Heliothinae on the basis of genitalia.

Methods: In current study, species of subfamily Heliothinae were collected with the help of light traps from the field area of Bahauddin Zakariya University Multan during March to May 2019. The specimens were killed and then placed in wet butter paper for softness. For study of genital organs, the abdomen was detached from the body and then placed into 10% KOH solution for 24 hrs. Dissection of abdomen was made with the help of fine forceps and needles, and the genitalia of the specimens were mounted in Hoyer's medium on the glass slides.

Results: Two species including *Helicoverpa armigera* and *H. zea* belonging to genus *Helicoverpa* while two species viz., *Heliothis peltigera* and *H. ononis* of genus *Heliothis* were identified on the basis of genitalia, with the help of available taxonomic keys.

Conclusion: With the proper identification of genitalia, researchers may devise effective insecticidal management strategies which will deteriorate the reproductive potential of pests.

Keywords: identification, lepidoptera, noctuidae, genitalia, *Heliothis*.

SPP-IPM-211

Predation of phytoseiidae (acari) against thrips and spider mites in laboratory conditions

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ABSTRACT

Background: Mites of the family *Phytoseiidae* (Acaria) are known to predate on small soft bodied insect pest like thrips, whitefly, aphid and phytophagous mites of families Tetranychidae, Tenuipalpidae, Eriophyidae, and Tarsonemidae. These mites have a great economic importance in IPM programs regarding their use as biocontrol agents in various parts of the world against harmful mites. Much work has been done on this aspect in the world, but a little work has been done in Pakistan.

Methods: An experiment was conducted in Acarology Research Laboratory, University of Agriculture, Faisalabad to study the predatory potential of phytoseiid mites against spider mites and thrips. The experiment was conducted with four replications under CRD. The predatory and spider mites were collected from different vegetable crops like cucumber, chilli, and bitter gourd. Mite feeding cells (plastic arena) with different predator pest ratio were used @ 1:5, 1:7 and 1:9 on

THEME-1:

INSECT PEST MANAGEMENT

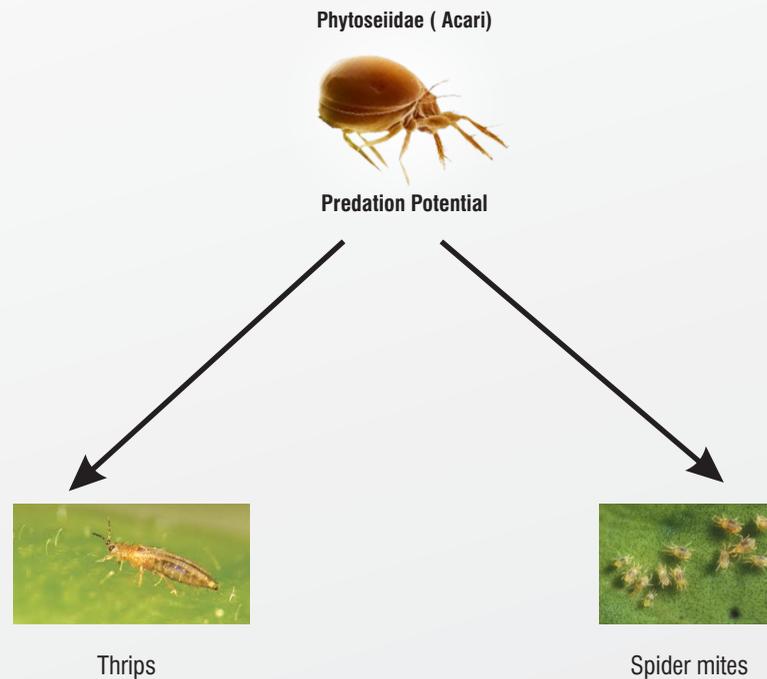
fresh leaves. Data of predation were recorded after 24, 48, 72 and 96 hrs respectively.

Results: Data was recorded each morning once a day. The number of consumed specimens were added in the same arena to maintain the said ratio of predator and pest. The comparison of feeding results was determined and found that in the ratio of 1:7 phytoseiid mites give more efficacy rate of predator as compared to the ratio of 1:5 and 1:9 respectively within thrips. The comparison of feeding results was also determined between phytoseiid against spider mites and it was found that in 1:9 phytoseiid mite ratio gives more efficacy as compared to 1:5 and 1:7 predator pest ratio.

Conclusion: Predatory mites can be used against spider mites and thrips in fruit and vegetable crops as potential biocontrol agents.

Keywords: predatory mites, spider mites, thrips, feeding potential

Predation of Phytoseiidae(Acari) against thrips and spider mites in laboratory conditions.



SPP-IPM-212

Zinc bio-transfer in *brassica* oil-seeds and its impact on mustard aphid infestation and morphology

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ABSTRACT

Background: Aphidis notorious pest of oil seeds crops. A number of approaches are used to constrain aphids to eliminate

THEME-1:

INSECT PEST MANAGEMENT

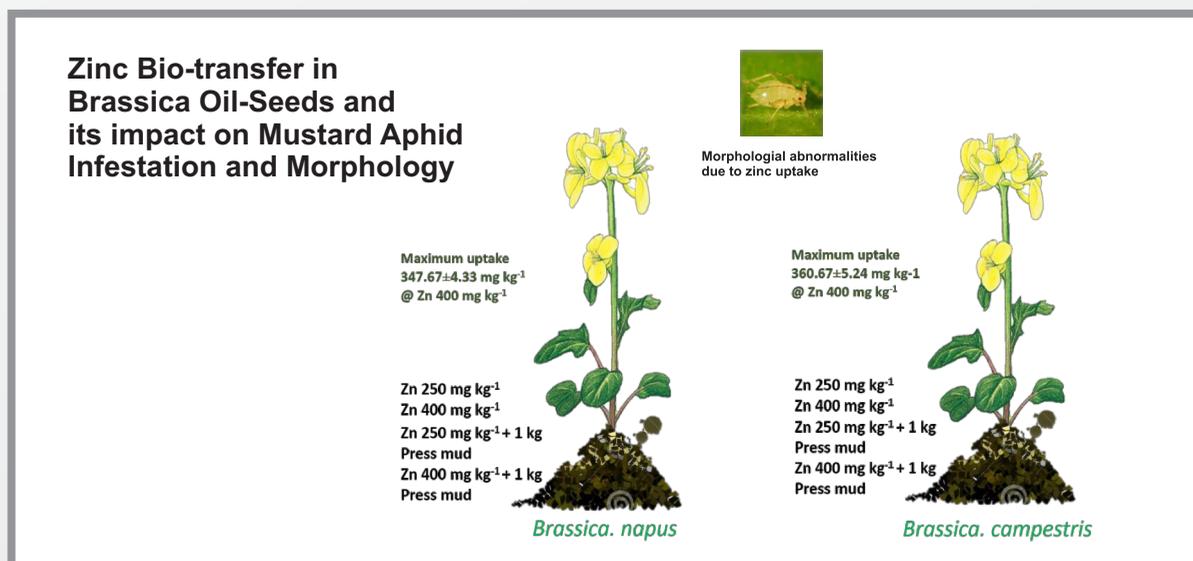
damage to oilseed. Integrated pest management including host plant resistance and biological control are possible environment friendly ways to overcome insect pest infestation including aphids. Plants from brassica species are well known for their pumping efficiency of heavy metal from soil due to their biomass. Plants with a certain amount of heavy metals content in sap poses significant impact on pests especially sucking insects.

Methods: Present research work was laid out under laboratory conditions to evaluate the effect of press mud and zinc heavy metal on bio transfer in brassica plants (*B. napus* and *B. campestris*) and its impact on mustard aphid infestation was observed. Experiment with five treatments including control i.e. Zn @ 0 (control); Zn 250 mg kg⁻¹ + press mud 1 kg; Zn 400 mg kg⁻¹ + press mud 1 kg; Zn 250 mg kg⁻¹; Zn 400 mg kg⁻¹; were used in this experiment. The Zn accumulation in both plant species and aphids were detected by employing atomic adsorption spectrophotometer (AAS). The developmental instability extent was calculated as fluctuating asymmetry (FA). Fluctuating asymmetry of four different bilateral characteristics was measured by determining the absolute difference between both left and right sides of aphids.

Results: The Maximum zinc heavy metal uptake up to 347.67 ± 4.33 mg kg⁻¹ in *B. napus* after the application of Zn 400 mg kg⁻¹ as compared to Zn+PM (400 mg kg⁻¹+ press mud 1 kg) treatment, where zinc uptake was observed as 310.33 ± 4.91 mg kg⁻¹. While, the minimum zinc heavy metal uptake was recorded up to 55.67 ± 3.48 mg kg⁻¹ in control treatment. Maximum zinc heavy metal uptake up to 360.67 ± 5.24 mg kg⁻¹ was observed after the application of Zn 400 mg kg⁻¹ as compared to Zn+PM (400 mg kg⁻¹+ 1 kg) treatment, where zinc uptake was measured as 323.00 ± 6.03 mg kg⁻¹ in *B. brassicae* after feeding on heavy metal contaminated *B. campestris* plants. Zn heavy metal uptake posed an important impact on body mass of *B. brassicae*. Maximum mean body mass was calculated from Zn 400 mg kg⁻¹ treatment up to 518.33 ± 10.13 μg, while the minimum mean body mass was found in control treatment as 283.33 ± 6.66 μg.

Conclusion: The study concluded that certain levels of zinc applied to *B. campestris* and *B. napus* plants can lead to morphological abnormalities in *B. brassicae*. The ultimate result of this can reduce the farmer's expenses on pest management activities and proved as environmentally friendly.

Keywords: ecofriendly, Aphid, Press mud, Bio transfer,



THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-213

In vitro screening of insecticide molecular compatibility with *Metarhizium anisopliae* against different aphid species.

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ABSTRACT

Background: Crop protection from insect pests is one of the most important subjects of present times. Aphids are among the sap sucking insects which cause high economical yield losses due to their mode of action. Aphids also act as a vector of various diseases. Farmers use various techniques to control aphid infestation. The objective of present study was the evaluation of comparative efficacy of insecticides with *Metarhizium anisopliae* through in vitro bioassay studies.

Methods: The fungus was cultured through potato dextrose agar (PDA) and different concentrations of insecticides were prepared. Compatibility of *M. anisopliae* with insecticides imidacloprid, pyriproxyfen, spirotetramat, and matrine was evaluated. The insecticides of more compatible nature were used for the control of aphids, *Aphis gossypii* and *Brevicoryne brassicae*. The maximum colony diameter of fungus (4.200mm) was observed with the 0.125% concentration of imidacloprid in comparison with pyriproxyfen 0.23% concentration showed the maximum colony diameter (3.500mm) and the insecticide which proved more toxic to *M. anisopliae* growth was spirotetramat at concentration of 0.062% with maximum colony diameter of (3.1 mm). The leaf dip method was used for the treatment of *A. gossypii* and *B. brassicae* species with aphidicides alone and in combination with *M. anisopliae*.

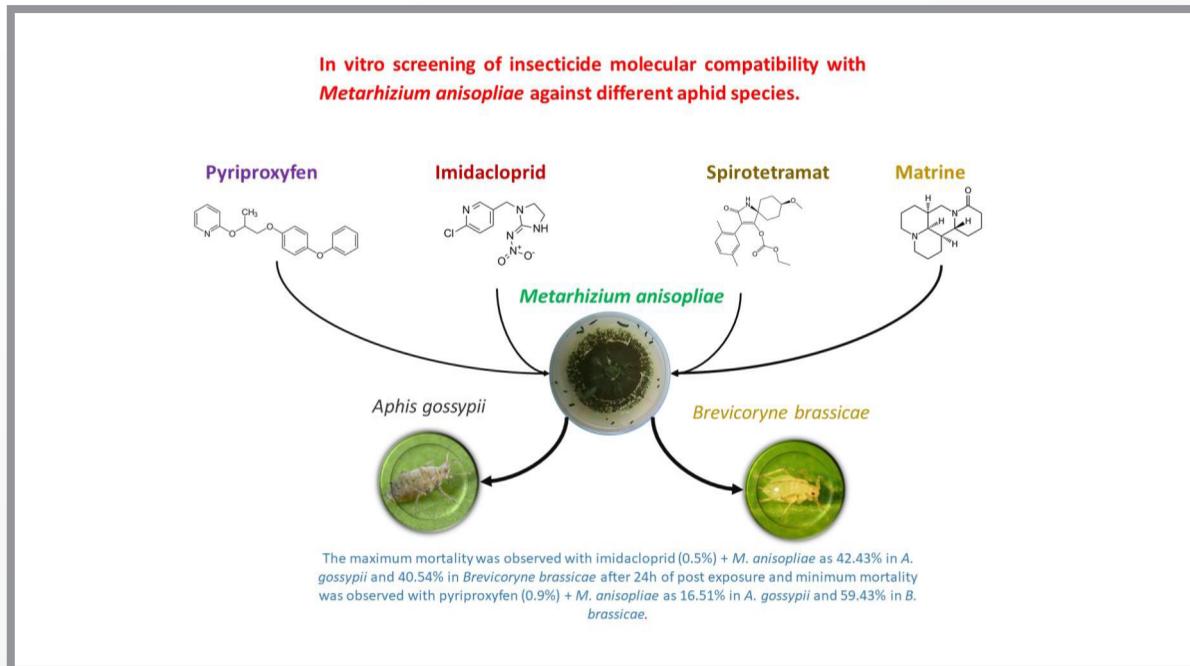
Results: The maximum mortality was observed with imidacloprid (0.5%) + *M. anisopliae* as 42.43% in *A. gossypii* and 40.54% in *Brevicoryne brassicae* after 24h of post exposure and minimum mortality was observed with pyriproxyfen (0.9%) + *M. anisopliae* as 16.51% in *A. gossypii* and 59.43% in *B. brassicae*. After 48h of post exposure maximum mortality was observed with imidacloprid (0.5%) + *M. anisopliae* as 78.49% in *A. gossypii* and 77.86% in *B. brassicae*. While minimum mortality was recorded with pyriproxyfen (0.9%) + *M. anisopliae* as 16.51% 42.43% in *A. gossypii* and 59.43% in *B. brassicae*. The maximum mortality 87% was observed with 0.5% imidacloprid + *M. anisopliae* (2.4×10^6 cfu/ml) after 72 hours of treatment. The pyriproxyfen at 0.9% concentration with *M. anisopliae* (2.4×10^6 cfu/ml) gave 84% mortality. The maximum mortality 81% was observed with spirotetramat 0.25% and *M. anisopliae* 2.4×10^6 cfu/ml after 72 hours of treatment. Alone concentration of insecticides imidacloprid 0.5%, pyriproxyfen 0.9% and spirotetramat 0.25% gave 75%, 63%, and 56% respectively. The *M. anisopliae* at different concentrations also gave significant results against *A. gossypii* and *B. brassicae*. The Highest mortality 54.45% was recorded with 2.4×10^6 cfu/ml concentration, and the 2.4×10^5 cfu/ml and 2.4×10^4 cfu/ml respectively gave 28.51% or 20.51% aphids mortality.

Conclusion: This study helped to check the efficacy of entomopathogenic fungi integration with pesticides as a biocontrol agent. Overall it is concluded that combined usage of insecticides and fungus is more efficient than the insecticides alone proved as the best package for IPM and also an ecofriendly approach.

Key words: *Metarhizium anisopliae*, Aphids, ecofriendly approach, Pakistan.

THEME-1:

INSECT PEST MANAGEMENT



SPP-IPM-214

Smart Pesticides

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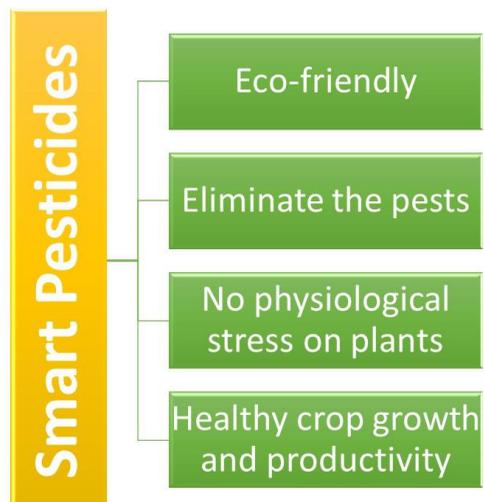
ABSTRACT

Background: Indiscriminate use of pesticides has caused environmental hazards, development of resistance in target pests and physiological stress on crops.

Conclusions: Four Brother Group of Pakistan has introduced Smart Pesticides Technology, our field experiments have proved that Smart Pesticides not only eliminated the pests (insect pests, weed pests, fungal pathogens) but also proved to be environmentally safe, having no physiological stress on plants, rather contributed to healthy crop growth and productivity. Now the Smart Pesticides are commercially available in the market.

Key words: Screening of different insecticides against

Smart Pesticides



THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-215

Comparative toxicity of phyto-extracts of indigenous flora of Soon Valley against some insect pests of agricultural and urban importance

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ABSTRACT

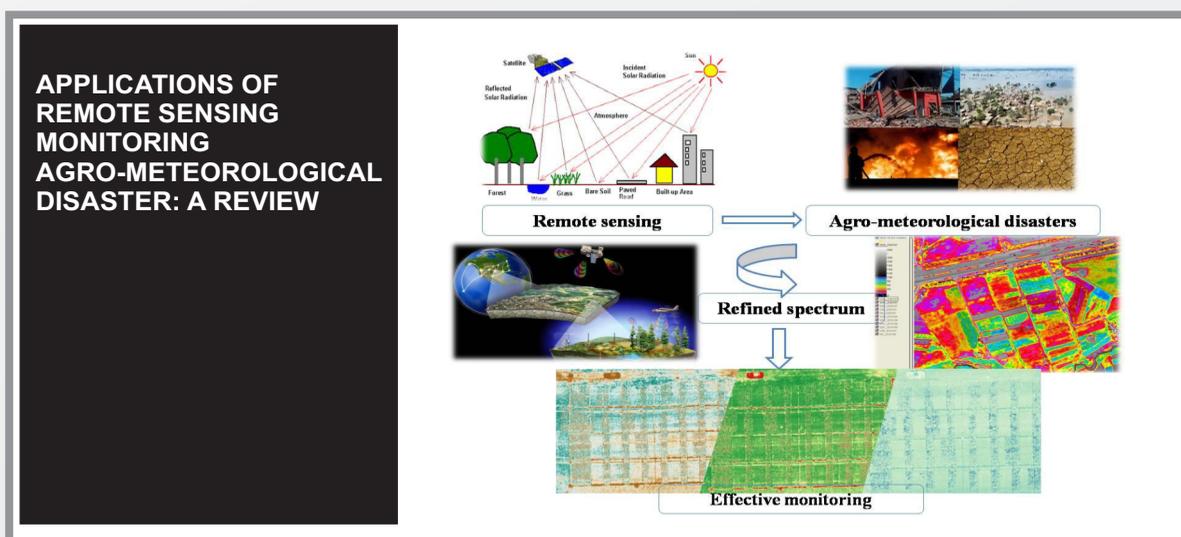
Backgrounds: Indiscriminate and irrational use of persistent synthetic insecticides has created many issues of environmental contamination and human health hazards, urging to seek for alternate biorational pest control options such as botanical pesticides. As indigenous plants of a particular biogeographical area may constitute bioactive compounds potentially effective against indigenous insect pest species, this laboratory study encompasses a first extensive evaluation of ethnomedicinal flora of Soon Valley and surrounding Salt Range (Khushab, Pakistan) for their toxicity potential against four major insect pests of economic importance.

Methods: Acetone extracts (10%) of forty plant species were evaluated against Asiatic citrus psyllid (*Diaphorina citri*), armyworm (*Spodoptera litura*), house mosquito (*Culex quinquefasciatus*) and subterranean termite (*Odontotermes obesus*) using twig-dip, leaf-dip, aqueous exposure and filter paper-dip bioassay methods, respectively.

Results: Results revealed that the extracts of *Mentha longifolia*, *Sonchus asper* and *Nerium indicum* were the most toxic to *D. citri* exhibiting up to 90% mortality. The extracts of *Dodonaea viscosa* and *Olea ferruginea* caused the highest mortality of *S. litura* (i.e. up to 70 and 58%, respectively). Maximum mortality of *C. quinquefasciatus* larvae was observed by the extracts of *Maerua arenaria* (87%), *N. indicum* (84%) and *Withania coagulans* (83%). While the most toxic plant extracts against *O. obesus* termites were *Periploca aphylla*, *Rhamnus* spp. and *Buxus papillosa* causing 89, 62, and 52% mortality.

Conclusions: These findings corroborate the effectiveness of indigenous plant extracts as safe and environment-friendly alternatives to hazardous synthetic insecticides and suggest the incorporation of these natural compounds in the pest management programs against agricultural and urban insect pests.

Keywords: Ethnomedicinal plants, ecofriendly, mortality.



THEME-1:

INSECT PEST MANAGEMENT

SPP-IPM-216

Applications of remote sensing in monitoring agrometeorological disaster: A Review

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ABSTRACT

Background: Agriculture activities are affected by many agrometeorological disasters, such as drought, flood, high temperature, etc. Remote sensing provides the effective parameters for atmosphere and land surface observations in regional scale, including vegetation index, leaf area index, fraction of photosynthesis active radiation, land surface temperature, soil moisture, drought index, flood area, etc.

Methods: The parameters of remote sensing are also used to drive models, which are valuable methods and tools to simulate the land biophysical processes and crop growth. In recent decades, more bands, more refined spectrum, higher spatial resolution, shorter observation intervals, and more kinds of observation modes are developed to provide stronger, powerful and various observation abilities, which can create more resolution ways for monitoring agrometeorological disasters in regional and global scale.

Conclusion: From the literature review, it is concluded that applications of remote sensing is an effective approach in monitoring agrometeorological disasters.

Keywords: Models, drought stress, crop growth, remote sensing.

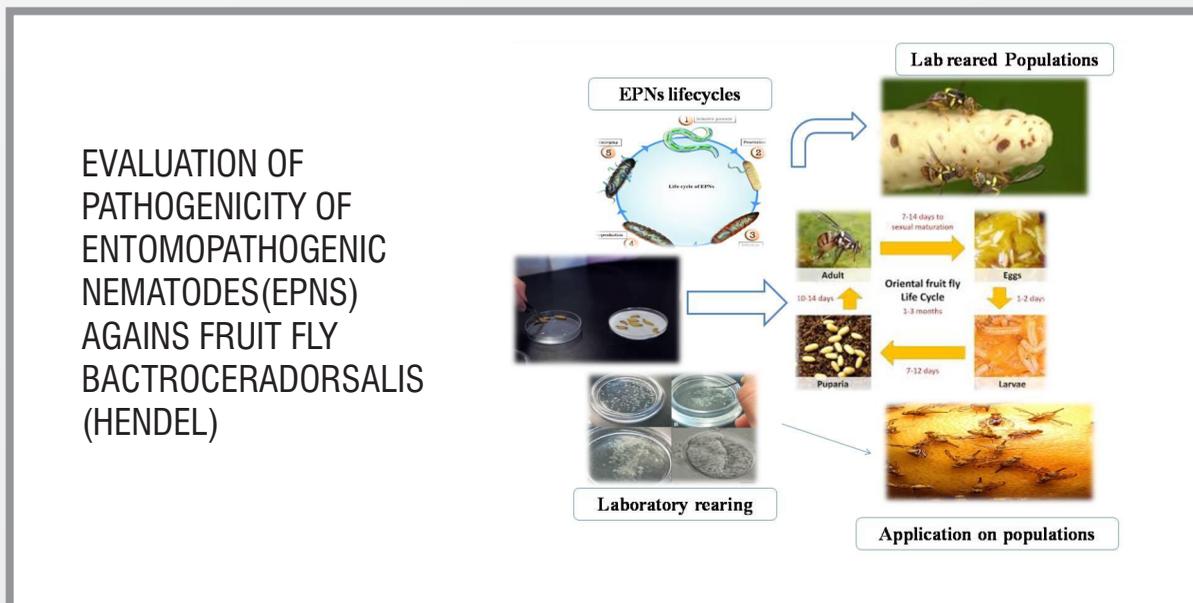
SPP-IPM- 217

Evaluation of pathogenicity of entomopathogenic nematodes (epns) against fruit fly *Bactrocera dorsalis* (hendel)

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ABSTRACT

Background: The oriental fruit fly, *Bactrocera dorsalis*, Hendel (Diptera: Tephritidae) is one of the major insect pests which renders the fruit to become unfit for human consumption. In severe cases, losses may reach up to 100% in some fruit crops.

Methods: The present study was performed at department of Plant Pathology, BZU, Bahdur sub campus, Layyah, aimed to investigate the pathogenicity of entomopathogenic nematodes (EPNs), *Heterorhabditis bacteriophora*, *H. indica*, *Steinernema carpocapsae*, and *S. asiaticum* against *B. dorsalis* larvae and pupae under laboratory conditions. 1 ml of EPNs, having 60, 90, and 120 infective juveniles (IJs) were poured into 9 cm Petri dishes with 20 g sterilized soil as supporting media.

Results: The highest larval mortality (70%) was obtained after 3 days of application of *H. bacteriophora* and *S. carpocapsae* and reached up to (96%) after 10 days. *S. asiaticum* and *H. indica* caused 91.16% and 85.87% mortality, respectively, after 10 days post-treatment at the highest nematode concentration (90 IJs/ml). Whereas, against the fruit fly pupae, *H. bacteriophora* caused 69.08% mortality after 10 days at the highest concentration (120 IJs/ml).

Conclusion: All nematode species showed high effectiveness against both stages of *B. dorsalis*. Their application can be further evaluated under field conditions to promote a good biological control of fruit flies for healthier fruit production.

Keywords: Infective juveniles, mortality, biological control

SPP-IPM-218

Evaluation of novel insecticides against *spodoptera exigua* h. (lepidoptera: noctuidae) in alfalfa seed crop

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ABSTRACT

Methods: A field experiment was conducted to evaluate the efficacy of eight new chemistry insecticides viz; Radiant (spinetoram), Coragen (chlorantraniliprole) Marshal (lufenuron), Runner (methoxyfenozide), Emamectin (emamectin benzoate), Belt (flubendiamide) steward (indoxacarb) and Talstar (bifenthrin) against an active infestation of army worm *Spodoptera exigua* (Hübner) larvae on Lucerne (alfalfa) seed crop at the Fodder Research Institute, Sargodha during three consecutive years of Rabi 2015-16 to 2017-18. The data was recorded before the treatment and then 3, 6, 9 and 12 days after treatment. Percent mortality was; 92% for belt; 91% for coragen; and, 88% for lufenuron at 3 days of post treatment. Percent mortality was 95% for lufenuron, 94% for belt, and 92% for coragen at 6 days of post treatment. Percent mortality was 84% for lufenuron and 82% mortality for belts at 9 days of post treatment.

Conclusion: It is concluded that lufenuron, belt and coragen are suggested to be sprayed on alfalfa seed crops against armyworm for better management.

THEME-1:

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SPP-IPM-219

Toxicity of different groups of insecticides and determination of resistance in *Aedes albopictus*

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ABSTRACT

Background: Huge number of insecticides are used for the control of agricultural pests and household pests like mosquitoes with over and under doses in Punjab, Pakistan. This resulted in insecticidal resistance in mosquitoes.

Methods: Adult and immature mosquitoes were collected from different habitats of Faisalabad with the help of aspirator and dipper respectively. Control populations were reared for 5 generations and caught from least exposed areas. These were reared and identified in lab and mosquitocidal assays were evaluated against larvae and adults after 24 h. Larvicidal LC₅₀ of temephos ranged 0.0075 to 0.422 $\mu\text{g gm}^{-1}$. In case of adulticides, three groups of insecticides used on papers to different populations collected from populated, agricultural and industrial areas of Faisalabad.

Results: Among the Insecticide group, synthetic pyrethroids were recorded as highly potent and extremely toxic at lowest concentration followed by Organophosphates (OP's) and carbamates. However, Synthetic pyrethroid group included Deltamethrin, recorded as highly potent (0.481 – 8.923 $\mu\text{g gm}^{-1}$) followed by cypermethrin (1.751 – 33.231 $\mu\text{g gm}^{-1}$). OP's group comprised of Pirimphosmethyl found highly toxic (11.312 – 299.612 $\mu\text{g gm}^{-1}$) followed by Malathion (21.001 – 592.925 $\mu\text{g gm}^{-1}$). The Carbamate group included Bendiocarb (71.01 – 6201.19 $\mu\text{g gm}^{-1}$). The Chi square value showed no heterogeneity in all experiments. The results also indicated that mosquito populations from agricultural areas were more resistant than populated and industrial areas. Biochemical analysis showed the elevated activity of enzymes (esterases, mixed function oxidases, glutathione S transferase and acetyl-cholinesterase) in resistant populations.

Conclusion: It was concluded that injudicious application of chemicals in an area, initiated risks of resistance, reappearance and resurgence of certain mosquitoes.

Key words: Mosquito, Insecticide, OP, bioassay.

SPP-IPM-220

Low doses of entomopathogens matter hugely, gateway to resistance development and retarded growth in *Helicoverpa armigera*

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ABSTRACT

Background: Entomopathogens greatly affect the growth and development of *Helicoverpa armigera* when applied under lab or field conditions.

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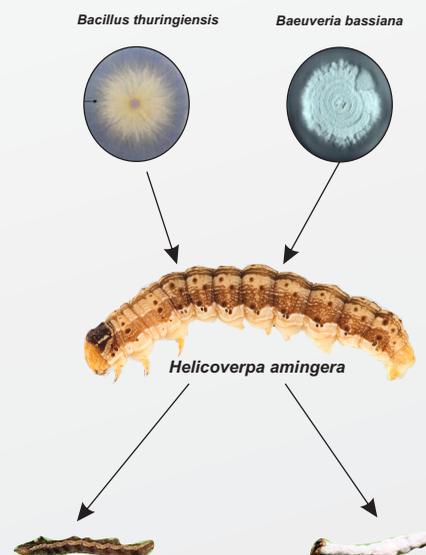
Methods: The present Investigations were carried out to observe the effect of *Bacillus thuringiensis* and *Beauveria bassiana* on the development, diet consumption, frass production, weight gain of 2nd and 4th instar larvae of *Helicoverpa armigera*. Growth and development were found adversely affected when treated with *Bb* and fed on *Bt*-mixed diets and significant variations were recorded for larval, pupal duration, pupal weight and adult longevity.

Results: Increase in larval and pupal duration while decrease in pupal weight and adult duration was observed depending upon the lethal action of the applied agent. The toxic nature of microbial agents also influenced weight gain, frass production and diet consumption. Larvae treated with lower concentration of *Bb* (1×10^6 conidia ml⁻¹) and *Bt* gained more weight than the high application rate (1×10^7 conidia ml⁻¹) or combined application. Initial weight of larvae exerted its impact on the weight gain and diet consumption and the trend was found linked to pathogenicity of applied agents. It can be surmised from the findings that microbial agents appreciably influence the growth and development, diet intake and frass production against *H. armigera*.

Conclusion: Hence it would be fruitful to make use of the susceptibility of *H. armigera* larvae to *B. bassiana* and *B. thuringiensis* to efficiently use these agents to lessen the feeding and survival under field conditions.

Keywords: Low doses, entomopathogens, resistance development, growth and development

Low doses of entomopathogens matter hugely, gateway to resistance development and retarded growth in *Helicoverpa armigera*



SPP-IPM-221

An investigation of *Caligula japonica* (Lepidoptera: Saturniidae) egg distribution and associated parasitoids on walnut trees (*Juglans regia* L.) in northwestern China

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ABSTRACT

Background: *Caligula japonica* is a serious defoliator pest of walnut trees, *Juglans regia*, in China. Important information about the occurrence of *C. japonica* egg masses on host plants and their indigenous parasitoids under field conditions are rarely documented. Here the distribution of egg masses of *C. japonica* on the trunks of *J. regia* and occurrence of its parasitoids in Kangxian, the most important walnut production area in northwestern China, were

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investigated.

Results: revealed that the egg masses were mainly located at 109.2 ± 62.3 cm height. The number of egg masses exhibited a significant positive linear relationship with the diameter of trees and a parabolic relationship with host tree height. The natural parasitism rate showed a significant negative linear relationship with the size of egg masses but no relationship with the height of egg masses. The percentage of parasitized egg masses and parasitism percentage of eggs were 49.0% and 7.0%, respectively. During the investigation we found seven egg parasitoid species belonging to three genera of Chalcidoidea, *Anastatus gansuensis* sp. nov., *A. fulloi*, *A. malingensis*, *A. japonicus* and *Mesocomys albitarsis*, *M. trabalae* (Eupelmidae) and *Aprostocetus brevipedicellus* (Eulophidae), in which *M. trabalae* had the largest Berger-Parker index (0.6963). In addition, the mycoparasitism of *M. trabalae* and *M. albitarsis* accounted for 39.7% of the total coparasitized egg masses. This investigation provides basic information for utilizing egg parasitoids against *C. japonica* in the future.

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An investigation of *Caligula japonica* (Lepidoptera: Saturniidae) egg distribution and associated parasitoids on walnut trees (*Juglans regia* L.) in northwestern China

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ABSTRACT

Background: Maize being one of the important crops of Pakistan having so many uses including forage, food and in industry. Production of maize is decreasing in Pakistan by the attack of Maize stem borer. Maize stem borer emerged as a serious threat to the maize industry causing upto 30% damage. Integrated management of MSB involves biological, Biotechnological and chemical management of the pest. In biological control egg parasitoids (*Trichogramma* Spp) and larval parasitoids (*Cotesia flavipes*) are being used. Temperature, rainfall and altitude directly involve the presence or absence of parasitoids. The rapid increase in populations of stem borer can also be controlled by RNA interference (RNAi) Technology. Application of RNA interference technique to breed maize in an efficient way to control maize stem borer is the need of time. Chemical management involves use of various insecticides including Emamectin benzoate, Imidacloprid, Carbofuron, furadan and fipronil. This review highlights the importance of maize crop and also increase in stem borer population. Furthermore, it draws attention towards various control mechanisms not being utilized but can be beneficial towards the effective control of the Maize stem borer and hence can be valuable to achieve food security and increasing the production of maize.

Keywords: Biotechnological, Maize stem borer, RNA interference, Parasitoids, Technique

SPP-IPM-223

Locust, a serious threat to the economy and livelihood, non-disruptive management of locust. A review

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ABSTRACT

Agriculture contributes 24% of the GDP and more than half of the population of Pakistan is directly or indirectly related to agriculture and is the largest source of foreign exchange for Pakistan. Locust almost covers 57 million hectares of the land with its invasion while the total land under crop cultivation is 23 million hectares hence locust proved as a big threat to the

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food security and livelihood of the people of Pakistan and has been reported in all provinces of Pakistan. Locust can feed on any green vegetation and can feed on all crops. Natural management can be productive for the management of locust in this way crops can also be protected by hazardous effects of insecticide and also cost us so much. Natural habitat of grasshoppers is grasses if these grasses are converted to agriculture crops for the large scale monocultures of food crops. In this way their habitat will be shrunk and their survival becomes difficult which introduces strong learning behavior. If properly managed they can be proved beneficial for us as they are highly nutritive and have 12 times more protein than livestock.

Keywords: Locust, Non disruptive Management, Economy, Livelihood, Monocultures, Beneficial, Nutritive

SPP-IPM-224

Botanical plant extracts impose adverse effects on the population dynamics of cotton aphid, *Aphis gossypii* Glover (Hemiptera; Aphididae)

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ABSTRACT

Background: Synthetic insecticides excessively consumed to control the economically important crop pests. Abundant use of chemicals may implicate the whole ecosystem badly at the end. A number of plant species and their related compounds are now recognized to have great pesticidal properties against a range of arthropod pests.

Methods: The research presented here to assess the potential trade-offs of using botanical extracts (Neem leaf extract, NLE and Moringa leaf extract, MLE) along with synthetic insecticide, Confidor 200 SL, against *Aphis gossypii* Glover. Meanwhile, also determined the impact of these insecticides on natural enemies in the experimental field.

Results: Data were recorded 12h before, as well as 1, 3, and 7 days after the application (DPA) of insecticides. Results revealed that chemical insecticide after 1 DPA was showed higher mortality (%) of aphid's population at leaf (33%) and boll stage (41%), whereas the botanical treated plots showed lower mortality used alone as well combine application (NLE, 24%: NLE + MLE, 24% respectively) but lower numbers were observed on the negative controls. The same trend of insecticidal activity was observed from all treatments after 3 DPA, but interestingly, after 7 DPA, the resurgence of beneficial insects was only recorded in botanical extract-treated plots. The Confidor presented an adverse effect on natural enemies where no or few natural enemies were observed compared to herbal extracts.

Conclusion: Overall, for long-term control, the combined use of botanical insecticides is proved to be more efficient in the management of the aphids than Confidor and caused no or little adverse impact on the beneficial insects. Results of the experiment showed that all the tested plant extracts have potential value to substitute synthetic insecticides in boosting pepper production within the framework of sustainable pest management.

Keywords: Cotton aphid; Plant extracts; beneficial insects; insect resurgence; environment-friendly

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SPP-IPM-225

Field survey of immature stages of *Aedes albopictus* in urban and rural areas and its management

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ABSTRACT

Background: To evaluate the population density of *Aedes albopictus* in a natural environment that triggered the distribution, relative abundance and uplift the vectorial capacity.

Methods: As per WHO protocol, we assessed the larvicidal potential of fifteen indigenous plants extracts. A total of 7926 larvae from Faisalabad belong to eight species (two species each for Aedine and Anopheline, and four Culicine species).

Results: The most dominating mosquito species *Ae. albopictus* (98.6%, n = 3987, with >50% population collected from five selected habitats), densely populated *Cx. quinquefasciatus* (48%, n = 1296) and diversified *Cx. pseudo vishnui* (30.9%, n = 734) found in all habitat. However, among *Anopheline species*, *An. subpictus* (68.3%, n = 807) was very abundant and *An. stephensi* (31.7%, n = 375) was a diversified species. The highest larval population was observed in discarded tires and swamps (forest pool) compared to bamboo stumps and public parks. The canonical component analysis depicted that population of *Ae. albopictus* fluctuates due to climatic conditions. Out of fifteen plant extracts, red chilly (LC₅₀=247.78, RTI: 0.58 and LC₅₀= 5.68, RTI: 0.43) was found to have a significantly higher toxic effect after 24 and 48 hours compared to Aloe vera that shows effect after 72 hrs.

Conclusions: This study provides the basic information of *Ae. albopictus* abundance in urban and rural environments round the year which could be helpful for the development of population prediction models and implementing the dengue vector management through indigenous plant extracts. Further research work is recommended in identifying the bioactive compounds and their mode of action.

Key words: Extracts, Climatic Condition, Bioactive compounds

SPP-IPM-226

Entomopathogenic Nematodes: A successful tool for the management of termites

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ABSTRACT

Background: Termites harmed the household items, agricultural products, 90% damage to sugarcane and about 43% to maize.

Methods: Nowadays, many synthetic insecticides are being used to control termites that have had great impact on human health and environment. On the other hand their use is also killing the beneficial organisms in the field.

Results: Many fungi, bacteria and nematodes are known to suppress termite activity, but entomopathogenic nematodes (EPNs) also called beneficial nematodes, have great potential to control termite's population. EPNs provide ecofriendly and safe alternative to chemical insecticides. EPNs have ability to kill hosts quickly, easy mass rearing, high reproductive potential, safety to plants and many other non-target organisms.

Conclusions: EPNs from two genera *Steinernema* and *Heterorhabditis*, showed promising results against termites, 80-

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100% control through these genera has been recorded. They enter into the host through natural openings i: e. mouth, anus and spiracles. After they enter into the host they release their symbiotic bacteria in the insect body's hemolymph and kill the host.

Keywords: Entomopathogenic nematodes, Ecofriendly, Spiracles, Hemolymph

SPP-IPM-227

Current status of augmentatively mix releassing *Trichogramma* parasitoids against the rice striped stem borer, *Chilo suppressalis* in north eastern China

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ABSTRACT

Background: The rice striped stem borer (RSSB), *Chilo suppressalis* (Walker), is one of the most economically important rice pests worldwide.

Methods: Many methods have been used to control RSSB, including cultural practices, pheromone traps, planting resistant varieties, and insecticides. Among these methods, farmers still prefer to use insecticides because of their high efficiency. Because of the importance of rice as a staple food crop and the risk posed by the high toxicity of insecticides to humans, non-target organisms and the environment, the use of natural enemies for controlling these stem borers is increasingly considered an essential management strategy. In an investigation of indigenous egg parasitoids of RSSB during 2009 and 2010, four *Trichogramma* species (*T. japonicum*, *T. chilonis*, *T. dendrolimi*, and *T. ostrinae*) were collected from paddy fields in northeastern China. With the objective of screening suitable candidates for controlling *C. suppressalis*, a series of researches were conducted in the laboratory and field, mainly including performance of *Trichogramma* on RSSB under different temperature and humidity; parasitism and suitability of *Trichogramma* on different aged RSSB eggs; adaptation to intermediate hosts for mass production; natural population dynamics of four *Trichogramma* species in paddy field; evaluation of biocontrol efficiency of *Trichogramma* against RSSB in paddy field.

Results: On the whole, *T. dendrolimi* and *T. japonicum* exhibited better biocontrol potential on RSSB. In order to guarantee biocontrol efficiency and reduce production cost, we developed a new technology of biocontrol on RSSB with mixing release of *T. dendrolimi* produced by the large eggs of *Antheraea pernyi* and *T. japonicum* produced by the small eggs of *Corcyra cephalonica*. Meanwhile, we also developed a new type of spherical apparatus for releasing *Trichogramma* in the paddy field. In 2016-2020, a total area of 237,333 ha was controlled on RSSB with *Trichogramma* released by the spherical apparatus. The mean biocontrol efficiency on RSSB was approximately 86% with 360,000 *T. dendrolimi* and 90,000 *T. japonicum* / ha divided into releasing 3 times.

Conclusions: Generally, we have got a preliminary achievement in biological control on RSSB with mix-releasing *Trichogramma* parasitoids in northeastern China.

Keywords: Stem borer, *Trichogramma*, Population dynamics, *Corcyra cephalonica*

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SPP-IPM-228

Effectiveness of lufenuron and few entomopathogenic fungi against maize weevil, *Sitophilus zeamais*, (coleoptera: curculionidae), under laboratory conditions

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ABSTRACT

Background: The current study was designed keeping in mind the different problems of chemical insecticides including health problems and issue of insecticides resistance.

Methods: Four entomopathogenic fungi (*Metarhizium anisopliae*, *Beauveria bassiana*, *Isaria fumosoroseus* and *Verticillium lecanii*) and IGR Lufenuron were used to find their efficacy alone and in different combinations against maize weevil. Among different entomopathogenic fungi, *M. anisopliae* proved very effective against this pest when used at the concentration of 4 mg/kg after 21 days of treatment.

Results: The results of current study revealed that mortality of maize weevil increased with the increase in concentration and time intervals in all treatment. When this fungus integrated with Lufenuron in different combinations, the synergistic effect was observed which enhanced the mortality. Maximum mortality (95.42%) maize weevil was recorded in 10 ppm of Lufenuron 4 mg/kg *M. anisopliae*. Lowest adult emergence was observed in 10 ppm of Lufenuron + 4mg/kg *M. anisopliae* (1.33 adults) followed by 7.5 ppm of Lufenuron + 4 mg/kg *M. anisopliae* with 2.00 adults after 30 days of treatment.

Conclusions: It was concluded from these results that *M. anisopliae* has a potential to control this pest alone and with Lufenuron efficiently, reduce the adult emergence, decrease the grain infestation and weight losses and it can be used as a tool in integrated pest management to control this pest.

Keywords: *Metarhizium anisopliae*, Insecticides resistance, Synergistic effect

SPP-IPM-229

Evaluation of entomopathogenic nematodes on *Spodoptera frugiperda* (Lepidoptera;Noctuidae)

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ABSTRACT

Background: Fall armyworm (*Spodoptera frugiperda*) is a polyphagous pest. It damages many important crops such as maize, cotton, sorghum, rice, sugarcane and many other crops. Use of conventional insecticides is harmful for the environment and can also cause resistance in insects. Therefore, biological control of this pest can be a natural and safer way. Entomopathogenic nematodes (EPNs) are the efficient biological control agents for many important insect pests like sawfly, borers, weevil, fruit flies, oriental fruit moth, armyworm, wax moth and many other pests.

Methods: The current research was planned to evaluate the efficacy of EPNs on larvae of fall armyworm. The experiment was conducted under lab conditions. Selected EPN concentrations i.e 100, 200 and 400 IJs per ml were applied to the fall armyworm larvae. The experimental design used was Completely Randomized Design (CRD). The mortality was recorded on three different time intervals (24 hrs, 48hrs and 72 hrs).

Results: The results revealed that after 24 hrs maximum 33% mortality, was observed on high dose. Moreover, after 48 hrs 50% mortality was observed on medium dose while 90% mortality was recorded on high dose and after 72 hrs 50% and 75 % mortality was observed on low dose and medium dose respectively while 100% mortality was recorded on high

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dose.

Conclusion: It is concluded that EPNs concentrations can be a good control option for Fall Armyworm. It can also be a safe use to control this pest and must be included in the IPM program for pest control.

Keywords: Mortality, Concentrations, Completely Randomized Design, IPM

SPP-IPM-230

Does Mosquito Diversity have some Correlation with Habitat Characteristics and Environmental parameters?

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ABSTRACT

Background: Mosquitoes transmit several epidemic diseases in humans and animals. Female mosquitoes feed on human and animal blood to lay eggs. Meanwhile, causative agents are transmitted for diseases like dengue, malaria, zika and chikungunya. Pakistan has a favorable environment for mosquito breeding and every year, many cases of mosquito borne diseases are reported in South Punjab.

Methods: District Muzaffargarh faces a significant number of casualties as a result of mosquito borne diseases. The diversity of mosquitoes is not known in this region. There was a need to identify the mosquito species present here along with factors affecting their populations. Mosquito larvae were collected from possible habitats in the district based on physico-chemical parameters.

Results: Surveys were conducted during August to November and 10 mosquito species were reported i.e. *An. nigerrimus*, *An. stephensi*, *An. culicifacies*, *An. subpictus*, *Cx. pseudovishnui*, *Cx. vishnui*, *Cx. quinquefasciatus*, *Cx. tritaeniorhynchus*, *Cx. bitaeniorhynchus* and *Cq. crassipes*. Both dengue vectors (*Aedes aegypti* and *Aedes albopictus*) were not found from the area under study. It was concluded that the population of mosquitoes were high near vegetation. The maximum population was recorded in the months of October and November. There was no mosquito recorded from the fish farm, poultry farm, air cooler and tires.

Conclusions: Determining the mosquito diversity and their association with ecological and physico-morphic characters helps understanding the problems associated with mosquito borne diseases.

Keywords: Mosquito, Physico-chemical, Diversity, Physico-morphic characters

SPP-IPM-231

Morphological features of cotton plant, a defensive tool against sucking pests: a review

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ABSTRACT

Background: Cotton (*Gossypium hirsutum*) is a sessile plant, and its exposure to continuous harsh environmental conditions make this cash crop susceptible to attack by various sucking insect pests. Cotton plant has acquired some intrinsic structural features which act as basal first line immune defense gadgets. Number of gossypol glands, trichome density count, Leaf area, hair length, waxy cuticle, guard cells, idioblasts, moisture contents (%) in leaves, and thickness of leaf lamina render phonetic resistance to cotton plant. Whitefly (*Bemisia tabaci*), jassids (*Amrasca biguttula*) and thrips

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(*Thrips tabaci*) suck the cell sap and make the cotton plant vulnerable to many plant viruses, also resulting in stunted growth and decreased yield. Gossypol is a phenolic compound produced by pigment glands in cotton stems, leaves, seeds, and flower buds. Gossypol production is multifactorial, depends upon physical factors and positively correlated with rainfall. *G. barbadense* has high gossypol concentration among all species. Whitefly adult population is negatively correlated with hair density on leaf lamina and midrib and its nymphal instars have positive correlation with gossypol glands. Jassid adults and nymphal instars correlated negatively with hair density and trichome length on leaf lamina, midrib and vein. Thrips also show this type of antixenotic behavior by positively correlating with gossypol glands on leaf lamina and negatively correlated with trichome density.

Conclusions: Injudicious and frequent use of insecticides resulted in unstabilized agroecosystems which not only developed resistance in sucking pests but also affected natural enemies to a great extent. Eco-friendly alternatives should be adopted to help the farmers' community. Studies should be done at gene level and these built in features must be utilized in IPM.

Keywords: Trichomes, Whitefly, Gossypol, defense gadgets, *Amrasca biguttula*

SPP-IPM-232

Impacts of climate warming on tropical and subtropical insects: A review

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ABSTRACT

Background: Insects belong to the most ancient group of living entities on earth able to survive almost in every type of ecosystem from hot springs to the harsh deserts of Africa. Distribution, insect diversity and population dynamics of the earth's insect species is drastically affected by global warming. Rising temperatures, changing precipitation patterns, elevated CO₂ increased the incidence of invasive/exotic species by altering survival/development rates, fecundity and dispersal. CO₂ elevation disturbed carbon-nitrogen balance in plants affecting insect-feeding behavior, plant compensation responses to herbivores and intra-specific competition. Insects respond to these environmental variables by shifting the timing of life-cycle events, adopting new morphological features, shifting range boundaries and sometimes they become extinct when situations go beyond tolerance. Developmental stages of these ectotherms are highly sensitive to the fluctuating temperatures. Altered temperatures bolster the population of these cold-blooded animals and result in increased insect-vector epidemics. Cash crops of tropical and subtropical areas are encountered by various insect pest species in recent years.

Conclusion: All associated factors like natural enemies, predators, parasitoids, host plants, symbionts, and mutualists are directly influenced by these continuously changing climatic conditions. Prolonged summers and short winter induced earlier breeding in insects which resulted in the outbreaks of potential vectors of medical importance like mosquitoes. Rising temperature resulted in the survival of many urban and agricultural insect species to new areas where they were not reported in the last few decades. Eco-friendly alternatives should be adopted to avoid such inconveniences in future. Steps should be taken to limitize the effects of greenhouse emissions.

Keywords: Fecundity, Symbionts, Cold-blooded, Population dynamics, Invasive

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SPP-IPM-233

Impact of different diets on the population buildup and biology of *Rhizoglyphus tritici* (Acari: Acaridae) under *in Vitro*

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ABSTRACT

Background: The family Acaridae, storage mites are considered an economically important pest of stored grain commodities. These mites are also used as diet for a rearing of predatory mites in laboratory.

Methods: The research was conducted at Acarology Research Laboratory, Department of Entomology, University of Agriculture, Faisalabad, Punjab, Pakistan, to check the impact of different diets on the population buildup and biology of *Rhizoglyphus tritici* at 25 degree temperature, 75% Relative humidity under CRD design with three replications. For population buildup data was collected after every seven days interval until 28 days was completed. There are 5 diets were used in an experiment to study the biological parameter of *Rhizoglyphus tritici*. The population buildup was maximum on diet 4 poultry feed.

Results: The minimum population was most probably on diet 2 (wheat flour + maize flour + nedo) and on diet 3 (wheat flour + glucose + yeast). Results showed significant difference between the incubation period of *Rhizoglyphus tritici* female and food type. The male and female longevity was maximum on diet 4 poultry feed and was minimum on diet 2 (wheat flour + maize flour + nedo) and on diet 3 (wheat flour + glucose + yeast). The total fecundity was different on different diets which were (214 eggs) on diet 3 (wheat flour + glucose + yeast) followed by (187.6 eggs) on diet 5 (poultry feed + yeast), (172.1 eggs) on diet 2 (wheat flour + maize flour + nedo), (117.5 eggs) on diet 1 (wheat grains) and (106.3 eggs) on diet 4 (poultry feed).

Conclusion: The results showed that the most suitable diet for rearing of *Rhizoglyphus tritici* was poultry feed and the least suitable diet was wheat flour + maize flour + nedo and wheat flour + glucose and yeast.

SPP-IPM-234

Association mapping reveals novel genomic regions controlling some root and stolon traits in tetraploid potato (*Solanum tuberosum* L.)

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ABSTRACT

Background: Tuber crops have measurable biological variation in root and stolon phenotyping and thus may be utilized to identify genomic regions associated with these variations. The study is the first comprehensive association mapping study related to potato root and stolon traits.

Methods: A diverse panel of 192 potato (*Solanum tuberosum* L.) genotypes were grown in aeroponics to reveal a biologically significant variation and detection of genomic regions associated with root and stolon traits. Phenotyping of root traits was performed by WinRHIZO, while SolCAP 25K potato array was used for genotyping.

Results: Significant variation was observed between the potato genotypes for root and stolon traits along with high

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heritabilities (0.80 in TNS to 0.95 in SL). For marker-trait associations, Q+K linear mixed model was implemented and 50 novel genomic regions were detected. Significantly associated SNPs with stolon traits located on Chr 4, 6, 7, 9, 11, and 12, while those linked to root traits on Chr 1, 2, 3, 9, 11, and 12. Structure and PCA analysis grouped genotypes into four sub-populations disclosing population genetic diversity. LD decay was observed at 2.316 Mbps ($r^2=0.29$) in the population. The identified SNPs were associated with genes performing vital functions such as root signaling and signal transduction in stress environments (GT-2 factors, protein kinases SAPK2-like and protein phosphatases “*StPP1*”), transcriptional and post-transcriptional gene regulation (RNA binding proteins), sucrose synthesis and transporter families (UGPase, *Sus3*, *SuSy*, *StSUT1*) and PVY resistance (*Rysto*).

Conclusion: The findings of our study can be employed in future breeding programs for improvement in production.

Keywords AM; SolCAP; Root; Stolon; Aeroptic; Potato

SPP-IPM-235

Use of native winter annual flowering plants for the conservation of pollinators

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ABSTRACT

Background: Population of pollinators is decreasing globally due to the loss of flowers and agricultural infestation which led to instability in ecosystems as well as decrease agricultural production. The planting of flowering plants in urban areas may serve as wide network of pollinator friendly environment for the purpose of the conservation of different pollinators.

Methods: Native winter annual flowers belong to the families of Asteraceae, Solanaceae, Brassicaceae, Lamiaceae, Violaceae and Caryophyllaceae were planted in the polythene bag. Those flowers were selected which were mostly grown in the Southern Punjab. Each variety of winter annual flowers was placed randomly in a patch of 5x5ft in circular shape. Preference of pollinators in terms of the abundance on particular flowering plant was observed. **Results:** Asteraceae and Lamiaceae families were the most visited by the pollinators. Among all pollinators syrphid fly (*Eristalinus aeneus*) were most abundant followed by honey bees (*Apis floria*). Brassicaceae family was the least visited by pollinators.

Conclusions: These results showed that Asteraceae and Lamiaceae were highly attractive towards the pollinators. Therefore, by growing the flowers of these families we can conserve the maximum numbers of pollinators.

Keywords: Pollinators, Winter annual flowers, Conservation, Agricultural production, Syrphid flies

SPP-IPM-236

Role of different levels of nutrients in pollinator attraction & sunflower yield

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ABSTRACT

Background: Sunflower is a highly cross-pollinated crop which is grown for its edible oil seeds. Pollination is important for crop production because 70% of crops rely on insect pollinators. Nutrients have a great impact on sunflower growth for maximum seed production. The flowering crops are dependent on both available nutrient and crop pollination.

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Methods: An experimental crop Sunflower (Hysun-33) was grown at the research farm of Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan. For evaluating the foraging behavior of pollinators, their abundance, and reproductive success of sunflower (seed yield and number of seeds) on different levels of recommended Potassium dose i.e. low (50%), medium (100%), high (150%) and control.

Results: Results showed that in sunflower field the maximum abundance of pollinators was observed on medium level among which Honey bees (*Apis florea*) was most abundant followed by Non-Apis bees *Pseudapis* sp. while the least abundance was recorded on high dose. The stay time of both Apis and Non-Apis bees was higher in medium level of potassium as compare to low and high level. There is no significant difference were observed in visitation rate of pollinators in medium level and control. Moreover, high production (number of seed and seed weight) of sunflower was achieved in medium K level as compare to high and low level.

Conclusions: Hence we can conclude that medium level of potassium fertilizer assist the pollinators and favor seed production in sunflower.

Keyword: Nutrients, *Apis*, Non-Apis bees, Potassium, Yield

SPP-IPM-237

Effect of selenium on foraging behavior of native pollinators in *Trifolium alexandrinum* L.

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ABSTRACT

Background: Selenium is an essential nutrient for both plants and humans. Supplements of Selenium can reduce the chances of heart diseases and cancer in humans as well as make plant drought tolerant. However, its hyper-accumulation in plants or plant parts can cause direct toxic effects on insects.

Methods: Therefore, current study was planned to evaluate the effect of exogenous application of selenium on native insect pollinators in berseem. Abundance, diversity and foraging behavior (in term of visit duration and visitation rate) of native insect pollinators was observed on different level of selenium. Selenium was sprayed 2 times manually at one week interval on flowering stage.

Results: Maximum abundance was observed on low selenium level i.e. 5gm/hectare while as the concentration of selenium increase the abundance of pollinator decreases. Among solitary bees *Pseudapis oxybeloides*, in honeybees *Apis mellifera* and among syrphid flies *Eristalinus aeneus* were most abundant. Moreover, the visitation rate of abundant pollinators was higher in control plot than Selenium applied plot while there is no significant difference in visit duration among all selenium level. We can conclude that high dose of selenium affects the foraging behavior of pollinators.

Conclusions: However, low dose promotes abundance in the berseem field which ultimately enhance the seed production of berseem.

Keywords: Nutrient, Pollinators, Exogenous application, Abundance, visitation rate

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Foraging behavior and pollination effectiveness on morphological characters of different sunflower hybrid

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ABSTRACT

Background: Sunflower (*Helianthus annuus* L.) is the main worldwide edible oilseed crop and its hybrid cultivars are predominantly grown on large scale to fulfill the demand of edible oil. Pollination is an essential ecosystem service and majorly contributes toward 35% of crop production all over the globe.

Methods: The experiment was conducted at MNS-UAM Research Farm, Multan in open field condition. Foraging behavior of pollinators, their abundance, and their impact on seed yield parameters i.e., head diameter, seed weight and number of seed in sunflower hybrids were observed. Two genotypes (Bird resistant and Bird tolerant) of hybrids sunflower were selected which have distinct morphological characters. In bird resistant genotype sunflower head was ground-facing, long bracts, convex shape with horizontally oriented heads while bird tolerant genotype have vertically oriented heads and concave or flat shape.

Results: The results revealed that in bird resistant genotype *Apis mellifera* was most abundant bee followed by *Apis florea* while *Apis dorsata* was least abundant as compared to bird tolerant genotype. Foraging behavior of pollinators in term of visitation rate and stay time were also recorded. Visitation rate of solitary bee (*Pseudapis* sp.) was highest in bird tolerant genotype followed by Honeybees (*Apis florea* and *Apis mellifera*) whereas syrphid fly (*Eristalinus aeneus*) has least visitation rate in bird tolerant genotype as compared to bird resistant genotype. However, stay time was of *Apis mellifera* was highest in bird resistant genotype. In seed yield parameter in bird resistant genotype was better than bird tolerant genotype. However, in open pollinated flowers seed weight and number of seeds was 50% high as compared to caged plant (with no pollinators visit).

Conclusions: There are future needs to grow only bird resistant cultivars which have distinct morphological characters.

Keywords: visitation rate, Stay time, Abundance, Bird resistant, Bird tolerant



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THEME-2:
PLANT DISEASE DIAGNOSTICS
AND MANAGEMENT

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-201

Response of Chickpea Germplasm to Wilt Disease incited by *Fusarium oxysporum* f. sp. *ciceris*

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ABSTRACT

Background: Chickpea (*Cicer arietinum* L.) is a rich source of plant protein. It can be grown between September and November in Pakistan under irrigated and rain fed conditions. A number of diseases attack chickpea but wilt disease is the principle one.

Methods: In the recent study twenty five chickpea genotypes were screened against chickpea wilt disease.

Results: Out of these only five genotypes (Pb-2008, 6027, 6028, 9022 and 6003) showed highly resistant (HR) response and did not show any kind of wilt symptoms. Six genotypes (6005, 6026, 6010, 6015, Dashat-2003 and Parbat-2003) were graded as resistant ®, six lines/varieties (9013, Noor-91, Punjab-9, Venhar-2000, Pb-2000 and 810) expressed moderately resistant reaction (MR), five genotypes (Thall-2006, 8020, 7021, 8026 and 7050) exhibited susceptible reaction (S) and three (Noor-91, 4004 and 7008) showed highly susceptible response (HS).

Conclusions: Screening of chickpea germplasm is a very cheap and economical method to manage this disease.

Keywords: Chickpea, *Fusarium oxysporum*, wilting

SPP-PP-202

Environmental-Responses Based Predictive Modelling for Stripe Rust Epidemic in Wheat Using Meteorological Data from Faisalabad Pakistan

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ABSTRACT

Background: Under favorable environmental conditions stripe rust caused by *Puccinia recondita* f.sp. *tritici* is a destructive disease of wheat crops all over the world. Although host genotype resistance and the application of fungicides are the most commonly used methods to control stripe rust, efficient disease predictive models are needed to reduce disease management expenses and improve sustainability of crop production. The objective of present study was to develop disease predictive models based on epidemiological variables viz. maximum temperature, minimum temperature, rainfall, relative humidity and wind speed.

Methods: The association among environmental responses and disease severity were calculated through Pearson correlation and stepwise multiple regression analysis was used to develop a model. For this purpose, 6 years (2009-2014) data of stripe rust severity and epidemiological variables collected from the Meteorological station of Ayub Agriculture Research Institute (AARI) Faisalabad were used.

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Results: The disease predictive model showed 84% variability in disease development. The model predictions were evaluated on the basis of 2 statistical indices, root mean square error (RMSE) and residual (%) which were & lt; 15, demonstrating that the model was fit to forecast disease development. The model was validated through 2 years (2014-2016) data set of environmental responses and stripe rust severity collected in University of Agriculture Faisalabad. The regression equations of the both models, 5 years ($Y = -37.32 - 0.461x_1 + 0.107x_2 + 2.67x_3 + 1.184x_4$) and two years ($Y = -16.81 - 0.259x_1 + 0.621x_2 + 0.72x_3 + 0.458x_4$), showed that they validated each other. Scatter plots

exhibited that maximum temperature (21.1-30.3 °C), minimum temperature (6-17.4°C), relative humidity (55-80%),

rainfall (2-8 mm) and wind speed (2-4 km/h) contributed to the stripe rust epidemic.

Conclusion: By understanding the epidemiology of stripe rust will enable us to predict its development, which will ultimately help the wheat growers to improve plant protection measures more accurately.

Keywords: wheat stripe rust, Disease modeling, *Puccinia recondita f.sp. tritici*

SPP-PP-203

Morphological and genetic characterization of *Fusarium oxysporum* and its management using weed extract in cotton

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ABSTRACT

Background: *Fusarium oxysporum*, a fungal plant pathogen, causes severe wilting and heavy losses in cotton. Present research was planned to appraise the weed extracts of *Parthenium hysterophorus*, *Chenopodium album*, Canada thistle and *Phalaris minor* against *F. oxysporum*.

Methods: Morphological identification of *F. oxysporum* was done by observing white cottony mycelium with dark-purple undersurface on growth media and oval to ellipsoid/kidney shaped oval tapering and three septate spores. Molecular characterization was done by amplifying the internal transcribed spacer region using the ITS universal primers, ITS1 and ITS4. The weed extract with concentrations of 5%, 10%, 15% and 20% were applied by using food poison techniques under complete randomized design. Data was taken 3, 5 and 7 days after inoculation of *F. oxysporum* on potato dextrose agar (PDA).

Results: *P. hysterophorus* showed maximum antifungal response (97%) against *F. oxysporum* whereas other treatments effectively inhibited the pathogen growth on PDA media. Tebuconazole, a fungicide, was used as positive control. *Trichoderma harzianum* showed 98% inhibition of *F. oxysporum* on PDA. Consortium of *Trichoderma harzianum* + weed extracts was applied to infected roots of cotton grown in pots under complete randomized design. No disease was observed in treatment *P. hysterophorus* + *T. harzianum* whereas maximum disease was calculated (50%) in other

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treatments as compared to control (100%).

Conclusion: The *F. oxysporum* causes heavy losses both in quality and quantity of this crop. Use of synthetic chemical fungicide for the management of this fungal pathogen causing serious environmental hazards. The use of weed extracts (*C. album*, *P. hysterophorus*, *C. thistle* and *P. minor*) alone and amended with *T. harzianum* is a new, innovative, effective, ecofriendly and economical approach for the management of *F. oxysporum* in cotton.

Keywords: *Fusarium oxysporum*, *Trichoderma harzianum*, weed extract

SPP-PP-204

Identification of Criniviruses Involved in the Yellowing Disease of Cucumber in Multan Region

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ABSTRACT

Background: Criniviruses Involved in the Yellowing Disease of Cucumber are of great importance.

Methods: During the growing seasons 2017 and 2018, 25 symptomatic cucumber samples were collected from the tunnel farms established in the vicinity of Multan and Lodhran districts of Pakistan. The collected samples were collected on the basis of typical yellowing accompanied by interveinal chlorosis, chlorotic spots and brittleness on the older leaves. Total RNA was isolated from the symptomatic samples using Trizol reagent and subjected to PCR technique using the specific primers (CCYV up and CCYV do) designed for the detection of Cucurbit chlorotic yellows virus (CCYV) which is involved in the cucurbit yellows disease (CYD). The specific primers were designed from the RNA dependent RNA polymerase (RdRp) region of the CCYV.

Results: showed that all the samples were infected with CCYV as all the tested samples showed 709bp fragment on the Gel Electrophoresis. These amplified PCR products were sequenced in both directions and a partial gene sequence was obtained. Sequence analysis of the obtained isolate (accession number: MN723535) showed that the virus has a low genetic diversity and the local isolates share a higher level of similarity with the other isolates retrieved from GenBank. Phylogenetic analysis tree revealed that the local isolate of CCYV is closely related to the isolates reported to infect melon plants in Japan (AB523788) and has lowest identity with the isolate (LM653109) reported to infect cucumber in Saudi Arabia.

Conclusion: To our knowledge this is the first report of CCYV on cucumber from Pakistan.

Keywords: Criniviruses, Cucurbit chlorotic yellow virus, RNA dependent RNA polymerase

THEME-2:

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SPP-PP-205

Plant Extracts Improve Vase-life of *Gladiolus grandifloras* by Limiting Bacterial Proliferation

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ABSTRACT

Background: Preservatives are highly important to increase relatively short vase life of commercial cut flowers hence, seeking natural, inexpensive and effective strategies to extend longevity is essential. Application of *Moringa oleifera* extract (MOE) and *Mentha piperita* extract (MPE) as preservative has been well reported however, reports regarding *Calotropis procera* extract (CPE) as preservative are still elusive.

Methods: Here we reported the impact of individual MOE, MPE and CPE preservatives on vase life, physiological processes and antioxidant activity of cut gladiolus spikes. Different levels of MOE, MPE and CPE were used to assess their role in enhancing vase life, open florets, relative fresh weight, water status, chlorophyll, and enzymes in cut spikes.

Results: Maximum vase life days were recorded at CPE compared to untreated flowers. CPE maintained relative water contents (RWC) and suppressed bacterial proliferation in vase solution. Additionally, CPE increased chlorophyll and carotenoid concentrations that altogether improved membrane stability of florets.

Conclusion: In conclusion, CPE extended maximum vase life of cut gladiolus through maintaining water relations, controlling bacterial growth and increasing enzymes activity therefore proved a novel preservative for cut flower induction.

Keywords: *Calotropis procera*, *Gladiolus grandiflorus*, plant extracts

SPP-PP-206

Phytotherapeutic Impact of Botanicals Aqueous Extracts on Tomato (*Lycopersicon esculentum* L.) Crop Infested by Root-Knot Nematodes

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ABSTRACT

Background: Root-knot nematodes (RKNs) are important soil-borne pathogens that cause heavy yield losses to tomato crops. Neem (*Azadirachta indica* L.) and hemp (*Cannabis sativa*) extracts have been reputed with efficient, cost-effective and environment-friendly plant disease management tools.

Methods: Aqueous leaf extracts of both plant species at three concentration levels (25, 50 and 75% w/v) and one combination (50% w/v of both) were applied on tomato cv Roma root to evaluate their efficiency against RKN in pot experiment under glasshouse conditions. Pots were filled with autoclaved soil, organic matter, and sand in equal amounts and aqueous extracts were mixed thoroughly at the final stage of soil preparation before transplantations. RKN 2000 J2 were inoculated 15 days after transplanting when plants successfully established their root system. The experiment was replicated thrice and terminated 70 days after nematode inoculation.

Results: Botanical aqueous extracts effectively reduced J2 penetration 70 days after inoculation and reduced the reproduction factor. The most effective concentration which reduced Gallings Index (GI) was Neem (75%), followed by

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combined application (50+50% w/v) of hemp and neem. Interaction of both extracts positively influenced plant health and reduced nematode infestation either due to increased nutrient supply and improvement in soil health.

Conclusions: Extracts are found effective in the low-temperature area and can be used as alternatives to each other where others are not available.

Keywords: Neem extract, Root knot nematode

SPP-PP-207

Diversity of viruses in alfalfa: Role, Mode of transmission and importance in management

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ABSTRACT

Background: Viruses are widespread in cultivated *Medicago sativa* L., and represent a key limitation to realizing the herbage production and quality of this important forage plant. Understanding the diversity of plant viruses in alfalfa and potential vectors will play an important role in management to minimize the emergence, transmission and impacts of viruses.

Methods: Next-generation sequencing (NGS) targeting transcriptome was applied to monitor the virus communities within alfalfa and the two main pests, thrips (*Odontothrips loti* Haliday and *Frankliniella intonsa* Trybom) and aphids (*Acyrtosiphon pisum* Mordvilko) species.

Results: A combination of transcriptome datasets with reference databases revealed the presence of eight candidate viruses. Five out of the eight viruses, *Alfalfa mosaic virus* (AMV), *Medicago sativa alphapartitivirus 1* (MsAPV1), *Medicago sativa deltapartitivirus 1* (MsDPV1), *Medicago sativa amalgavirus 1* (MsAV1) and *Bean yellow mosaic virus* (BYMV), were confirmed by RT-PCR.

Conclusion: We identified and determined four RNA viruses from alfalfa samples, two viruses (AMV and MsAPV1) from thrips samples and one virus (BYMV) from *T. trifolii*. All sequences isolated from our insect samples showed more than 95% similarity with the sequences from alfalfa samples or NCBI (National Center for Biotechnology Information) reference database. In this study, RNA-seq analysis supports that RNA plant viruses infecting alfalfa and carried by main pests are dominated by AMV and MsAPV1.

Keywords: Next generation sequencing, Transcriptome, RNA viruses

SPP-PP-208

Effect of different chemicals on floral induction and control of floral diseases in mango cultivar S.B. Chaunsa

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ABSTRACT

Background: Mango (*Mangifera indica* L.) is a major fruit crop of tropical and subtropical areas of Pakistan. A wide variation in flowering behavior has been observed in sub-tropics due to environmental change during the flowering season of mango. Late flower emergence and outbreak of the floral diseases have disturbed the spray module and prevailing management strategy against the floral diseases particularly due to prolonged winter season. **Methods:** The current research was aimed on the effect of some treatments for the timely and synchronized flower emergence, fruit

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setting and to escape from the floral diseases like apical necrosis, blossom blight and powdery mildew on mango cultivar S.B Chaunsa. A total of eleven combinations of three fungicides viz., Champion 70% w/w (Copper hydroxide) Cabrio-Top 60% wse (Pyrachlostrobin + Metiram), Contaf Plus 51% w/v (Hexaconzole) with two dormancy breaking chemicals named Potassium Nitrate (KNO₃) and Calcium Nitrate (CaNO₃) were tested in laboratory by making their solution and mixing to observe their compatibility with each other.

Results: A trial of these treatments along with control was also conducted in the field during 2018 at MRI, Multan with 36 experimental plants keeping 03 plants for each treatment. The dynamics of mango inflorescence attributes and floral diseases to the exposure of these treatments were noted. Generally, no reaction in laboratory and phyto-toxicity reflection was observed in the study. Potassium Nitrate showed the best performance with 5.51 times more flower induction in mango. Similarly, Potassium Nitrate with combination of Copper hydroxide also remained more effective not only to emerge more flowers but also to combat apical necrosis, blossom blight and powdery mildew by 92.50, 74.40 and 60.20 percent decrease in disease respectively.

Key Words: Flower emergence, Floral diseases, Fungicides, Mango, Dormancy breaking chemicals

SPP-PP-209

Molecular Characterization of Zucchini Yellow Mosaic Virus (Zymv) Infecting Ridge Gourd (*Luffa acutangula* L) in Punjab, Pakistan

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ABSTRACT

Background: Zucchini yellow mosaic (ZYMV) included in the genus Potyvirus is one of the most destructive pathogens of cucurbits, including ridge gourd (*Luffa acutangula* L.) which is widely grown in Indo-Pak subcontinent. ZYMV causes significant yield losses to cucurbit crops worldwide and difficult to manage.

Methods: In the present study, a total of 300 leaves and fruit samples of ridge gourd with virus and virus-like symptoms were collected from 03 districts of Punjab, Pakistan. To perform an initial screening of ZYMV these samples were subjected to Plate trap Antigen-Enzyme linked immunosorbent assay (PTA-ELISA) using monoclonal antibodies and further confirmation was done through RT-PCR amplification and sequence analysis.

Results: Serological findings showed that overall disease incidence during 2018-2019 was 28.33%. The prevalence of ZYMV was confirmed in all ridge gourd sampling sites. ELISA-positive samples were confirmed through RT-PCR and sequence analysis. Comparison of sequences with those isolated available in Gene bank showed 91%-98% nucleotide and 98%-100% amino acid-based homology. Phylogenetic tree analysis showed that ZYMV Pakistani isolates (MN897100, and MN897101) infecting ridge gourd were closely related to the isolates previously reported from South Korean, Chinese and Turkish, which strengthen the belief that ZYMV Pakistani isolates reported in this study has Asian origin.

Conclusion: Identification of new ZYMV isolates strengthen the breeding programs for the development of resistance genotypes of cucurbits to manage this notorious virus.

Keywords: Ridge gourd, ZYMV, PTA-ELISA, RT-PCR, GenBank

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SPP-PP-210

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

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ABSTRACT

Background: Garlic (*Allium sativum* L) belongs to family Alliacea, an aromatic bulbous cool season vegetable crop, grown at domestic level as well as commercially. The average garlic crop yield in Pakistan is often low and variable owing to many viruses. Viral diseases of garlic reduce the yield up to 50% during growing season.

Materials: Garlic leaf samples from Pakistan showing yellowish chlorotic strips, mild mosaic and leaf distortion were tested for Allexivirus incidence using reverse transcription-polymerase chain reaction (RT-PCR) with degenerate primers AllexCP+-74/ AllexNABP-R75. After sequencing, two sequences of 819 nt comprised of 417 nt of CP gene and 387 nt of NABP gene was submitted to GenBank with accession no. MH021116-17 and one sequence containing 417 nt of CP gene with accession no. MH021118.

Results: Sequence identity matrix revealed that Pakistani GarV-C isolates of this study shared 95.6-98% of nucleotide identity among themselves while 82.2-88% identity with previously reported GarV-C isolates being higher with the Australian JQ899448 isolate and lowest with the Japanese isolate LC097169. In all the Pakistani GarV-C isolates Allexivirus characteristic features were observed i.e. CP motif "KFAAFDFFNNAVSSDSAP" and NABP motif "CFDCGGYLLNNH VC" and they are clustered with each other forming sister clad with isolates from Australia, Japan Brazil and Czech Republic affirming the results of evolutionary distances and sequence identity matrix. No recombination event was detected in isolate examined. Fu, & Li's F*, Fu, & Li's D* and Tajima's D statistical test results revealed that CP gene of GarV-C isolates 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-C in garlic from Pakistan. The study findings will enable breeders to grow resistant Allexivirus varieties and also lead to forecast the chance of resistance breakdown in future pathogen mediated resistant transgenic lines of vegetable crops.

Keywords: *Allium sativum*, Allexivirus, RT-PCR, coat protein.

SPP-PP-211

Molecular Characterization and Identification of Economically Important Potyviruses in Cucurbitaceae Family from Gujranwala Division of Punjab, Pakistan

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ABSTRACT

Background: Cucurbits (cucumber, pumpkin, watermelon, melon, squash, bottle gourd, Round Gourd, Squashes) as a

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main source of energy, vitamins and minerals belongs to family Cucurbitaceae is mainly produced throughout the Gujranwala division, Pakistan.

Methods: Surveys were conducted to determine the prevalence and incidence of major RNA viruses. In total 515 samples of cucurbit species collected from 43 fields in six districts (Narowal, Sialkot, Gujranwala, Gujrat, Mandi Buhaddin and Hafizabad) of Gujranwala division. Zucchini yellow mosaic virus, Papaya ring spot virus, Watermelon mosaic virus and Cucumber mosaic virus was detected through ELISA and ZYMV also detected by RT-PCR.

Results: The results showed that ZYMV was most predominant virus of cucurbits found in Gujranwala division with overall incidence of 21.4%, followed by PRSV 6.8%, WMV 1.7% and CMV 1.2% of the collected samples. Highest mixed double infection with combination ZYMV+PRSV was detected in 1% followed by ZYMV+WMV and WMV+PRSV both were detected in 0.4% samples while triple infection was found only 0.2% in samples of cucurbits. Overall disease incidence of viruses was higher in Gujranwala (40.2%) followed by Narowal (34.7%), Gujrat (28.6%), Mandi Buhaddin (27.1%), Hafizabad (24.7%) and Sialkot (23.3%). Likewise, the ZYMV incidence was higher in Angel Gourd and no viral infection was recorded in snap melon and ash gourd in Gujranwala division.

Conclusion: All cucurbits vegetables were highly prone to ZYMV followed by PRSV and WMV. Round gourd was found to be infected with ZYMV confirmed with ELISA and RT-PCR followed by cloning, sequencing and blast analysis.

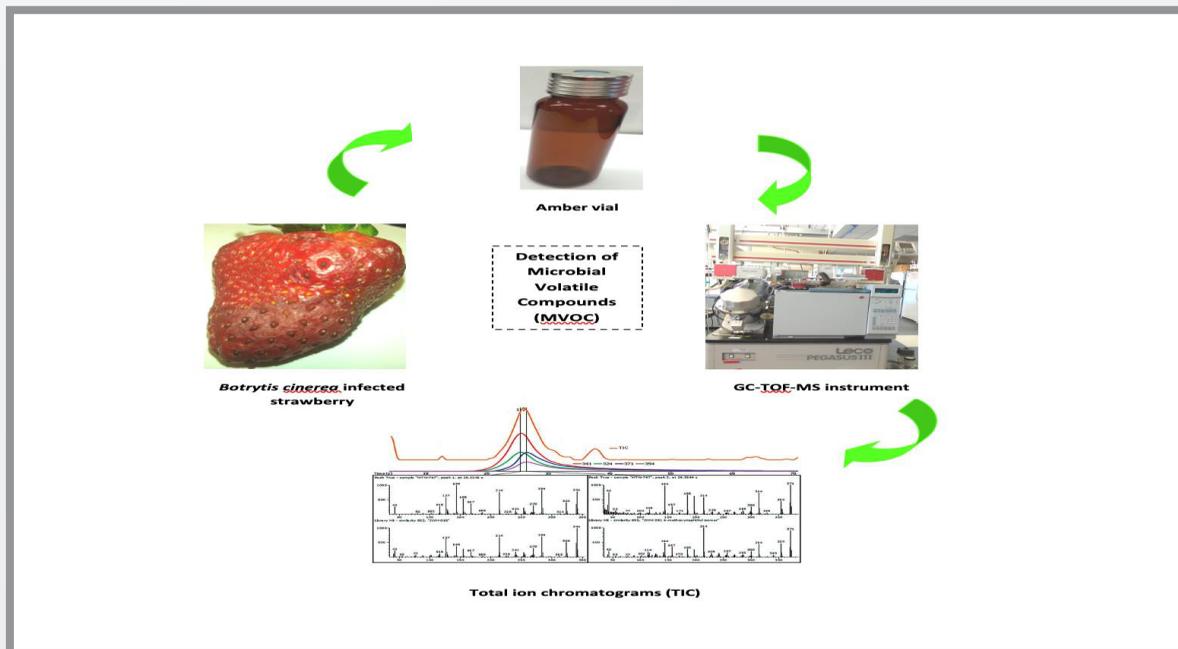
Key words: Cucurbit, Potyviruses, Virus, ZYMV, PRSV, WMV, CMV, ELISA, Symptomatology

SPP-PP-212

Untargeted HS-SPME-GCMS for volatile analysis on postharvest strawberries prior to visible symptoms of *Botrytis cinerea* infection

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ABSTRACT

Background: Post-harvest spoilage occurs due to microbial growth on a fruit or release of extracellular and intracellular (following cell lysis) enzymes in the fruit environment. Gray mold disease of strawberries is caused by *Botrytis cinerea* fungus. The pathogen invades blossoms, and then infects maturing fruit at the postharvest stage. Fruit eventually covered with gray mass of mycelia on the market shelf or storage. However, an early detection could sustain the economic life span of the infected fruits. The current study attempts to identify the microbial volatile organic compounds (MVOCs) in the infected strawberries prior to visible symptoms such as loss in glossiness, color or other initial disease symptoms in the artificially infected strawberries.

Method: Detection of MVOCs from infected strawberry samples were done via Headspace-solid phase microextraction (HS-SPME) for gas chromatography mass spectrometry (GC-MS) or HS-SPME-GC-TOF-MS analysis using an in-house protocol. GC-TOF-MS instrument was used to achieve this objective.

Results: Constitutively produced or induced fruit volatile organic compounds (VOC) due to *Botrytis cinerea* infection prior to visible symptoms were detected and identified. These compounds could be categorized as defensive compounds that may have caused loss in glossiness and changes of the skin surface structure of the fruit. In addition to that, MVOCs of the fungal pathogen were also detected and identified in samples with 25% DS.

Conclusion: As a conclusion, the detected fruit VOCs and MVOCs could be used as early detection bio-markers of Gray mold disease caused by *Botrytis cinerea* strains via eNose device in-situ.

Keywords: VOC, MVOC

SPP-PP-213

Current Status and Coat Protein Cistron Based Characterization of Cucumber Mosaic Cucumovirus Brinjal Isolates of Subgroup IB from Pothwar Region of Pakistan

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ABSTRACT

Background: Cucumber mosaic cucumovirus (CMV) is a destructive and menace to a wide range of plant species including brinjal crop worldwide. This study was carried out to define the current status of CMV infecting brinjal crop in Pothwar region of Pakistan and characterization of CMV brinjal isolates as well as to recognize the sources of resistance in brinjal genotypes.

Methods: A total of 660 leaf samples with the virus and virus-like symptoms were collected from different districts of Pothwar region and subjected to CMV specific DAS-ELISA using monoclonal antibodies. Two ELISA positive samples from each district were further confirmed by RT-PCR and subsequently sequenced based on their coat protein cistron. Moreover, 10 brinjal genotypes were tested against CMV-Pak eggplant isolate.

Results: ELISA results indicated that approximately 56% samples were CMV positive and the disease incidence was highest i.e. 62.50% in Jhelum district followed by Rawalpindi (58.33%), Chakwal (58.33%) and Attock (55.55%) districts with the lowest disease incidence (46.15%) was recorded in Islamabad district. RT-PCR amplification and sequences analysis results shows that all isolates were identical to each other so nucleotide sequence of one eggplant isolate was deposited in GenBank with accession number MH119063. BLAST and phylogenetic analysis revealed that CMV-Pak eggplant isolate shared 90-94% nucleotide and 80-100% amino acid similarities with other isolates available in GenBank.

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ELISA results categorized three genotypes (Singh Nath 666, Neelum, Brinjal Jamak) as moderately resistant, two genotypes (Round Black, Global Brinjal PPL) as susceptible and rest of the five genotypes (Bemissal, Brinjal Shilpa, Short Purple, Brinjal PPL, Namyal Ratchburi) as moderately susceptible.

Conclusion: The three moderately resistant genotypes could be recommended to farmers for farming and plant breeders for developing new brinjal resistant genotypes to CMV. To the best of our knowledge, this study for the first time provided evidence that CMV infects brinjal/ eggplant in Pakistan.

Keywords: Brinjal, CMV, ELISA, Resistance, CP Cistron, Genetic Diversity

SPP-PP-214

Assessment of the Chili veinal mottle virus CP cistron based transgenic *Nicotiana benthamiana* plants for virus resistance

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ABSTRACT

Background: Vegetables are an important source of income and high value crops for small farmers. Chili (*Capsicum* spp.) is one of the most economically important vegetables of Pakistan and it is grown throughout the country. It is a rich source of nutrition especially vitamins A, B, C and E along with minerals as folic acid, manganese (Mn), potassium (K) and molybdenum (Mo). Chili possesses seven times more amount of vitamin C than orange. Vitamin A, C and beta-carotenoids are strong antioxidants to scavenge the free radicals. Chili production is restricted due to various biotic factors. Among these viruses, Chili veinal mottle virus (ChiVMV) is one of the most destructive and menace agents that inflicts heavy and colossal losses that accounted for 50% yield loss both in quality and quantity.

Methods: Pathogen-Derived Resistance (PDR) approach is considered one of the effective approaches to manage the plant viruses. In this study, ChiVMV was characterized on a molecular level, the coat protein (CP) gene of the virus was stably transformed into *Nicotiana benthamiana* plants using *Agrobacterium*. The transgenic plants were challenged with the virus to evaluate the level of resistance of plants against the virus.

Results: It was observed that the plants expressing CP gene have partial resistance against the virus in terms of symptom's development and virus accumulation.

Conclusions: Translation of this technique into elite chili varieties will result in mitigate the ChiVMV in the crop as well as economic benefit to the farmers.

Keywords: Chili, ChiVMV, CP gene, Transgenic plants, Viral resistance

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SPP-PP-215

Endophyte *Bacillus subtilis* L1-21 regulates the relationship between nutrients and huanglongbing pathogen *Candidatus Liberibacter asiaticus*

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ABSTRACT

Background: Huanglongbing (HLB) pathogen '*Candidatus Liberibacter asiaticus*' (CLas) brings a great concern to phloem nutrient transport in diseased-affected citrus plants. Endophytic bacteria are associated with improving plant growth by the production of hormones that increase availability of nutrients.

Methods: This study was conducted to find out relationship between HLB pathogen, endophyte population and nutrient availability in citrus plants. For initial studies, citrus shoots with were treated with dd H₂O, 50%, 70%, 100% Hoagland solution by hydroponic method.

Results: Results indicated that 50% Hoagland solution revealed higher number of endophyte population (1.05×10^7 CFU/g) compared to 70%, 100% concentration of Hoagland solution and control (3.80×10^5 CFU/g). In addition, after 15 days of treatment, results indicated that 50% Hoagland solution + *B. subtilis* L1-21 displayed maximum number of endophytes population (9.00×10^4 CFU/g to 2.36×10^5 CFU/g). The CLas titer in the treated citrus plants reduces significantly. Another experiment was conducted on diseased citrus groves with different treatments involving endophyte and nutrients in the form of Zn, Fe, Mn, and Mg. After 6 months of treatments, results indicated that treatment of *B. subtilis* L1-21 with different nutrient solutions displayed more reduction of pathogen copies (4.55×10^5 to 7.15×10^4).

Conclusion: Taken together, Hoagland solution is more effective in hydroponic method compared to foliar spray and using endophyte *B. subtilis* L1-21 with association of nutrient solution could manage the HLB pathogen.

Keywords: *Candidatus Liberibacter asiaticus*, Endophyte, *Bacillus subtilis*

SPP-PP-216

Evaluating Anti-Bacterial Compounds for Blight Management in Pomegranate (cv. Sawa)

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ABSTRACT

Background: Bacterial blight (BB) of pomegranate caused by *Xanthomonas axonopodis* pv. *Punicae* (Xap) is among the most devastating natural calamities that inflicted huge losses to growers especially in South Punjab, Pakistan since 1995. The objective of the current study was to devise good agricultural practices (GAP) exploiting effective bactericides for adaptation to control this notorious disease.

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Methods: The experiment was conducted in an orchard at Allahabad district Rahim Yar Khan Punjab, Pakistan to evaluate the efficacy of different antibacterial chemicals viz., copper oxychloride (0.3%), copper hydroxide (0.25%), streptomycin sulphate (500ppm), streptomycin (500ppm), bismethiazole (0.2%) and copper oxychloride + streptomycin (0.3% + 500ppm). Six repeated foliar applications (1st week of May to last week of July) were done with four replications on Sawa cultivar of pomegranate using Randomized Complete Block Design (RCBD). The data regarding disease incidence (%), severity and reduction percentage was collected from leaves, fruit, twigs and tree. Analysis of variance and mean separation was done using Tukey's multiple rang test at $P < 0.05$.

Results: Result obtained showed significant variation among treatments. However, streptomycin (500ppm) + Copper oxychloride (0.3%) was proved to be more effective with minimum disease incidence (%) on leaves, fruits, twigs and trees e.i., 8.33%, 7.01%, 1.65% and 3.1%, respectively as compared to control. Maximum disease reduction e.i., 80.75%, 74.15%, 35.2% and 78.2 %, respectively was noted on leaves, fruits, twigs and whole plant with streptomycin (500ppm) + Copper oxychloride (0.3%) application. The minimum disease severity on leaves, fruits, twigs and whole plant (2.78, 3.81, 1.45 and 2.91, respectively) was observed when applied streptomycin (500ppm) + Copper oxychloride (0.3%) as compared to rest of the bactericides. In conclusion, repeated application of Streptomycin + Copper oxychloride may be recommended for the management of bacterial blight in Pomegranate cv. Sawa.

Keywords; Bacterial blight, GAP, In-vivo, Disease incidence, Disease severity and Disease reduction.

SPP-PP-217

Characterization of New Recombinant Begomovirus Infecting *Euphorbia pulcherrima* in Pakistan

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ABSTRACT

Background: Begomoviruses are ssDNA viruses, transmitted by whitefly, and are notorious pathogens of dicotyledonous plants. Apart from crops, these viruses also infect ornamental plants which contribute billions of dollars in the global economy. *Euphorbia pulcherrima*, Willd. ex Klotsch (*Euphorbiaceae*), also known as poinsettia, is an economically important plant and was reported to host begomoviruses from the world. The present study was aimed at characterization of begomoviruses from symptomatic poinsettia.

Methods: The poinsettia plant showing vivid leaf curling and yellowing symptoms was collected from Rawalpindi and subject to total genomic DNA extraction followed by whole genome amplification of viral DNA by rolling circle amplification technique. The amplified fragments were cloned and subsequently sequenced for further analysis.

Results: The complete nucleotide sequence of isolate PK1 and PK1A proved to be 2733nt and 2731nt long shared 99.7% identity with each other and maximum identity 90.8 and 90.6 respectively with *Euphorbia leaf curl virus* [China: Shandong Qingzhou:2012] [KC852148]. Two recombination events were also recorded with *Pedilanthus leaf curl virus* [PK:RYK1:Euphorbia:04] [DQ116884] as major and *Euphorbia leaf curl* [China:Guangxi 35:2002] [AJ558121] and *Euphorbia leaf curl virus* [China:Fujian:2006] [FJ487911] as minor parents. The phylogenetic analysis clustered the both isolates with reported begomoviruses from China. Following the latest guidelines of ICTV regarding species demarcation threshold for begomoviruses, both isolates belong to a tentative new specie for which "Euphorbia yellow leaf curl virus"

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(EYLCuV) name was proposed.

Conclusion: The study underlines the need to explore the ornamental plants for discovery of new begomoviruses which will enable researchers to understand the population genetics of begomoviruses for adoption of better management practices.

Keywords: Euphorbia yellow leaf curl virus, begomoviruses, Rolling circle amplification

SPP-PP-218

Molecular Identification and Characterization of Begomovirus Associated with Sponge Gourd Mosaic Disease in Okara

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ABSTRACT

Background: Sponge gourd (*Luffa cylindrica*) is an important cucurbitaceous vegetable in Pakistan and is affected by yellow mosaic disease which is an economically imperative disease of sponge gourd responsible for severe reduction in its production. Disease causes yellow spots on newly emerging disease, mosaic, mild leaf curling and distortion, small leaves and misshapen fruits. The disease is reported to be caused by a ssDNA viral strain namely Tomato leaf curl New Delhi virus (ToLCNDV) of the genus Begomovirus. The current research was planned to analyze the virus affecting the gourd crop in Okara region of Pakistan.

Methods: For this purpose, infected leaves of sponge gourd were collected from sponge gourd growing areas of Okara. Total genomic DNA was isolated by using CTAB method and amplified by using Begomovirus specific primers. Coat protein region of DNA-A was targeted. The amplified PCR product was sequenced commercially.

Results: Online BLAST of the isolated sequences was done on NCBI which showed 99-100% similarity with already submitted ToLCNDV sequences. Phylogenetic analysis was done by using MEGA 7 software and MUSCLE alignments were made between 3 sequenced isolates of ToLCNDV and previously identified reference sequences of ToLC-NDe. The phylogenetic evolutionary analysis revealed that the Tomato leaf curl New Delhi virus is associated with sponge gourd mosaic disease in Okara region of Pakistan.

Conclusion: This preliminary research work opens new frontiers for the development of sustainable management strategies for the management of sponge gourd mosaic disease.

Keywords: begomoviruses, Tomato leaf curl New Delhi virus, ssDNA viruses

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SPP-PP-219

Role of Soil and Environmental factors in managing fusarium wilt of chillies caused by *Fusarium oxysporum* f. sp. *capsica*

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ABSTRACT

Background: Fusarium wilt is the most destructive disease of all chilli growing areas of the world. Soil and environmental factors play a crucial role in the development of disease.

Methods: Thirty varieties/ advanced lines were collected and were evaluated in sick field for two years (2018-19 & 2019-20) under RCBD at research area of Department of Plant Pathology, University of Agriculture Faisalabad. Results: Two advanced lines (10507 & 10501) expressed resistant and some advance lines/varieties (1377, 4829, 10560, 1776, Maxi and Desi) exhibited susceptible to highly susceptibility response towards Fusarium wilt of chilli pepper during both years. Maximum soil and air temperature, minimum soil and air temperature, wind speed and soil moisture expressed positive whereas relative humidity negative and rainfall exhibited non-significant correlation with disease development on all varieties of chilli pepper for two years. Maximum disease was recorded at maximum soil (30- 35 °C) and air temperature (25-30 °C). Disease predictive model based upon two years soil and environmental data was developed which explained 80% variability in disease development. Regression models on five varieties/ advanced line (Desi, Skyline, Sanam, Maxi and 10554) were developed, which were in close conformity with observed values of disease incidence for two years models. Cow and poultry manure at four levels were evaluated against Fusarium wilt.

Results: Both expressed significant results but the soil in which cow manure was used (as source of OM) expressed minimum disease incidence at all levels.

Conclusion: For management of Fusarium wilt of pepper three antagonistic organisms (*Trichoderma viride*, *T. koingii* and *T. harzianum*) antagonistic organisms (*Trichoderma viride*) expressed significant results under lab. and greenhouse conditions.

Key words: Soil Factors, Fusarium wilt, Environmental factors, management

SPP-PP-220

Evaluation of Major and Environmentally Driven Genes for Resistance in Pakistani Wheat Landraces and their Prospected Potential against Yellow Rust

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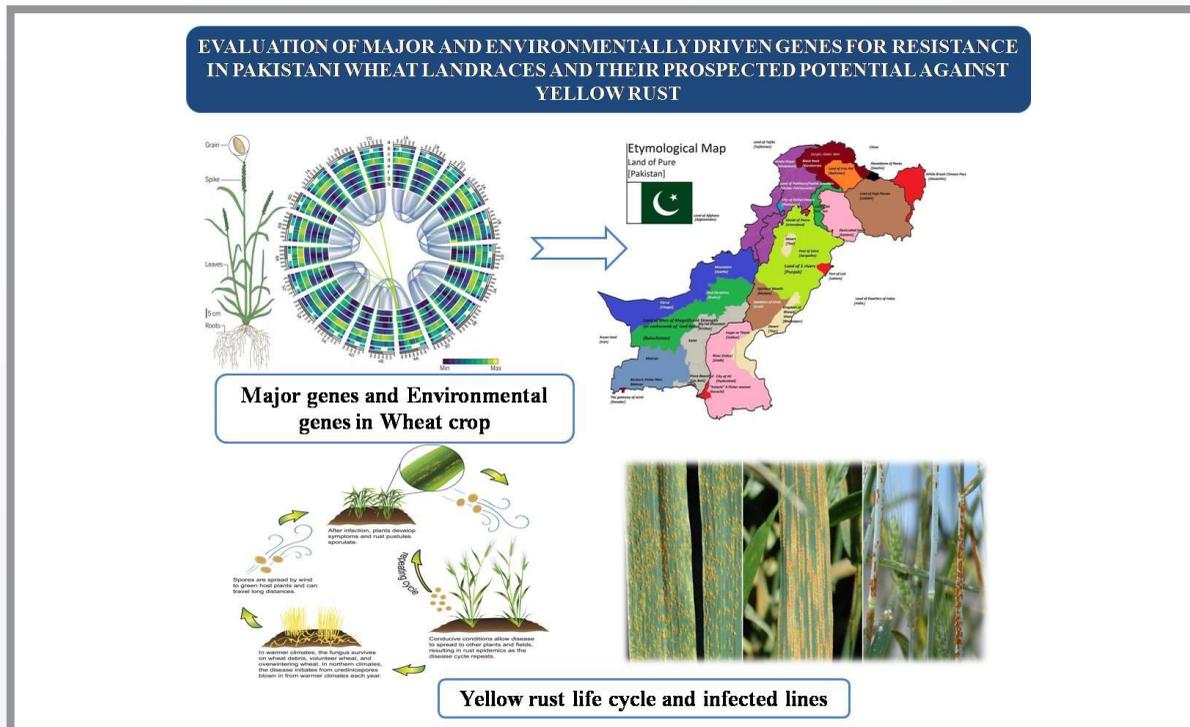
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THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT



ABSTRACT

Background: Yellow rust is caused by *Puccinia striiformis tritici*, the most devastating wheat disease with continuous challenge of emerging virulences breaking vertical resistance worldwide resulting in epidemics. Vertical resistance genes incorporation is a sustainable, economical and environment-friendly approach to control rust diseases. Wheat landraces (WLR) acquired vertical resistance through long time exposure of host pathogen survival competition in specific areas having unique agronomic traits, genetic base and resistance against biotic and abiotic agents can be exploitable commodities for future food production.

Methods: Fifty Pakistani WLRs already with known vertical resistance were screened against 7 potential Pakistani Pst races at seedling stage under glasshouse conditions to postulate resistance genes. Resistance magnitude was compared among the landraces.

Results: Six genes Yr1, Yr8, Yr9, Yr43, Yr44, and YrTr1 were successfully postulated either singly or in combination along with unidentified genes in 45 landraces. Pakistani Pst races are available to Yr5, Yr10, Yr15, Yr24, Yr32, YrSp and YrTye. Most frequently postulated genes are Yr44 found in 22 genotypes, YrTr1 in 21, Yr9 in 19, Yr43 in 18, Yr8 and Yr1 in 14 wheat landraces. Multiple Yr gene pyramiding was observed in (B-74, B-281, B-530) with the presence of Yr8, Yr9, Yr43, Yr44, and YrTr1 and single gene were postulated from 12 genotypes. WLRs (B-03, B-158, B-160, B-171) reaction was immune showing presence of novel Yr genes.

Conclusion: Study provides information regarding yellow rust resistance genes originated independently against localized Pst races with desirable agronomic traits since long and can be an option for food security in changing environmental challenges.

Keywords: eco-friendly, vertical resistance, yellow rust

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-221

Efficacy of different Fungicides against *Alternaria raphani* infesting Radish

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ABSTRACT

Background: Radish (*Raphanus sativus* L.) can be infected by *Alternaria raphani* with the possible outcome of significant loss. A study was undertaken to determine the efficacy of postinfection application of fungicides on control of the pathogen.

Methods: The systemic fungicides Inspire XT (Difenoconazole + Propiconazole), Solex (Triademefon + Carbendazim), Amistar Top (Azoxystrobin + Difenoconazole), Folicur (Tebuconazole), Score (Difenoconazole), and Inspire (Difenoconazole) were tested in vitro and in vivo against

Results: *A. raphani*. Inspire XT, Score, and Inspire produced the most inhibition of *A. raphani* in vitro at 5, 10, and 15 mg-L⁻¹. The least inhibition was produced by Solex. In vivo, Inspire XT produced the best control of the disease with zero disease incidence and severity, whereas Solex was least effective at controlling the disease.

Conclusion: The systemic fungicides tested can be used to manage *A. raphani* on radish to reduce economic loss.

Keywords: fungicides, radish, Inspire XT, postinfection application

SPP-PP-222

Varietal Screening of Tomato Germplasm against Late Blight Caused By *Phytophthora infestans*

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ABSTRACT

Background: Tomato (*Lycopersicon esculentum* L.) is an important crop as being model for genetic studies and second most consumed vegetable worldwide. Traits variability in different cultivars of tomato makes it more suitable for breeding and genetic studies. There have been a number of problems in cultivation of tomatoes with conventional germplasm. Late Blight disease caused by *Phytophthora infestans* is one of the major threats to tomato cultivars in Pakistan causing severe losses in yield.

Methods: Present study was done to evaluate resistant genotypes among the twenty-one genotypes collected from different countries. Experiment was conducted using Completely Randomized Design (CRD) with three replications in the field area of College of Agriculture BZU Bahadur Sub Campus Layyah during the year 2018 & 2019.

Results: The experiment indicate some varieties were moderately resistant (F4T5 (ISL), West Virginia 63, Floradel), some were susceptible (Cromco, Robar, Nunhem's Tuckqueen, Tres Cantos Fito, Muchamiel, Fortuna and Centennial, M.O.G. 10) and some were highly susceptible (Dwarf Moneymaker, Balady, Pusa Ruby, ZhongShuy 4, ZhongShuy 5, 8 A II, Jaguar F1 and Rio Grande) over control.

Conclusion: So no variety found resistant while moderately resistant (F4T5 (ISL)) can be used for cultivation if proper management is applied.

Keywords: Tomato, late blight, *Phytophthora infestans*

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-223

In Silico RFLP and Recombination Analysis of Cucumber mosaic cucumovirus (CMV) subgroup II isolate infecting Pumpkin in Pothwar region of Pakistan

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ABSTRACT

Background: Pumpkin (*Cucurbita sp.*) is one of the most important cucurbitaceous vegetable crop grown across the globe and considered as a good source of potassium, beta-carotene and antioxidants. In the subcontinent, it is known as “Petha or Halwa Kaddu”. As like other cucurbits, successful production of pumpkin is hampered by a number of plant viruses. The most important viral pathogens of pumpkin are *Cucumber mosaic cucumovirus* (CMV), *Zucchini yellow mosaic potyvirus* (ZYMV), *Papaya ringspot potyvirus* (PRSV), *Watermelon mosaic potyvirus* (WMV) and *Squash mosaic comovirus* (SqMV) causes serious damage throughout the world.

Aim: This study was conducted to document serotypes of CMV isolates, their validation with In silico RFLP and detection of Recombination events in Pakistani viral isolates infecting pumpkin.

Methods: In summer 2017, a total of 30 leaf samples of pumpkin with symptoms of mosaic, interveinal chlorosis, chlorotic streaks, leaf stunting were collected from five fields in the Attock district with an average incidence of 50% based on visual observations. All the symptomatic and 2 healthy leaf samples were subjected to DAS-ELISA against the polyclonal antisera of CMV. ELISA positive 13 samples were subjected to reverse transcription-polymerase chain reaction (RT-PCR) with CMV specific primers CMVF-45/CMVR-45. Obtained sequences were compared and aligned with respective CMV sequences retrieved from GenBank, reported from elsewhere in the world. Aligned sequences were simulated using HinfI restriction enzyme in CLC Main Workbench 8.0 and resulting gel was analysed for serotyping of isolates using BioNumerics v7.6. Recombination events was detected with RDP4 using standards methods.

Results: A sequence of 852 nt comprised of 657 nt of complete coat protein gene (CP) and with some portion of 5' and 3' untranslated region (UTR) was submitted to GenBank with accession no. MH119069. BLASTn tool revealed that Pakistani CMV isolate belong to subgroup II and shared 92.2-93.7% of nucleotide identity with already reported representative subgroup II isolates being higher with the Japanese isolate AB006813 and lowest with the Hungarian L15336 isolate. In silico RFLP simulation with HinfI revealed the presence of distinct 178 bp band in all the subgroup II isolates. Analysis of virtual agarose gel in BioNumerics v 7.06 and resultant phylogram revealed that isolate AAHAPu clustered with representative subgroup II isolates and confirmed the BLASTn and sequence identity matrix results. In recombination detection analysis, the Pakistani CMV isolate AAHAPu (MH119069) was found likely to be a recombinant between the Hungarian (L15336) and Pakistani (MH119066) isolates with recombinant breakpoints between 473th and 595th nucleotides.

Conclusion: In this study, CMV subgroup II isolate AAHAPu infecting pumpkin was identified which is likely to be recombinant between another Pakistani subgroup II and Hungarian isolate. The recombinant isolate detection necessitate more investigation about the temporal and spatial analysis of CMV to forecast the chance of resistance breakdown in future pathogen mediated resistant transgenic lines of vegetable crops.

Keywords: Pumpkin, CMV, CP, Recombination, In silico RFLP

THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-224

Management of Root Knot Nematode *Meloidogyne incognita* in Soybean

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ABSTRACT

Background: Soybean (*Glycine max* L.) belongs to family *Leguminosae* and the source of high quality oil and protein. It also contains Ca, P, vitamin A, B, C and D. Soybean is also called “meat of field” due to high protein contents. The plant parasitic nematodes especially root-knot nematodes (*Meloidogyne incognita*) attack on roots of soybean plants.

Methods: The present investigation was done to check the efficacy of nematicides and plant extracts against *Meloidogyne incognita*. The seeds of soybean variety (Ajmeri) were taken from Ayub Agriculture Research Institute (AARI) and sown into sterilized soil in earthen pots. The nematodes were isolated from infected soil and roots by using Baermann funnel method for culture preparation. After 30 days of sowing, inoculation of pure culture of *M. incognita* was done in soybean plants. After 10 days of inoculations, two nematicides (Cadusafos and Cartap hydrochloride) and two plant extracts (neem extract and garlic extract) were applied by soil drench method with five replications and no treatment was done in control plants. After 60 days, plants from each treatment were observed and data were recorded. The data were recorded on the

basis of number of galls, number of juveniles, number of egg masses and plant height.

Conclusion: The Cadusafos was most effective against the *Meloidogyne incognita*, because the lesser number of galls, no. of juveniles, no. of egg masses and plant height was observed. The Cartap hydrochloride and neem extracts were less effective than Cadusafos. On the other hand, garlic extract was less effective from neem extract because nematode reproduction parameters were high in garlic as compared to neem extract.

Keywords: *Meloidogyne incognita*, Soybean, Neem

SPP-PP-225

Effect of seed and seedling priming on the root knot nematode *Meloidogyne incognita* infesting brinjal crop

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ABSTRACT

Background: Root knot nematodes *Meloidogyne incognita* are very destructive obligate parasites of brinjal causing both quantitative and qualitative losses. Recent work was planned to establish the invitro management of these root parasites through nutrition and plant growth stimulant for safer environment.

Methods: Current study was designed using priming of seeds and seedlings with Salicylic acid (SA) and Potassium chloride (KCL) with different doses to evaluate their defence against *M. incognita*. Brinjal seeds were separately soaked

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for 24 hours with 100 ppm, 150 ppm and 200 ppm concentration of SA and KCL respectively. After 21 days these plants were inoculated with approximately 2000 eggs of *M. incognita*. Seedlings of brinjal were also treated with same doses of SA and KCL prior to inoculations.

Results: The seed priming with SA was greatly effective in reducing the number of root galls, egg masses and eggs at 200 PPM concentration. Increasing doses of all the priming agents decreases the number of root galls, egg masses and eggs in all the treatments. However, seedling treatments with plant defence stimulants reduced the number of root galls, egg masses and eggs a bit less than seed treatment with the same trend in the data recorded.

Conclusion:

It was concluded that seed treatment with salicylic acid was more promising than seedling or root dip treatment. Therefore, this method can also be successfully used in integrated management of RKNs as an eco-friendly approach.

Keywords: Brinjal, *Meloidogyne incognita*, Salicylic acid, Potassium chloride

SPP-PP-226

Management of *Alternaria* black spot of rose

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ABSTRACT

Background: Rose (*Rosa indica* L) is important plant uses worldwide in medical, cosmetic, happy events, celebrations and food tonic supplement. Fungal diseases (powdery mildew, anthracnose, rust, root rots, *Alternaria* black spot, cercospora leaf spot and grey mold) are well known for threat to cultivation of rose plant for commercial scale. Among them *Alternaria* black spot disease is the most dangerous one.

Methods: Present study was done in the field area of College of Agriculture, Bhadur sub.campus Layyah in 2019 using RCBD 3 factorial design. The study was carried out to evaluate and to check efficacy of five fungicides (Ridomil Gold, Companion, Acrobat MZ, Dodine and Myclobutanil) to control the disease at different concentration and days.

Results: Results indicate that disease is effectively controlled by Ridomil Gold (17.68%) followed by Acrobat MZ (24.35%), Myclobutanil (34.69%), Companion (49.72%) while Dodine showed least efficacy (44.84%) over control (73.54 %).

Conclusion:

Ridomil gold can be used to control *Alternaria* black spot of rose.

Keywords: *Alternaria*, leaf spot, *Rosa indica*

SPP-PP-227

Efficacy of different fungicides to control Black spot of Rose

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ABSTRACT

Background: Rose (*Rosa indica* L.) is widely used throughout the world for welcome parties, celebrations, love moments, ornamentally as well as food tonic supplement. Various fungal and bacterial diseases such as *Cercospora* leaf spot, Powdery mildew, *Agrobacterium tumefaciens*, black spot, *Botrytis* Blight, and rust are found associated with roses

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at all stages of its growth. Among all these diseases black spot disease is more severe, dominated and occur worldwide.

Methods: The current study was conducted in 2019 in the field area of the college of agriculture BZU, Bahadur Sub Campus Layyah using RCBD 3 factorial design. The research was conducted to test and verify the effectiveness of five fungicides. (Acrobat MZ, Antracol, Myclobutanil, Amistar Top and Companion) to control the disease at different concentration and days.

Results: Results specify that disease is effectively controlled by Antracol (18.03%) followed by Acrobat MZ (25.25%), Myclobutanil (35.87), Amistar Top (44.17%) while Companion show the less efficacy (47.98%) against control (55.96%).

Conclusion: So Antracol can be used to effectively control the black spot of roses.

Keywords: *Diplocarpon rosae*,

SPP-PP-228

Evaluation potential of Tomato germplasm against Early Blight (*Alternaria solani*)

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ABSTRACT

Background: Tomato (*Lycopersicon esculentum* L.) is an important consumable vegetable and ranks second after potato worldwide. Many fungal diseases (anthracnose, septoria leaf spot, late blight, early blight and buckeye rot) infect tomato crop and heavy losses of yield. Among all the fungal disease early blight (Caused by *Alternaria solani*) is the most destructive one causing heavy losses in yield of tomato sometimes as high fruit loss.

Methods: To evaluate the resistance of this threat in tomato germplasm, twenty genotypes were screened using Randomized Complete Block Design (RCBD) with three replications at experimental area of College of Agriculture, BZU Layyah during 2018-2019.

Results: Results indicate three varieties (F4T5 ISL, Floradel and West Virginia 63) are tolerant to early blight while remaining are susceptible and highly susceptible.

Conclusion: So these tolerant varieties can be further processed to develop one variety for cultivation.

Keywords: Tomato, *Alternaria solani*, *Lycopersicon esculentum*

SPP-PP-229

Efficiency of Different Nematicides Against Root Knot Nematodes in Tomato Rehman Wali

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ABSTRACT

Background: Tomato (*Solanum lycopersicum*) belongs to nightshade family Solanaceae. Tomato exhibits high nutritional values as it is a rich source of fatty acids, proteins, fiber and vitamins. Root knot nematodes produce galls on the roots of tomato plants and negatively affects in the growth, productivity and yield losse.

Method: The seedlings of tomato variety (Naqeeb) were taken from Ayub Agriculture Research Institute (AARI), Faisalabad. Seedlings were transplanted in the research area of the department of Plant Pathology,

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University of Agriculture, Faisalabad by following Randomized Complete Block Design (RCBD). Culture of root knot nematodes was prepared from infected soil sampling. Inoculation was done after three weeks of transplanting. After 1 weeks of inoculation, three nematicides (benomyl, Carbofuran and carbosulfan) were applied through foliar spray method with three replications for management purpose. After 25 days of chemicals application, roots of inoculated plants were observed to assess the nematode infestation. Then, data of different parameters such as number of galls, number of egg masses and number of juveniles were recorded.

Results: Carbofuran showed significant result against the root knot nematodes because the number of galls were 21, 36 number of egg masses and number of juveniles were 102. Benomyl was less efficient than Carbofuran. The Carbosulfan was least efficient against the root knot nematodes than other chemicals because the number of galls were 110, 180 number of egg masses and number of juveniles were 617.

Conclusion: On the basis of results, the Carbofuran must be used in the management against the root knot nematodes in future experiments.

Keywords: Root knot nematode, Tomato, Nematicide

SPP-PP-230

Application of Advance and Innovative Techniques in Plant Protection

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ABSTRACT

Background: The application of “Omics” techniques in crop protection, that has been expressed the potential for “omic” based technologies derive innovation in crop protection is powerful when applied to understanding plant pathogen interactions and genetic variation among crop genotypes and populations of target organisms (pathogens, weeds and microbes). Few advance ideas on using “omics” more extensively in conventional crop protection strategies that includes, using molecular approaches to optimize the integrated use of agrochemicals with crop varieties of differing genetic Background (matching fungicides mode of action with host resistance). Identification of new crop protection targets for intervention in pathogens, pests, and weeds which may provide the basis for screening chemical and biological agents. Beneficial endophytes and resistance elicitors enhanced crop protection and improve its efficacy. Exploiting natural “plant protection strategies” including, pest and disease resistance, as well as embracing less studied interactions such as allelopathy.

Conclusion: Developing synergistic mixes and formulations of pesticides, and directly identifying novel bioactive natural products through bio-prospecting.

Keywords: omics, crop protection, Innovative techniques

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SPP-PP-231

Prevalence and Incidence of Lentil Wilt in Pakistan

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ABSTRACT

Background: Lentil (*Lens culinaris Medikus*) is a significant nutritional protein source in South Asia including Pakistan and various parts of the world. The crop is susceptible to a severe soil-borne wilt incited by the fungus *Fusarium oxysporum f. sp. lentis*.

Method: Project was started for assessment of the disease, their determination and recovered isolates of the pathogen. The crop is susceptible to wilt, a serious soil-borne threat incited by the fungus *Fusarium oxysporum f. sp. lentis*. Surveys were shown during the Rabi season of 2019-2020 to obtain information on the distribution and natural incidence of lentil wilt.

Results: It was evident from the investigation that the incidences of Fusarium wilt disease of lentil varied with the location, variety and season. Layyah district with 5 locations were surveyed during the crop season of year 2019-20, out of which 2 showed 100% disease prevalence. In total, 4 isolates of *F. oxysporum f. sp. lentis* were recovered.

Conclusion: So, in Layyah districts disease prevalence is 100% and pathogen exist with four different isolates.

Keywords: Lentil wilt, Lentil, *Fusarium oxysporum*

SPP-PP-232

Inhibitory effect of various fungicides on mycelial growth of *Alternaria alternata*; cause of *Alternaria* leaf spot disease on *Rosa Indica L.* in Pakistan

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ABSTRACT

Background: Rose (*Rosa indica L.*) belong to *Rosaceae* family is a leading ornamental plant and grown widely over the world. Rose plant is attacked by many diseases (powdery mildew, anthracnose, rust, root rots, *Alternaria* black spot, *Cercospora* leaf spot and grey mold). Among all these diseases *Alternaria* black spot because major losses of yield in roses.

Methods: Present study was carried out to purify and detection of the pathogen. In vitro, experiment was done at Plant pathology lab of College of Agriculture BZU Layyah by using food poisoning technique to evaluate efficacy of five fungicides (Companion, Dodine, Myclobutanil, Acrobat.MZ and Ridomil Gold) against *Alternaria* black spot.

Results: Among all fungicides, Ridomil Gold was the most active as compared to others. Maximum inhibition was observed after 3rd (89%), 5th (91.6%) and 7th (93.3) day by Ridomil Gold and minimum 4.3% mycelial inhibition was observed by Acrobat.MZ.

Conclusion: Thus, *Alternaria* leaf spot disease (caused by *Alternaria alternata*) of rose can be best controlled by using Ridomil Gold.

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Keywords: Fungicides, *Alternaria alternata*, *Rosa indica*

SPP-PP-233

Biological control of diseases: A recent trend in Agriculture

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ABSTRACT

Background: The intentional use of living organisms or their metabolites is that to suppress, decrease or kill the population of invading disease-causing agents through non-target or host-specific biocontrol agents such as insects, bacteria, viruses and fungi, which is broadly termed as biological control or biocontrol. Biological control is considered safe for both humans as well as non-target organisms, effective, biodegradable and environment-friendly. Due to intensified cropping to increase production, chemicals are used indiscriminately to control diseases, pests, weeds, etc. leading towards the harmful impact not only on humans and animals health but also on the environment through their residues. Public attitude is changing with increasing awareness of the detrimental effects of chemicals towards pollution free environment. Many agrochemicals are removed from markets due to pressure created by many legislative and social platforms in concern to environmental sustainability. Among agricultural control measures, almost 1% of biological products control equally that 15% of synthetic chemicals can do.

Conclusion: That's way, demand or acceptance of biological control gained momentum as a central component in Integrated Disease Management (IDM) programs as well as used as a suitable alternate for harmful chemicals.

Keywords: Biological control, bio-control agents, Integrated disease management

SPP-PP-234

Use of synthetic fungicides to reduce the disease severity and incidence of *Ascochyta rabiei*, the cause of Chickpea (*Cicer arietinum* L.) blight

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ABSTRACT

Background: The *Ascochyta* Blight is the most important disease of chickpea in Pakistan and all over the world which affects the qualitative and quantitative chickpea yield. The application of foliar sprays of fungicides is essential to control this disease. To check the efficacy of two fungicides namely Carbendazim and Mancozeb on *Ascochyta* Blight field trials were conducted during 2018/2019 cropping seasons in the Research Area of the Department of Plant Pathology, Bahadar sub-campus Layyah.

Methods: The experiments were laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental plots were sprayed 3- 7 times with the help of knapsack sprayer. Data for disease severity and incidence were recorded by adopting method proposed by Amadioha (2003) and subjected to analysis of variance following PROC

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GLM procedure in Minitab Ver.17.

Results: The foliar application of fungicides proved most conducive in suppressing the disease development. A significant reduction in disease was recorded with exogenous application of 3-7 times over control. Disease incidence and severity (%) was reduced by 64.4, 60.14, 38.15, and 31% in Layyah Punjab Pakistan following application of 4, 5, 6 and 7 foliar sprays, respectively as compared to control.

Conclusion: Cultivation of vulnerable varieties of chickpea in District Layyah Punjab Pakistan under high disease pressure and conducive environmental conditions may require 4-7 exogenous sprays with either Carbendazim or Mancozeb while 3-5 foliar sprays with either of the two fungicides are required for effective management under low disease pressure.

Keywords: exogenous, *Ascochyta blight*, chickpea

SPP-PP-235

Principal Component Analysis to Assess the Genetic Diversity in Wheat Germplasm Based Upon Physiomorphic Traits

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ABSTRACT

Background: Genotype performance during breeding program can be improved by analyzing the Euclidean distance (ED) among wheat genotypes.

Methods: In present investigation, 30 wheat advanced lines were investigated for eleven physio-morphological and yield attributing traits namely days to booting (DTB), days to heading (DTH), peduncle length (cm) plant height (cm) effective tillers, number of spikelet per spike, spike length, grains per spike, thousand-grain weight (g), grain yield (kg ha⁻¹) and protein percentage in a Randomized Complete Block Design (RCBD) with three replication at the Research Area of Plant Pathology University of Agriculture Faisalabad during December 5, 2018 to evaluate elite advanced lines after clustering them on the basis of their genetic variation in performance.

Results: Multivariate analysis exhibited that thirty advanced lines formed 4 different clusters. Cluster 2 and 3 showed maximum values for spike length, effective tillers, number of spikelet per spike, number of grains per spike, protein percentage, thousand-grain weight and yield and lowest peduncle length, days to booting and days to heading. Cluster 1 demonstrated maximum values for days to heading, days to booting, peduncle length and plant height and lowest for effective tillers, protein percentage, number of grains per spike, grain yield and thousand grain weights.

Conclusion: Multivariate analysis suggested that members of cluster 2 had the highest influence on gain yield (GY) and could be used as high yielding wheat elite lines in Faisalabad condition of Pakistan.

Keywords: genetic diversity, principal component analysis, cluster analysis

THEME-2:

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SPP-PP-236

In vitro Efficacy of Fungicides Against *Colletotrichum capsici*

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ABSTRACT

Background: Chilli is a universal spice for its biting pungency and is used in different ways. It ranks 3 rd after tomato and potato. Many fungal and bacterial diseases (Anthracnose, Cercospora leaf spot, Charcoal rot, Choanephora blight (wet rot), Damping-off root rot, Downy mildew, Fusarium stem rot, Fusarium wilt, Gray leaf spot, Gray mold, Phytophthora blight, Powdery mildew, Southern blight, Verticillium wilt and White mold) attack chili and cause severe losses of yield. Anthracnose is one of the most severe disease that is caused by *Colletotrichum capsici*. About 50% losses of chilies are caused by anthracnose. The disease is both seed borne and air borne and affects seed germination and vigour to a greater extent.

Method: Five fungicides viz: Carbendazim, Antracole, Aliette, Acrobat and Dithane M 45 at their standard conc. and one control were evaluated against *C. capsici* by poisoned food technique.

Results: Among these the Carbendazim proved to be the best (2.81 cm) at $\alpha=0.05$ in inhibiting the colony growth *Colletotrichum capsici* followed by Antracole, acrobat, Alliet and Dithane M 45 respectively.

Conclusion: Carbendazim can be used to manage this disease effectively.

Keywords: Chilli, fungicides, *Colletotrichum capsici*

SPP-PP-237

Enhancement in Plant Immunity by silicon for drought stress in wheat (*Triticum aestivum* L.)

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ABSTRACT

Background: Plant immunity is an important component of plant defence system. The role of plant immunity is demonstrated against biotic and abiotic stresses. The present study is aimed at alleviating the plant immunity against drought stress in wheat.

Methods: A pot experiment was performed by using two varieties of wheat (Faisalabad-2005 and Ujala) in a completely randomized design with three replications under two drought stress levels (15% and 30%). The silicon (K_2SiO_4) 2.5 mM was applied to enhance the plant immunity for drought. Drought stress was applied till harvesting in wheat. Important physiological and biochemical parameters were studied and ANOVA was applied to analyze the data.

Results: Soil application of silicon enhanced morphological, physiological and biochemical attributes and also enhances the productivity, antioxidants and yield attributes under drought stress. Silicon had positive effects on wheat plants under different levels of water but there were more significant effects under 30% drought.

Conclusion: Therefore, soil application of silicon could be used to enhance productivity, morphological, physiological and biochemical attributes under drought stress.

Keywords: Plant immunity, silicon

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PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

SPP-PP-238

Disease Mapping and Evaluation of Cotton Cultivars Against Cotton Leaf Curl Disease in District Multan

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ABSTRACT

Background: Cotton is Pakistan's economically significant and valuable crop. It is the potent source of fiber, natural edible oil and also known as white gold across the globe. Cotton is mostly cultivated in Sindh and Punjab. Cotton leaf curl disease (CLCuD) is the main limiting factor for cotton yield in Pakistan, which is caused by begomoviruses. The present study was aimed to assess the resistance level of cotton cultivars in Multan district and to identify resistance sources against CLCuD.

Methods: During cotton season 2018-19 and 2019-20 in district Multan (Multan city, Multan Saddar, Shujabad and Jalalpur Pirwala) different commercial cotton cultivars such as IUB-2013, IUB-2015, IUB-2018, SS-32, BS-15, BS-18, MNH-886 and MNH-992, were mostly cultivated in district Multan. We surveyed different locations of Multan during cotton season 2018-19 and 2019-20 and cotton varieties were randomly rated according to disease rating scale. The germplasm containing 100 genotypes was also screened against CLCuD. The samples from rated genotypes samples were collected and tested for the presence of begomoviruses by specific primer pair amplifying downstream region of coat protein gene.

Results: During 2018-19 and 2019-20 cotton rated as susceptible to highly susceptible on the basis of disease rating scale. The two cotton varieties IUB-2018 and MNH-992 were rated susceptible during 2018-19 and 2019-20 with mean disease severity index of 38.49% and 35.94%; 47.91% and 47.87% respectively. The seven cotton varieties IUB-2013, IUB-2015, MNH-886, BS-15, BS-18, SS-32 and FH-142 were rated susceptible to highly susceptible during 2018-19 and 2019-2020 with a mean severity index of 46.77% and 61.87%; 48.87% and 63.25%; 61.92% and 61%; 58.39% and 67.55%; 60.68% and 67.50%; 51.75% and 49.25%; 48.37% and 50.80 respectively. In 2018-19 and 2019-20, there was no resistant, tolerant or even moderately tolerant commercial cotton cultivars. All symptomatic cultivars were tested positive by using PCR.

Conclusion: The study has shown the prevailing resistance level in commercial cotton varieties and the potential of *Gossypium arboreum* genotypes to be incorporated into cotton breeding programs aided by biotechnological approaches for CLCuD resistant genes transfer to cultivated cotton.

Key words: Disease Incidence, Begomoviruses, CLCuD, Multan

SPP-PP-239

Extent of Siris (*Albizia lebbek*) Decline in Narowal, Gujranwala, Lahore and Sialkot Districts

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THEME-2:

PLANT DISEASE DIAGNOSTICS AND MANAGEMENT

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ABSTRACT

Background: Siris is an important tree in District Sialkot and is important for fuel and timber wood but it is threatened by decline. The study was conducted to assess the Siris decline in three main districts of Punjab.

Methods: A survey of four districts of Punjab viz. Narowal, Gujranwala, Lahore and Sialkot were conducted during May-June 2019-20 to study the present scenario of siris (*Albizia lebbbeck*) decline in these areas and to find out relationship between disease severity and edaphic conditions. From each of the four districts, canal banks, highways and roadsides, and agricultural lands were surveyed. From each district 700 – 1200 plants were observed.

Results: Maximum mortality of 65 – 85 % was observed along the canal banks. Along the highways and roadsides 25 – 45 % plants were found dead. In the Punjab University about 8 % plants were found dead while 15 % wilting ranging from mild infection to highly diseased. The least disease incidence and mortality rate was observed on plants growing on agricultural lands, along the roadside of all districts. Disease incidence and severity seemed to have no relation with soil pH. Generally older plants were found to be more susceptible to the disease attack than the younger ones.

Conclusion: It was concluded that plant resistance to disease attack was associated with proper irrigation management. Apparently stressed conditions especially high soil moisture content is responsible for the attack and severity of the disease. It is recommended that along the canal bank siris should be replaced with Eucalyptus spp. Furthermore, seeds from the resistant siris plants, standing healthy among the hundreds of dead ones along the canal banks, should be used to raise nurseries for siris plantation on suitable places away from the canals.

Key words: *Albizia lebbbeck*, wilting, decline, disease incidence.

SPP-PP-240

Integration of *Pasteuria penetrans* with chemicals for the management of Root knot nematode in tomato

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ABSTRACT

Background: Root knot nematodes are considered major pathogen of vegetables as caused severe yield losses.

Methods: Present investigation was done to exploit the nematocidal potential of chemicals integrated with *Pasteuria penetrans* for the management of root knot nematode, *Meloidogyne incognita* in tomato. Efficacy of chemicals (Cartap, Priority, Nova Star and Proclaim) and *P. penetrans* was checked against *M. incognita* at different time intervals; 14 and 28 days on nematode reproduction parameters. Effect of chemicals and *P. penetrans* was also evaluated against invasion and development of root knot nematode in tomato roots. Fifteen hundred juveniles of *M. incognita* were inoculated in tomato plants.

Results: A gradual decline was noted in the effectiveness of chemicals with the increase in time interval. Number of egg masses were minimum in Cartap + *P. penetrans* while maximum in control treatment. After 28 days galling index was high as compared to 14 days interval. Minimum invasion of juveniles of *M. incognita* was observed in Cartap + *P. penetrans* (43.1) followed by Priority + *P. penetrans* (61.3) while maximum invasion was observed in control plants (147.3). After 14 days maximum fourth stage juveniles were observed in control treatment (65.1) while minimum were observed in Cartap + *P. penetrans* (21.1). After 28 days of inoculation, highest number of egg masses were recorded in control (217.5) while minimum were observed in Cartap + *P. penetrans* (48.6).

Conclusion: Considerable suppression in root knot nematode population was observed with the integration of *P. penetrans* with chemicals for the immediate and long term management plan.

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Keywords: *Meloidogyne incognita*, *Pasteuria penetrans*, Root knot nematode

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Control of *Botrytis cinerea* by using different plant extract under laboratory conditions

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ABSTRACT

Background: Strawberry (*Fragaria ananassa* Duch) is one of the most important crops among fresh fruits belonging to Family *Rosaceae* and genus *Fragaria*. It is a rich source of complex vitamin C, fiber, potassium, manganese, fluorine, copper, iron and iodine and particularly ellagic acid phytochemicals. It is used as fresh fruit or in juices, ice - cream, jams and bakery products. In the storage condition it is seriously attacked by *Botrytis cinerea* which cause grey mold of strawberry.

Methods: In the present study, Survey of strawberry field in different region of sumandari, Sahiwal and University of Agriculture, Faisalabad and diagnose different diseases of strawberry like grey mold of strawberry and other fungal diseases of strawberry was conducted. Different plant extracts were evaluated for their efficacy to control this notorious fungus. To test the efficiency of plant extract against the *Botrytis cinerea* we used agar diffusion method, poisoned technique method by using different concentrations (120,200,500,700 and 1000 µl.l⁻¹), radial growth test, conidial germination assay, a technique of Thompson.

Results: These plant extracts gave good result to control the fungus that causes strawberry rot. Then statistical analysis was recorded data by using completely randomized method (CRD). Inhibition of growth calculated by % of inhibition of radial growth relative to the measure control.

Conclusion: This fungus *Botrytis cinerea* can be managed by essential oils and plant extracts. Strawberry was also treated with a salt solution, sucrose solution and vinegar solution which reduced the chances of strawberry rot.

Keywords: Botrytis, phytochemicals, strawberry

SPP-PP-242

Postharvest Fruit Sanitation Combined with Oxalic Acid Treatment Alleviate Disease Incidence and Maintain Overall Quality of Ripe Papaya Fruit

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ABSTRACT

Background: Papaya fruit is highly nutritive fruit crop being grown in the tropical and sub-tropical regions of the world. However ripe fruit is extremely prone to postharvest fruit decay owing to incidence of various postharvest diseases.

Methods: This research plan was aimed to check the effect of sanitation alone and in combination to oxalic acid (OA) on postharvest disease incidence and quality of ripe papaya fruit cv. 'Red Lady' at shelf under ambient conditions (25±2°C & 55-65% RH). From previous pilot study findings, an optimized dose of OA (5mM) was applied as postharvest dips along

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with sanitation *viz.* (Untreated (control), 5% Chlorine alone, 5mM-OA alone & 5% Chlorine + 5mM-OA) on ripe papaya fruit. The treated fruit were kept at ambient conditions for 8-days, various physiological, physico-chemical and antioxidative attributes were evaluated. The experimental design was Completely Randomized Design (CRD) with factorial arrangement replicated thrice.

Results: Papaya fruit treated with 5mM-OA alone exhibited significant lower ethylene production, respiration rate, fruit weight loss and significant higher fruit firmness than untreated and other treated fruit. However, postharvest disease incidence and various biochemical parameter including ripening index, total anthocyanin contents, total antioxidants and activities of catalase, peroxidase and superoxide dismutase enzymes was observed in the papaya fruit treated with 5mM-OA combined with 5% chlorine in comparison to other treatments.

Conclusion: Papaya

Keywords: Antioxidative attributes, ambient conditions, *Carica papaya*, shelf life

SPP-PP-243

Begomoviruses and their impact on different chilli varieties under different environmental conditions

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ABSTRACT

Background: Many viruses cause disease in chilli crops. The significant increase in the incidence of viral diseases may be due to a combination of factors. Most of these viruses are insect's transmitted, but they also transmitted by infected mechanical tools or seed are serious problem for the production of chilli crop in Pakistan. Begomoviruses cause severe disease among other viral diseases of chilli plants. The 12 different chilli lines/varieties tatapuri, talhari, CH111, CH99, CH10, CH109, CH108, CBS1292 and GSL111 were tested for their relative susceptibility and resistance to begomovirus infection in open field areas of different locations of two districts D1 and D2 along with their enzymatic studies. The use of resistant lines/varieties is important strategies to control the harmful effect of chemicals.

Method: In irrigated chilli growing areas of southern Punjab, the survey was conducted and different locations were randomly selected to estimate the incidence and severity of begomovirus infection by keeping a view the occurrence of begomovirus infection on commonly chilli grown varieties with regard to biochemical analysis, such as SOD, PAL, CAT, POD, Chitinase, B 1, 3 glucanase and phenols, which is involved in resistance of chilli crops by following Aebi 1983 method.

Result: Data of disease incidence and severity was recorded of each chilli lines/varities against begomovirus infection. Out of twelve tested lines/ varieties tatapuri, talhari, CH111, CH99, CH10, CH107, CH109, CH108, CBS1292 and GSL111 were found highly susceptible while two cultivars Hot queen and hybrid 46 are categorized as moderately susceptible. The disease incidence (DI) is more than 50 to 73 % in tatapuri, talhari, CH111, CH99, CH10, CH107, CH109, CH108, CBS1292 and GSL111 with disease severity (DS) is more than 21 to 30 %. DI in hotqueen and hybrid are 45 to 35 % with DS was less than 20 %. The biochemical enzymatic activities including Protein, PAL, POD, SOD, CAT, total Phenolics, PPO, B1.3-glucanase and chitinase activities found high in healthy samples of all tested chilli lines/varities as compared to begomovirus infected samples. In moderate susceptible varieties including hot queen and hybrid 46, overall biochemical and antioxidant activities were high while in highly susceptible varieties all enzymatic activities are low.

Conclusion: The survey and biochemical activities of different chilli lines/varieties revealed that there is no single line/varieties were found resistant towards Begomovirus infection. The activity of POD, PPO SOD, CAT, Phenols, Protein, PAL, chitinase and B-1.3-glucanase enzyme were found high in Hotqueen and Hybrid146. The two cultivars were found

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less susceptible with low disease incidence or severity in the field and showed that these enzymes were actively involved in induction resistance in Chilli host plant. Among 12 chilli lines/varieties found susceptible due to their genetic makeup so there is no resistance resource of chillies crop against Begomovirus infection.

Keywords: Begomoviruses, chilli leaf curl disease

SPP-PP-244

Prevalence of Cotton Infecting Begomoviruses in Weeds of Punjab, Pakistan

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ABSTRACT

Background: Weeds are playing important role in transmission of begomoviruses responsible for Cotton leaf curl viruses (CLCuD) and act as potential source of inoculum. Different weeds are growing around the cotton crop and during off-season in the field throughout the year act as hosts for cotton infecting begomoviruses (family *Geminiviridae*) in the absence of cotton crop. Weeds have higher adaptability to changing environment and widely distributed throughout the world. Whitefly (*Bemisia tabaci*) cryptic species on weeds during off-season and growing cotton season, transmit begomoviruses from weeds to cotton crop. To understand the dissemination of begomoviruses from weeds, the study was aimed to identify the weeds harbouring cotton infecting begomoviruses.

Methods: The weed samples exhibiting characteristic begomoviruses symptoms were collected from different areas of cotton belt in Punjab, Pakistan during 2018-19. CTAB method was used for isolating total genomic DNA from weed samples followed by diagnostic PCR for cotton infecting begomoviruses species amplifying downstream region partial coat protein gene. The PCR products were resolved on 1% agarose gel and visualized under UV light.

Results: The results *Trianthema portulacastrum* L. (Itsit), *Amaranthus viridis* L. (Chulai), *Withania somnifera* L. (Akson) and *Parthenium hysterophorus* L. (Carrot Grass) were tested positive for Cotton leaf curl disease causing begomoviruses while other samples of weeds did not show positive results for begomoviruses.

Conclusion: These research findings underline the need to eradicate specific weeds from off-farm areas to minimize the Cotton leaf curl disease incidence and severity.

Keywords: Cotton, Weeds, begomovirus diversity, *Bemisia tabaci*, CLCuV transmission

SPP-PP-245

Deep Learning Driven Cotton Leaf Curl Disease Diagnosis and Severity Index Estimation

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ABSTRACT

Background: Cotton is an important crop and Pakistan is the fourth biggest producer of cotton in the world. It faces an epidemic attack of cotton leaf curl disease (CLCuD) which leads to low production and loss of economic revenue. The CLCuD is severe cotton disease transmitted by the whitefly (*Bemisia Tabaci*). The major symptoms of this disease are thickening the veins of leaf, curling of leaf and enations (leaf out growth) on leaves. The main objective of the proposed study is to develop a system based on deep learning methods which will identify and index the CLCuD through images of

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symptomatic cotton leaves.

Conclusions: The dataset of cotton leaf images will be obtained from Institute of Plant Protection for the training of proposed system and subsequently the images are index according to the severity of virus. This system will identify the severity of CLCuD using transform learning approach through deep convolutional neural network (DCNN).

Keywords: Cotton Leaf Curl Virus, Disease, Machine Learning, Transform Learning, CNN

SPP-PP-246

Citrus huanglongbing pathogen *Candidatus liberibacter asiaticus* elimination through indigenous citrus endophytes

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ABSTRACT

Background: The future of orange juice is at stake due to wreaking havoc on the citrus industry caused by huanglongbing (HLB), one of the most serious and uncontrollable citrus diseases worldwide, is caused by nonculturable pathogen, *Candidatus Liberibacter asiaticus* (Clas). On one hand, no HLB-resistant plant varieties are available and on the other hand failing prevention and treatment strategies, the disease remains incurable. Indigenous endophytes of citrus trees play important role in plant health, with good communication between native endophytes and the host plant. Much remains unknown about core microbiome function and importance for plant health, as a limited number of studies have been conducted on the core microbial communities of specific plants. However, it is still unknown donor beneficial microbiota from healthy citrus plants could minimize disease incidence in citrus and is more effective in function in recipient host.

Methods: Here, we used a combination of experiments including novel half leaf method to leverage endophytes against Clas pathogen, and quantitative PCR was used to check the total copies of pathogen inside diseased leaves. Illumina HiSeqTM2500 was used to analyze gene transcripts in diseased and healthy citrus plants, and edgeR package (<http://www.r-project.org/>) was used to identify differentially expressed genes (DEGs). Using LC-ESI-MS/MS, we compared the metabolic profile of citrus plants before and after treatment with endophyte.

Results: In the present study, number of Clas pathogen copies present inside diseased midribs was considerably reduced after treatment with 10^6 CFU/mL of endophyte *Bacillus subtilis* L1-21. In addition, we found significant increase in the population number of citrus endophytes inside the leaves which reached to a considerable level of 10^9 CFU/g. The control effect of endophyte L1-21 was 100%. In diseased citrus grove, after one year application (one time each month) with endophyte help in reduction of pathogen from 10^9 pathogen/gram to 10^4 pathogen/gram of diseased citrus leaf. Additionally, transcriptomic and metabolomics approaches to gain information about the molecular mechanisms of pathogen resistance and citrus defense against Clas in endophyte treated diseased and healthy citrus trees were conducted. Important genes regulated in the citrus trees treated with endophytes were pathogen resistance genes, carbohydrate metabolism, starch and sucrose biosynthesis, cell wall modification, important transcription factors, genes responsible for photosynthesis, and protein folding. In general, the expression of defense related genes, and important transcription factors, WRKY, were much greater in the endophyte treated citrus trees. Metabolomics analysis revealed that purine metabolism, biotin metabolism, and betalain biosynthesis, terpenoid-quinone biosynthesis, phenylalanine, tyrosine and lysine biosynthesis, isoflavonoid biosynthesis were investigated by KEGG enrichment analysis ($p_{adj} < 0.05$).

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Conclusions: This study highlighted restructuring citrus microbiome with native endophytes can be used in citrus field to mitigate HLB disease.

Keywords: Citrus, endophytes, citrus greening, pathogen resistance, metabolites

SPP-PP-247

Enhanced production of mushroom using different growth media

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ABSTRACT

Background: Mushroom cultivation becomes an important source of improving the economic status of all types of farmers in developing countries. Now a day's Oyster mushroom cultivation become important agribusiness because of natural abilities to grow under various condition at different temperature. Crop can be successfully harvested with low input as well as big source of recycling of waste agricultural products

Methods: The mycelium from slants containing PDA medium is used in production of spawn. The different substrate material included wheat straw, sorghum waste, sawdust, sugar cane leaves, maize leaves were collected from different field areas and cotton waste as a by-product from the cotton mill. The substrate materials were soaked in water with addition of nutrients e.g ammonium, nitrogen and potassium and biological supplements viz rice husk, chicken manure, wheat bran, mustard cake (MC) and soybean meal (SM) at rate of 10g/l in water were added in moist substrate. The spawned mushroom mycelia grows on different tested substrates with addition of nutrients by using a method of lamp spawning on a dry weight basis of substrates. The spawn was amended at 2% (w/w) of substrate in each substrate. Inoculated bags were placed in control condition at 25°C temperature for spawn running. Humidity and water contents were regularly checked. The chemical and biological efficiencies were compared by calculating yield (means) of mushroom in three flushes

Results: On wheat straw substrate total yield after 3 flushes of *Pleurotus ostreatus* (strain PK 505) with addition of nitrogen, ammonium, and potassium, yield were 351, 388, 361 gm while in control it was 344 gm respectively. On cotton waste with addition of N, P, K nutrients, total yield was 381, 377, 381 gm as compared to control it was 357 gm. While On Sorghum waste substrate less yield was obtained as compared to other two substrates. Yield in 3 flushes on sorghum straw were 343, 345, 356 while in control it was 338 gm. Addition of biological supplements to substrate significantly increased yield except in addition to chicken manure to wheat straw, cotton wastes, sugar cane and maize leaves substrates. The obtained yield on these four substrates fortified with chicken manure resulted in low yields as 342, 347, 330, 339 grams while in control the obtained yield was high as 344, 347, 333 and 341 grams respectively. The yield of *Pleurotus ostreatus* on wheat straw substrate with addition of rice husk, chicken manure, and wheat bran were 350, 342, 367 gm, as followed to mustard cake and soybean, obtained yield after three flushes were 350, 367 gm respectively while in control obtained mean yield was 344 gm

Conclusions: Addition of N, P, K and biological supplements to tested substrates significantly enhanced mushroom cultivation with increasing yield. Our result clearly indicated that wheat straw, cotton waste, sorghum waste substrate, sawdust, sugarcane leaves with addition of these nutrients significantly increased crop yield. Addition of these nutrients to tested substrates positively affected oyster mushroom cultivation properties.

Keywords: *Pleurotus ostreatus*, Spawn production medium, Oyster mushroom



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THEME-3:
WEEDS MANAGEMENT

THEME-3:

WEEDS MANAGEMENT

SPP-WM-301:

Testing resistance of canary grass and wild oat against ACCase and ALS inhibiting herbicides

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ABSTRACT

Background: Herbicide resistance is one of the serious issues faced by contemporary agriculture. Managing herbicide resistant weeds is a serious threat for obtaining economical crop production.

Methods: The research was conducted at RISQ test facilitation center, MNS-University of Agriculture, Multan, during Rabi 2018-19 and 2019-20 to assess the level of herbicides resistance in *Phalaris minor* and *Avena fatua* collected from wheat (*Triticum aestivum* L.) fields of various regions of south Punjab, Pakistan through Syngenta Resistance In-Season Quick (RISQ) test. It was comprised of two herbicides viz., Pinoxaden and Sulfosulfuron. Two grassy weeds i.e. (*P. minor* and *A. fatua*) were sampled from selected locations. The study was conducted under laboratory conditions under completely randomized design (CRD) with three replications.

Results: The data collected from the experiments were statistically analyzed by using Fisher's analysis of variance technique and the treatment means were compared by using Tukey's HSD test at probability level of 1%. Level of herbicides resistance, tolerance or susceptibility in both weeds against ACCase and ALS inhibiting herbicides was evaluated. Pinoxaden performed best for all experimental locations in comparison to Sulfosulfuron against both *P. minor* and *A. fatua*. The *A. fatua* was >80% resistant to Pinoxaden and sulfosulfuron in these locations. The *P. minor* was at the stage of tolerance in all these locations. However, it was noticed after analysis that for samples of *P. minor* from Vehari district, the level of resistance was >90% to Pinoxaden and sulfosulfuron herbicide.

Conclusion: Hence the farmers should remain vigilant and if *P. minor* and *A. fatua* are not being controlled then precautions should be taken along with management. Farmers should manage such weeds before flowering and seed setting stage to avoid their further spread in future.

Keywords: Canary grass, herbicide, resistance, weed, RISQ test, wheat, wild oat

SPP-WM-302

Spatial variation of weed populations in wheat crops of Sialkot under the influence of various edaphic factors

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ABSTRACT

Background: Weeds are undesirable plants and are often pioneers in secondary succession. Out of 8000 weed species found in nature, only 250 are considered significant for agricultural purposes. The present research was carried out to determine the composition and spatial distribution of weed species under the influence of edaphic factors in wheat crops of Sialkot, Pakistan during December 2019 to April 2020.

Methods: Quadrat method was employed and phytosociological attributes such as frequency, density and abundance were calculated by laying ten quadrats of size 1m² randomly in each field. The edaphic variables i.e., Electrical conductivity, soil pH, soil TDS, and soil texture were determined. Pearson's correlation was used to detect the associations of weed species using the sampling data collected around the wheat fields.

Results: A total of 32 weed species associated with 17 families and 28 genera were discovered in 150 quadrats. Fabaceae and Asteraceae were the most abundant families. The results showed that most of the weed species were

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positively correlated.

Conclusions: The current study provides valuable information to the scientific community about weed flora in the wheat crop of the investigated area. Moreover, deviation in weed management from manual to chemical weed control in Sialkot is now being observed. Therefore, inferences obtained from the present investigation would be beneficial in devising a substantial weed management program as well as making knowledgeable judgement in choosing selective herbicides.

Keywords: Weeds, management, wheat

SPP-WM-303

Evaluation of Acetyl-CoA carboxylase inhibitor resistant little seed canary grass (*Phalaris minor* Retz.) and wild oat (*Avena fatua* L.) in Punjab, Pakistan

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ABSTRACT

Background: Herbicide resistance in little seed canary grass and wild oat is getting common in wheat crops.

Methods: Present study was conducted to determine the level of pinoxaden (acetyl-CoA carboxylase inhibitor) resistance in little seed canary grass and wild oat by growing these weeds in wire house, Students Farm, Department of Agronomy, University of Agriculture, Faisalabad. Seed samples of eight resistant biotypes of canary and one resistant biotype of wild oat were collected from different locations. Seed of the susceptible biotype was collected from Ayub Agricultural Research Institute, Faisalabad. Resistant and susceptible biotypes of the weeds were sown in pots. After complete emergence, 10 plants were retained per pot and others were discarded. Pinoxaden was sprayed at 3-4 leaf stage as a post emergence. Four levels of pinoxaden were applied on resistant biotypes and five levels of pinoxaden were sprayed on susceptible biotype of the weeds. The data on plant height (cm), shoot and root fresh weight (g), shoot and root dry weight (g), total dry matter (g), number of tillers, percent injury (%), percent mortality (%), resistance index and LD 50 were recorded. The collected data were analyzed by standard procedure and treatments means were compared using Fisher analysis of variance technique with Tukey's test at 5% probability level.

Results: Results revealed that all biotypes of little seed canary grass were resistant at 1X, whereas five biotypes Fsd 1, Fsd-3, Fsd-4, Fsd-5 and Fsd-7 were found resistant even at 2X and Fsd-2, Fsd-6 and Fsd-8 were sensitive at 2X. Highest LD 50 and resistance index (34.65 g a.i. ha⁻¹ and 8.05 respectively) was recorded in FSD-5. On the other hand susceptible biotype was found highly sensitive to pinoxaden even at 0.25X. LD 50 of susceptible biotype of little seed canary grass was 4.30 g a.i. ha⁻¹. Wild oat resistant biotype was found resistant at 1X whereas, sensitive at 2X. LD 50 and resistance index of resistant biotype of wild oat was 11.48 g a.i. ha⁻¹ and 2.67, respectively.

Conclusion: Susceptible biotype of wild oat was highly sensitive to pinoxaden application.

Keywords: Herbicide, resistant, biotype, oat

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Impacts of weed competition on yield and quality of fodder Maize

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ABSTRACT

Background: Maize (*Zea mays* L.) is the extensively cultivated as fodder crop in Pakistan and provides succulent palatable and heavy tonnage of green fodder. Weeds cause significant reduction in yield, palatability and nutritive value of fodders. Evaluation of critical weed control period is important to insure high yield and quality of fodders.

Methods: A field study was conducted to determine the effects of weed competition on fodder maize sown at different seed rates. Two factors i.e. seed rate (90 and 110 kg ha⁻¹) and weeds competition period (zero competition, competition for 2 weeks after emergence (WAE), competition for 3 WAE, competition for 4 WAE, competition for 5 WAE and competition for full season) were considered.

Results: The maximum number of weeds (205.65) plants m² was recorded when maize fodder was sown at seed rate of 90 kg ha⁻¹ and weed competition with maize was until 5 WAE. However, more weed-dry weight was recorded when maize fodder was sown using seed rate 90 kg ha⁻¹ and full season weed competition was allowed. The more leaves per plant (17.03), green fodder yield (75.16 t ha⁻¹), dry matter yield (17.26 t ha⁻¹), crude protein (8.38%) were recorded when maize fodder was kept weed free throughout the growing season, while maximum crude fiber (34.54 %) was recorded when weeds were allowed to compete with maize fodder throughout the growing season. As far as seed rate was concerned, maximum leaves per plant (14.18), green fodder yield (58.71 t ha⁻¹), dry matter yield (13.05 t ha⁻¹) and crude fiber (34.19 %) were recorded when maize fodder was sown using seed rate 110 kg ha⁻¹.

Conclusion: Weeds must be controlled till four weeks of crop emergence for better maize fodder production with seed rate of 110 kg ha⁻¹.

Keywords: Maize, weeds, fodder

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Detection of Begomoviruses association with weeds and ornamental plants

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ABSTRACT

Background: Begomoviruses are one of the most central plant viruses which infect a wide variety of plants such as crops, ornamentals, weeds and causes considerable losses to agriculture and horticultural crops in all over the world. The weeds and ornamentals are extensively spread with high environmental flexibility and may serve as alternative hosts and reservoirs of this virus. The symptomatic samples weed and ornamental of rough cocklebur, jangli chulai, khabal grass, lehli, chibber, laal dhodhak, tandla, itsit, Parthenium, bhakra, marigold, Jasmine, sky flower, croton, and China rose were collected.

Methods: The DNA was extracted by following CTAB method and then PCR by using two primers pairs of Beta 01, Beta 02 and Beg 1and Beg2 was performed for confirmation of pathogen. The PCR products were visualized by using Gel documentation Jar apparatus by using agarose gel and molecular marker of 1-kbp ladder.

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Results: By using beta and begomo primers presence of pathogen was confirmed in jangli chulai, tandla, Parthenium, bhakra or in ornamentals croton and china rose the pathogen was confirmed, The amplified band of 700, 900, 1000, 1500 bp was mostly observed. In our result commonly present weeds in vicinity of major infected crop field were infected by begomoviruse, According to PCR result mostly Parthenium, tandla and croton samples the required bands were visualized.

Conclusion: Our results confirmed that weeds and ornamental plants are reservoir of Begomoviruses. The Begomoviruses host shift may be of some recombination events occurred accidentally or periodically which may cause virus to shift from its host to alternate hosts during off season of their specific host plant in the field.

Keywords: Begomoviruses, weeds

SPP-WM-306

Chemical weed control in wheat raised on stale seedbed

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ABSTRACT

Background: Stale seed bed can reduce the weeds infestation in field after wheat sowing.

Methods: For effective weed control in wheat a research was undertaken at research area of MNS University of Agriculture Multan. Stale seedbed was prepared prior to wheat sowing following treatments Control, Glyphosate @ 1.48 L ha⁻¹, Paraquat @ 2.47 L ha⁻¹, Atlantis @ 247.1 g ha⁻¹, Glyphosate @ 0.73 L ha⁻¹ + Paraquat @ 1.2 L ha⁻¹, Glyphosate @ 0.73 L ha⁻¹ followed by Atlantis @ 123.5 g ha⁻¹, Paraquat at 1.2 L ha⁻¹ followed by Atlantis @ 123.5 g ha⁻¹, Glyphosate @ 0.73 L ha⁻¹ + Paraquat @ 1.2 L ha⁻¹ + followed by Atlantis @ 123.5 g ha⁻¹ was tested in randomized complete block design (RCBD) with three repetitions. The data on weeds density and yield was collected with standard procedure.

Results: Results revealed that significant lower weed count (25 m², 19 m²) and dry biomass (6.29g, 8.33g) at 30 and 45 days after sowing was recorded in plots having received glyphosate + paraquat followed by atlantis. The highest number of productive tillers (320 m²), thousand grain weight (25.47g), grain yield (4156 kg ha⁻¹) and harvest index (33.13%) were recorded in glyphosate + paraquat followed by atlantis.

Conclusion: Based on better weed control and higher grain yield compared with other treatments glyphosate + paraquat followed by atlantis revealed statistically lower weed density and improved yield of wheat. Since the experiment was conducted for a single season, the repetition over season, evaluation on wider scale in different cropping systems will assist in being more conclusive for adaption of this potent but ignored technology.

Keywords: Weeds, stale seedbed, herbicide and yield.

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Interference of horse purslane (*Trianthema portulacastrum* L.) and other weeds affects yield of autumn planted maize (*Zea mays* L.)

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ABSTRACT

Background: Weeds vary for their interference ability and reduce crop yield to a varying level. Losses in field crops vary across weeds and extent of damage potential also vary. Horse purslane (*Trianthema portulacastrum*) is considered as weed of major category with most damages in crop fields in Punjab, Pakistan.

Methods: To assess comparative losses of *T. portulacastrum* (HP) relative to other weeds, the experiment was set during consecutive summer seasons 2018 and 2019 at the Research Farm MNS-University of Agriculture, Multan, Pakistan. Experiment consisted three replications which were laid out under randomized complete block design. Experiment consisted of ten treatments viz: weeds free (whole season), HP free till 20 Days after emergence (DAE), HP free till 40 DAE, HP free till 60 DAE, all weeds free 20 DAE, all weeds free 40 DAE, all weeds free 60 DAE, weedy check (all weeds), weedy check except HP and weedy check containing only HP.

Results: During 2018 in all weeds weedy check, maximum HP relative density (33.33%) was observed while in 2019, plot where weeds were controlled from growing till 20 DAE showed (80%) relative density at 30 DAE. HP maximum frequency (66.67%, 77.78%) and relative frequency (66%, 100%) was recorded at 45 DAE in plots where HP was kept controlled till 20 DAE and all weeds kept controlled till 20 DAE, respectively. Maximum number of grains per cob (738, 700.68), 1000 grain weight (306.66, 271.51g) and grain yield (6150, 8015 kg hec¹) were recorded in plots which were kept all weed free till 60 DAE. As the competition period of weeds increased over 40 DAE, it substantially reduced yield of maize. Keeping the plots HP free till 40 DAE in the maize fields with HP as the major dominating weed, likely increase in maize grain yield is up to 30% compared to the fields where HP left un attended throughout the growing season. However, if maize field is infested with a mix of weeds with more than one dominating weeds including HP, compared to weedy situation the whole season, 30% higher grain yield can be obtained if all weeds are kept controlled till 40 DAE.

Conclusion: It can be concluded that whether the farmers face heavy HP infestation only or the mix of weeds as dominating weeds, in either case farmer should control weeds within first 40 days in maize field for better grain yield.

Keywords: *Trianthema portulacastrum*, critical period of competition, weed dynamics, yield, *Zea mays*.

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Stale Seedbed Technology with an Additional Tillage affects Weed Dynamics and Yield of Wheat

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ABSTRACT

Background: Weed seed bank removal promises effective solution for managing weeds in crops fields.

Methods: To investigate the influence of stale seedbed on weed dynamics and yield performance of wheat a field study was undertaken at Research farm, MNS University of Agriculture Multan. Current study was carried out under randomized complete block design with three replications. This study consisted of eight treatments viz: one till + no herbicide, one till + glyphosate 48% SL at 711 a.i mL/ha, one till + paraquat 20% SL at 494 a.i mL/ha, one till + atlantis (mesosulfuron-

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methyl and iodosulfuron-methyl sodium) 6% WG at 15 a.i g/ha, one till + glyphosate at 48% SL 711 a.i mL/ha + paraquat 20% SL at 494 a.i mL/ha, one till + glyphosate 48% SL at 711 a.i mL/ha followed by atlantis 6% WG at 15 a.i g/ha, one till + paraquat 20% SL at 494 a.i mL/ha followed by atlantis 6% WG at 15 a.i g/ha, one till + glyphosate 48% SL at 711 a.i mL/ha + paraquat 20% SL at 494 a.i mL/ha followed by atlantis 6% WG at 15 a.i g/ha.

Results: *Cronopus didymus* and *Chenopodium album* density was maximum in one till + no herbicide while, minimum was observed in one till + glyphosate + paraquat followed by atlantis treatment at 45 DAS and 60 DAS, respectively. While maximum dry weight of both weeds was recorded at harvest. Maximum productive tillers m⁻² (246.33), 1000-grain weight (31.88 g) and grain yield (4.65 tons/ha) were recorded in one till + glyphosate + paraquat followed by atlantis.

Conclusion: It can be concluded that adoption of stale seedbed technology and post emergence application showed a check on weeds growth till 60 DAS to maximize the economical wheat yield. There is a need to explore chemical and mechanical weed control under stale seedbed sole and in combination along with varying cropping systems under climate change scenarios to minimize soil weed seed banks and reduce the reliance on herbicides.

Keywords: Wheat productivity, weeds, weed dynamics, yield

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Determination of resistance in *Phalaris minor* Retz. against ALS and ACCase inhibiting herbicides through RISQ test in Punjab, Pakistan

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ABSTRACT

Background: *Phalaris minor* Retz. (family Poaceae) is one of the most obnoxious weed in wheat crop that may cause severe yield losses and deteriorate grain quality. This weed is highly spreading in wheat fields not only in Pakistan but in many countries of the world. Various management practices are being adopted by the farmers for its control including chemical herbicides at top. The most commonly used herbicides belong to Acetolactate synthase (ALS) and Acetyl-CoA carboxylase (ACCase) inhibiting mode of actions. The injudicious and repeated use of such herbicides has resulted in development of resistance in weeds leading to lower yield. The current study was designed to explore the status of herbicide resistance in *P. minor* against commonly used herbicides (Sulfosulfuron and Axial) and to facilitate the farming community to effectively manage this weed in collaboration with Syngenta Pakistan.

Methods: For quick decision to use proper herbicide in field, Resistance In-Season Quick (RISQ) test developed by

Syngenta Pakistan was used at MNS University of Agriculture, Multan. The weed samples (2-3 leaves stage) were collected from farmer field transported to Herbicide Resistance Laboratory, MNS UAM. The herbicide solution was prepared and mixed in plant agar solution according to the protocol designed by the Syngenta and poured in plastic petri plates. The weed samples were transplanted in petri plates and placed in growth room at 25 ± 5 °C, 50 ± 5 % RH and 10:14 light hours. The weed mortality data was recorded after 10 days of treatment.

Results: The results of weed susceptibility showed that *P. minor* was highly resistant (mortality less than 60%) to Sulfosulfuron as compared to Axial herbicide. However, *P. minor* showed partial resistance (mortality 60-79%) to Axial. There were a total of 42, 48 and 46 weed samples that showed high resistance to Sulfosulfuron from Multan, D.G. Khan

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and Bhakkar areas respectively. The axial represented partial resistance to 1, 10, 15 samples from Multan, DG. Khan and Bhakkar respectively.

Conclusion: Most of the population of *P. minor* had become resistant to Sulfosulfuron herbicide which indicates that farmers should use the alternative herbicide after consultation with the relevant expert. Moreover, the herbicides should be used very carefully according to crop need and following all protocols for effective management of weeds.

Keywords: Dumbi sitti, wheat, herbicide resistance, acetolactate synthase, acetyl-CoA carboxylase

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Climate change a great threat to weed management

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ABSTRACT

Background: Weed management is greatly affected by the changing climatic conditions like temperature, precipitation, and elevated carbon dioxide concentration level. Climate change imposes a great impact on weed growth, weeds are adapted to rising temperature and CO₂ concentration and exhibiting great resilience. Due to this, weeds are decreasing the crop production by competing with crops with a greater physiological plasticization and contain great diversity in the gene pool. Weed management under such climatic conditions becomes a foremost challenge to sustainable crop production because, with a positive impact on the growth of weeds, climatic factors also influence the effectiveness of herbicides. To understand the impact of climatic factors on herbicides, it is necessary to evaluate the mode of action of various herbicides according to the changes in environmental conditions. Environmental factors such as solar radiation, CO₂, temperature, precipitation, and soil moisture affect the activity, uptake, and translocation of herbicides.

Conclusion: New herbicide formulations should be prepared according to the changing climatic factors, and biological control should be studied and used. Extensive research should be done to know the impact of changing climatic factors on herbicide efficiency, how the effects can be minimized, identification of potential biocontrol agents are necessary for weed management in future climatic scenarios.

Keywords: Climate change, weed management, environmental factors, herbicides, crop weed management

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Studying biological nitrogen fixation in chickpea in response to molybdenum and pre-emergence herbicide

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ABSTRACT

Background: Herbicide application have negative effects on biological nitrogen fixation (BNF), by affecting Rhizobial activity and nodule formation which leads to less productivity especially in chickpea.

Methods: A field study was carried to explore biological nitrogen fixation in chickpea under the influence of molybdenum and pre-emergence herbicide. Experiment was conducted at the Research Farm, MNS-University of Agriculture, Multan during Rabi, 2019. Experiment was replicated thrice in randomize complete block design with split plot arrangement. Treatment was weed control (no-herbicide application and pre-emergence application of pendimethalin at the rate 910 g a.i. ha⁻¹) and seed Enhancement (no-inoculation, seed inoculation, inoculation with addition to 2 g Ammonium Mo per kg of seed).

Results: Data collected regarding emergence, seedling growth and biological nitrogen fixation parameters. For statistical analysis of collected data Fisher's ANOVA techniques with 5% probability level will be used. Differences between means was chalked out via HSD test DSTAAT. Both factors weed control and seed enhancement significantly influenced yield attributes. Maximum dry matter (470 gm⁻²) was accumulated by Rhizogold+ 2g Mo. Inoculation and weed control influenced significantly number of pods plant⁻¹, number of branches plant⁻¹, plant height. However, seed per pod remain un effected by both factors. Seed enhancement treatment produced maximum number of nodules and dry weigh, but there is a decline observed regarding number of root nodules and their dry weight where pre-emergence herbicide was applied. However, these losses were compensated in plots where seed inoculation was assist with Mo application as seed treatment. Maximum net benefits (210741 PKR ha⁻¹) were associated with seed inoculation and pre-emergence herbicide applied.

Conclusion: So it is concluded that herbicide application is important to attain maximum yield of chickpea under irrigated condition, but seed inoculation with quality inoculum and addition of micronutrient like Mo is necessary.

Keywords: Chickpea, inoculation, BNF, Mo.

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Mycoherbicides: A biological strategy to control weeds

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ABSTRACT

Background: In early 1900s, mycoherbicides concept was firstly introduced and their potential was demonstrated, however, their use started after World War II. Natural living agent such as fungi, virus, bacteria, nematode and protozoa-based herbicides are broadly term as bioherbicides while when fungus used as a biocontrol agent it termed as mycoherbicides. Mostly mycoherbicides used for controlling weeds in agricultural system developed from higher plants, microorganism or microbiological phytotoxins. Unlike other weed controlling methods (Mechanical and Chemical), mycoherbicides have certain advantages like host specificity, no residual problems, low side effects, less laborious and no resistance problem (so far). Due to higher public awareness towards healthier and sustainable cropping system, mycoherbicides gained acceptance as targeting only unwanted plants, avoid chemical contamination, conserve environment.

Conclusion: Until now, several mycoherbicides are registered such as Collego, Dr. BioSedge, Smolder, CASST, etc. and several are under registration process. With the passage of time their numbers increase rapidly with the cooperation of both Public and private sector. However, extreme cautions are needed while choosing a biocontrol agent because invasiveness on non-target weeds by some agents has been reported. Globally, trend shifted towards biological control after the evolution of first herbicide resistance in weeds, however, that ended the Golden era of chemical herbicides.

Keywords: Mycoherbicides, herbicides, weeds

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Weed: A yield limiting factor

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ABSTRACT

Background: Pakistan is an agricultural country and more than half of its population belongs to agriculture background directly or indirectly and plays a vital role in alleviation of poverty. Agriculture provides basic raw material to our industry and have great share in GDP. Agricultural produce is mainly affected by many abiotic (temperature, edaphic factors etc.) as well as biotic (weeds, insects, pathogen) factors which reduce its yield to greater extent. Almost 250 weeds species were considered most important out of 8000 species in agriculture crop world. Overall losses due to weeds (34%) are far more than any other factors i.e., Insects pest (18%) and pathogens (16%). They play dual role in plant community, not only provide habitat to insects and animals, restore habitat and biodiversity, replenish organic matter, check soil erosion and useful in carbon sequestration but also problematic to crop as they serve as alternate host to many plant pathogens, restrict air circulation, also compete for space, nutrients as well as for light. They also restrict crop growth through their



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Monitoring neonicotinoids resistance, diagnostic mechanism and cytochrome P450 gene expression in a field population of *Myzus persicae* (Sulzer)

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ABSTRACT

Background: Green peach aphid, *Myzus persicae* is a significant insect pest with a known history of developing resistance to insecticides. Neonicotinoids manage green peach aphid, but the frequent and excessive use leads to resistance development. Monitoring the status of resistance and mechanism study in *M. persicae* are essential for resistance management.

Methods: Toxicity data, along with synergist piperonyl butoxide (PBO) for neonicotinoids in a field- population (FP) were collected and compared to a laboratory susceptible clone (SC) of aphids. Moreover, expression of metabolic resistance cytochrome P450 gene *CYP6CY3* and an arginine-threonine substitution were checked in the FP population, causing a single point mutation (R81T) at $\beta 1$ subunit of nicotinic acetylcholine receptor (nAChR) within D loop.

Results: In toxicity bioassays, a high level of resistance to imidacloprid was developed in the FP aphids with a 101-fold resistance ratio and moderate resistance level to acetamiprid, i.e., 10.9-fold. Bioassays dosed with synergist PBO suggested that cytochrome P450 enzymes were involved in resistance to neonicotinoids. The mRNA transcriptional level of the *CYP6CY3* gene was significantly higher in FP compared to SC. The R81T mutation associated with neonicotinoid resistance was found with 26% resistant allele frequency in FP aphids.

Conclusions: Both P450 enzymes and R81T mutation of nAChR were found in field-evolved neonicotinoid resistance and therefore suggest appropriate management strategies to suppress resistance development in green peach aphid.

Keywords: *Myzus persicae*, Green peach aphid, Neonicotinoids, *CYP6CY3*, R81T mutation

SPP-Biotech-402

Production of insect resistant transplastomic potato lines against colorado potato beetle (*Leptinotarsa decemlineata*)

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ABSTRACT

Background: Insect pests damage 14% of the global agricultural crop where 74% was recorded for potato. Economic damages by notorious super pest *Leptinotarsa decemlineata*, the Colorado potato beetle (CPB) have been documented up to 85%. To date, chemical pesticide dependent control measures for CPB were proven inadequate due to tremendous

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adaptive malleability of insect pest to those chemical agents and where environmental pollution also remaining a burning question. Recently, transplastomic approach has become promising and alternative technology aimed to incorporation of higher level of foreign insecticidal protein into potato plastome to minimize the insect mediated economic damages.

Methods: The current study was conducted to produce transplastomic potato lines through the incorporation of gene of interest into the chloroplast genome where two intergenic regions (trnA and trnI) of plastome sequence were used as flanking sequence to favors homologous recombination. Transformation vector contains FLARE-S (fusion of aadA and gfp genes) as bifunctional visual and selectable marker under the control of prn promoter to provide dual selection on plant regeneration, green tissue specific promoter (psbA) was used to confined the expression of target gene within only green part of transplastomic plants. Both leaves and internodal explants from four potato cultivars were transformed with chloroplast transformation vector by Biolistic gene gun method. Bombarded explants were cultured on MS medium supplemented with BAP (2.0 mg L⁻¹), NAA (0.2 mg L⁻¹), TDZ (2.0 mg L⁻¹) as well as GA3 (0.1 mg L⁻¹) where spectinomycin 50 mg L⁻¹ was used as a selection agent.

Results: Transplastomic lines have been regenerated using optimized in-vitro culture protocol at our laboratory and the integration of gene of interests into the chloroplast genome of spectinomycin resistant shoots were screened by standard molecular techniques. RT-qPCR exhibited accumulated levels of those genes in primary transplastomic shoots. The transplastomic lines were capable of ensuring high insect mortality (100%) to both larval and adult stages of CPB. Foliage consumption and weight gain of CPB feed on transplastomic leaves was lower compared to their control plants that revealed the insecticidal effect of transplastomic lines on CPB.

Conclusions: We believe that compared with conventional nuclear based transgenic technology, our ongoing transplastomic approach will remain a viable solution to control the CPB with the accumulation of higher levels of insecticidal cry protein into the chloroplast genome. Besides this, through the reduction of pesticide dependency it will ensure an eco-friendly approach in agriculture with minimized health hazards.

Keywords: *Leptinotarsa decemlineata*, Pesticides, transplastomic approach, eco-friendly

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Identification of differentially expressed resistance genes against begomoviruses in cotton by using past NCBI database

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ABSTRACT

Background: The complexity of any infectious disease is primarily due to the complicated interactions between the sets of genes involved in the process. Similarly, there are several host proteins and genes in the case of cotton leaf curl virus disease (CLCuD) that interact with viral proteins and control the integration of disease. Cotton, Pakistan's major cash crop, suffers from CLCuD due to geminivirus resulting in 30% loss. Begomoviruses consists of complex genomic components i.e. DNA-A or DNA-A and DNA-B and various associated helper satellites. The virus complex is still evolving. Thus, sustainability of cotton production is at potential risk in many cotton growing countries. Viral infection initiates a complex interaction between the virus and the host. Understanding host responses during viral infection can help in the development of effective strategies for virus control. RNA-Seq studies have been applied extensively to uncover the responses of plant hosts to viral infection. However, the comprehensive molecular mechanisms underlying CLCuD-

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cotton interactions remain poorly defined. The main objective of this study is to identify those protein and genes that are differentially expressed by using past NCBI database.

Methods: Those genes and gene families that are reported in NCBI database showing resistance against begomoviruses in cotton will be filtered out. Widely cultivated cotton species, *Gossypium hirsutum*, is generally susceptible to CLCuD, while the diploid species, *G. arboreum*, is a natural source for resistance against CLCuD. Here, RNA-Seq-based study will be used from NCBI database to analyze differential gene expression in different varieties of cotton under CLCuD infestation. RNA will be extracted from leaves of selected plants for expression analysis of candidate genes conferring resistance to cotton leaf curl virus (CLCuV). After gene expression analysis, these genes and gene families that are differentially expressed will be selected for further in silico analysis.

Results: Weighted gene co-expression network constructed from the RNA-Seq dataset will indicate hub genes which might have a role in the defense response of cotton against CLCuD.

Conclusions: Function annotation will help in identifying genes pathway and their functional role. Our finding may offer an idea how to make resistant varieties by controlling these genes.

Keyword: Begomoviruses, *Gossypium hirsutum*, CLCuD, Gene Expression

SPP-Biotech-404

Silencing the function of Vg gene abolishes egg production in the red palm weevil, *Rhynchophorus ferrugineus* (Olivier)

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ABSTRACT

Background: The red palm weevil (RPW), *Rhynchophorus ferrugineus* (Olivier), possesses high invasive potential and has been reported as the most destructive pest of date palm trees. The vitellogenin gene (Vg) plays a key role in egg production and thus has a special importance in reproduction and proliferation of all oviparous species.

Methods: The Vg-based dsRNA was synthesized by using MEGAscript® RNAi Kit (Life Technology). Almost 10-12 days old, RPW female pupae were used for the RNAi study. A total of 2- μ g (10 μ l) of RfVg dsRNA was injected dorsally in the second abdominal segment by using 0.5 ml BD Micro-Finetr Plus syringe to silence the function of vg gene in RPW.

Results: The results of present study revealed about 96% suppression of Vg gene expression at day 15 and 95.6 and 98% Vg gene down regulation at day 20 and 25 of post injection periods, respectively. This significant reduction in Vg gene expression resulted in the dramatic failure of vitellogenin protein expression. The 0% egg hatchability was the result of significant down regulation of Vg mRNA expression, which led to insufficient production of vitellogenin protein to ensure normal egg development and hatchability.

Conclusions: This study provides evidence supporting the potential use of emerging RNAi technology in pest management. Moreover, the results of Vg gene silencing at the molecular level also demonstrated that the Vg gene played a vital role in the reproduction of oviparous organisms.

Keywords: *Rhynchophorus ferrugineus*, RNAi, Silencing, Vitellogenin

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Molecular identification and characterization of the begomovirus causing pedilanthus leaf curl disease in Faisalabad

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ABSTRACT

Background: Pedilanthus leaf curl disease (PeLCuD) is a major constraint in the production of pedilanthus plants because it causes dramatic reduction in pedilanthus yield which is caused by Pedilanthus leaf curl virus (PeLCuV). The typical symptoms of the disease are leaf distortion, stunted growth, vein thickening, leaf curling, severe downwards curling of leaves, swelling and vein yellowing of leaves.

Methods: Present study was designed to analyze the begomovirus associated with PeLCuD in Faisalabad, Pakistan. For molecular identification and characterization of virus, diseased samples were collected from vicinity of University of Agriculture Faisalabad. Genomic DNA was extracted by using CTAB method. Amplification of isolated DNA was done by using begomovirus specific primers CLCV1 and CLCV2. Coat protein region of DNA-A component was targeted and amplified. Amplicon size of 1.5 kb was observed. After purification of amplified PCR products, associated isolates were sequenced commercially. Phylogenetic analysis was evaluated among closely related begomoviruses.

Results: BLAST analysis revealed that the isolates showed 99-100% similarity with PeLCuV. Phylogenetic analysis was done by using MEGA vr 7 software. MUSCLE alignments were made between 3 sequenced isolates of PeLCuV and previously identified reference sequences of PeLCuV. The phylogenetic evolutionary analysis revealed that the disease is associated with PeLCuV.

Conclusions: This preliminary research work opens new frontiers for the development of sustainable management strategies for the management of PeLCuV disease.

Keywords: PeLCuD, Begomovirus, Primers, CLCV

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Identification and expression analysis of putative chemosensory protein genes (csps) based on transcriptome analysis of english grain aphid *Sitobion avenae* (Fabricius)

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ABSTRACT

Background: The use of olfactory recognition proteins promotes contact between insects and the environment; therefore, insects can dynamically adjust in host plant conditions using chemical signals. Chemosensory proteins (CSPs) of aphids are believed to be responsible for the basic olfactory molecular associations that trigger the

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chemoreception. *Sitobion avenae* (Fabricius) is one of the most common damaging wheat field pests in the world. Indeed, a pest control strategy based on conservation of environment and can be effectively used for widespread use is particularly important.

Methods: To help the better insights into the olfactory system, in this study, we produced the transcriptomes of adult wingless and winged aphids.

Results: Among the 104,024 Unigenes, in the de novo assembly, 6 putative CSPs sequences were identified. To analyze the expression profiles of these genes, qPCR was performed. We found the 4 CSPs (SaveCSP7, SaveCSP8, SaveCSP9 and SaveCSP10), were markedly up regulated in the wingless morph of *S. avenae*.

Conclusions: The unique features of high abundance of CSPs in wingless form of aphids might be suggesting the fundamental physiological functions in the aphid physiology and ecology. Further studies on functional and aspects of these genes associated with chemoreception might potentially explore the new targets for integrated pest management of *S. avenae*.

Keywords: *Sitobion avenae*, Chemosensory protein, Olfactory system

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Establishment of a tobacco plant based transient gene expression system

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ABSTRACT

Background

NIM1-Interacting (NIMIN) genes are found in the whole plant kingdom. In Arabidopsis, four *NIMIN* genes are present. The *NIMIN* gene family in Arabidopsis comprises, *NIMIN1b*, *NIMIN1*, *NIMIN2* and *NIMIN3*. *NIMIN* proteins interact with NON-EXPRESSOR OF PATHOGENESIS-RELATED GENES 1 (NPR1)/NON-INDUCIBLE IMMUNITY 1 (NIM1). The NPR1 is the central protein that regulate the Systemic Acquired Resistance (SAR) in Plants. *NIMIN* genes are expressed at different time point during SAR pathway, and the encoded proteins interact differentially with NPR1 during this mechanism. However, the exact function of different *NIMIN* members in the SAR pathway is not known.

Methods

The present study is conducted to establish a transient gene expression system to explore the functional implication of *NIMIN* proteins in induction of *PATHOGENESIS-RELATED (PR)* genes of group 1. A *-1533PR-1a_{pro}:GUS Nicotiana benthamiana (N. benthamiana)* reporter line was generated, which exhibits strong induction of the *PR-1a_{pro}:GUS* transgene in response to the SAR signal salicylic acid (SA). This line was used for the transient overexpression of *NIMIN* genes. Effects of *NIMIN* proteins on reporter gene induction were monitored after agroinfiltration and application of SA to *NIMIN* expressing leaf tissue. In order to avoid *PR-1a_{pro}:GUS* induction by the agroinfiltration procedure prior to SA treatment of leaf tissue, the conditions for bacterial infiltration had to be optimized. Most importantly, density of the *Agrobacterium* suspension used for infiltration of *N. benthamiana* leaves turned out to be highly critical for *PR-1* gene expression.

Keywords: Transient Gene Expression System, NIM-1 interacting Proteins, Pathogenesis-Related -1 proteins

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Prevalence of nosocomial *Klebsiella pneumoniae* : risk factors and clinical impact

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ABSTRACT

Background: Over the last few years, China has confronted a large number of people infected with *Klebsiella pneumoniae* (Enterobacteriaceae): a ubiquitous pathogen, notorious to cause nosocomial infection. The pathogenic causal agent, *K. pneumoniae* (KpC4) is gram negative, lactose fermenting bacteria with a protuberant capsule. *K. pneumoniae* was uncovers to cause pulmonary and urinary diseases in humans and animals and reported to exist in plant endophytes, commonly known as opportunistic pathogens of humans/animals.

Methods: Only a single experimental study was found to describe the virulence of the maize pathogen to both organisms (maize and mice) by isolating the strains from infected mice that caused typical top rot symptoms on maize by artificial inoculation. These findings will serve as an alert to plant, medical and veterinary scientists regarding a potentially dangerous bacterial pathogen infecting both plants and animals/humans.

Results: The maize plants in the field could serve as a reservoir for *K. pneumoniae* infection which might infect animals and probably humans when conditions are favorable. However, much work is required to characterize the newly discovered factors, understanding how infections differ between healthy and immunocompromised patients, and identifying attractive bacterial or host targets for treating these infections.

Conclusions: The new findings not only are significant in the developing control strategy for the new disease in Yunnan, but also serve as a starting point for further studies on the mechanism of pathogenesis and epidemiology of *K. pneumoniae*.

Key words: *K. pneumoniae*, plant endophytes, maize pathogen

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Application of Biotechnology and its Impact on Food Safety and Security

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ABSTRACT

Background: A global recession, along with highly increased food prices in many countries in unregenerate manner, have caused some 100 million more people than last year suffering from silent hunger and poverty that would leave the world extremely vulnerable. The global food crisis potentially imposes a serious risk towards world peace and security. The crop production however will have to be dramatically increased to meet the need. The ability of biotechnology to act as a tool to assist in solving the issue is far from being fully exploited. Low crops production is considered to be the main reason for poverty and food insecurity in the world. High percentage of poor and food insecure people are living in developing countries and in rural areas. Therefore, biotechnology can increase the crops yield through introducing high-yielding varieties resistant to biotic and abiotic stresses, reduce pest-associated losses and increase the nutritional value of foods which is a very important factor in rural areas or developing countries. Furthermore, in order to reduce or eliminate

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food insecurity, postharvest approach in wasting less is of a vital strategy to supplement increasing food productivity. Hence, the environmental issues in supplying safe and nutritious foods in a sustainable manner should be taken into account. Biotechnology research and development have already produced significant products on the market and will further have a pivotal role to play in encouraging and enhancing food production, considering the safety and environmental quality. Although the major concern being the safety and potential impact of genetically modified organisms (GMOs) on human health, the future of biotech crops looks encouraging as the global area of biotech crops continue to increase yearly and commercialization of drought tolerant maize and Golden Rice are expected in 2013/2014. Thus, biotech crops could possibly contribute to accomplishing the 2015 Millennium Development Goal particularly in reducing poverty by half through maximizing crop productivity.

Conclusion: Microorganisms play a vital role in sustaining soil health and productivity, in the process of plant biomass conversion to produce both food and fuel, and in the production of novel foods and feeds mainly by fermentation. The literature discussed the current trends and future perspectives on how biotechnology and genetic engineering can help us to provide safe and secure food and can act as a valuable tool to reduce poverty.

Keywords: Biotechnology, Food Security, Economical issues, Poverty.



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